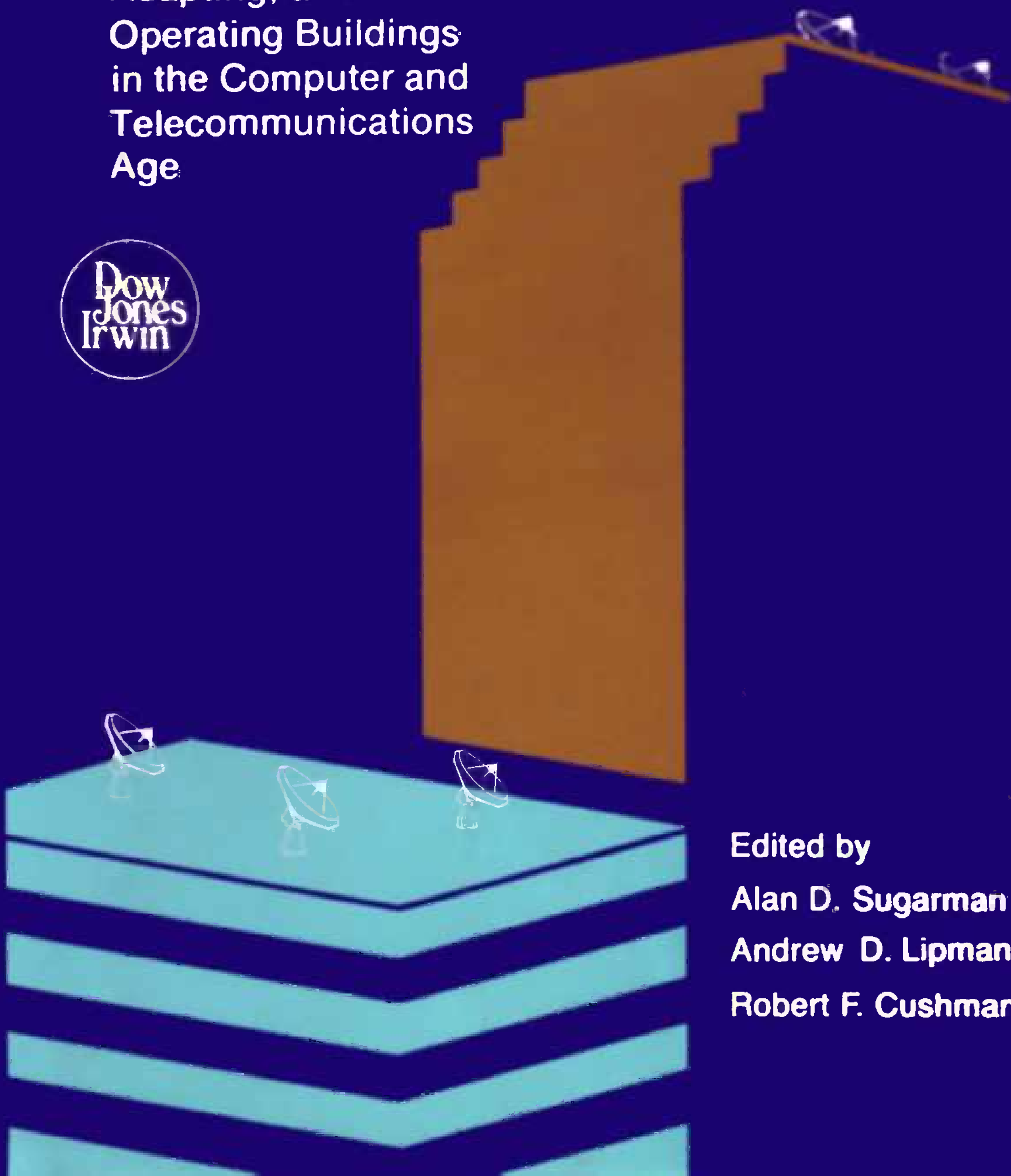
High Tech Real Estate

Planning, Adapting, and Operating Buildings in the Computer and Telecommunications Age

Dow Jones Irwin



Edited by
Alan D. Sugarman
Andrew D. Lipman
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The integration of telecommunications and real estate is proceeding rapidly, driven by technological developments, deregulation, divestiture and the rising expectations for the transmission of information. Many real estate people are not familiar with telecommunication technologies. Conversely, technical people do not always understand the real estate market. *High Tech Real Estate* bridges this information gap.

The revolutionary changes in technology and communications have redefined the value of real estate. Rather than "location, location, location," the new definition focuses on—

- access to sophisticated telecommunications
- building designs that accommodate new communication and office technology needs
- enhanced telecommunications and other tenant services

High Tech Real Estate represents the first compilation of materials covering the confluence of real estate and telecommunications. Its interdisciplinary approach makes it a crucial reference for business people and professionals involved in this emerging field.

Sugarman
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Cushman

High Tech
Real Estate

Dow Jones Irwin

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High Tech Real Estate Dow Jones-Irwin 1985
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This book is dedicated to Abigail who was born the day we first met to plan this book and to Carole, Deborah, and Debra

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Preface

The purpose of this book is to present a comprehensive multidisciplinary approach to the subject of high tech real estate. The book is intended to bridge a knowledge gap that the editors have observed as they have acted as counselors and advisers to developers, communication companies, lenders, and investors in this emerging area. Most of the subjects contained herein have never been presented in printed or book form before; certainly, these subjects have never been presented in comprehensive fashion. The authors of the chapters address every major aspect of high tech buildings and teleports from all affected professional disciplines. The chapters are written in a nontechnical manner so as to be understandable and meaningful to professionals outside a particular discipline. Even within a discipline, however, professionals will find new information and insights as well as a comprehensive overview of their field.

Only recently have the real estate and telecommunications industries intentionally joined forces to create enterprises formed around single buildings, around a complex of buildings located in the same or different geographic areas, or around regional telecommunications projects such as teleports. The resulting union has been synergistic and has presented dramatic opportunities—as well as potential pitfalls—to real estate developers, communications companies, computer companies, landlords, and information-age tenants. The union has also presented challenges to architects, engineers, interior designers, and real estate developers (as well as to their lawyers, accountants, and consultants) who are planning buildings that are expected to last into the next century. In contrast, many buildings completed in recent years have become obsolete before their time; more than one post-1970 building has been abandoned by tenants due to functional obsolescence relating to telecommunications inadequacies.

High tech buildings and teleports have resulted from the convergence of various technical and regulatory developments. The recent technological revolution—with quantum leaps in performance and decreases in costs—has brought about fiber optics, digital equipment, and satellite uplinks. Attempting to grapple with these technologies, the Federal Communications Commission and state regulators have permitted carriers, users, and third parties greater freedom in supplying and maintaining telecommunications services and equipment. A series of deregulatory decisions by the FCC and the breakup of AT&T have eliminated the telephone company's traditional role as the end-to-end telecommunications service provider. Deregulation and divestiture have also created new options and opportunities in the telecommunications and real estate industries for both established companies and entrepreneurs. Finally, the nature of the workplace is evolving rapidly to accommodate an information age: The explosive emergence of office automation and microcomputers are just two examples of the future trends in office work. Corresponding to this explosive growth are ever-increasing expectations as to the distribution and transmission of information. Thus, information transmission and telecommunications become a central focus of the office and, therefore, of commercial real estate.

High tech buildings and related services go by many names: Smart Buildings, Intelligent Buildings, Telecommunications Enhanced Real Estate (TERE), Shared Tenant Services (STS), Enhanced Shared Tenant Services (ESTS), Telerealty, and Shared Telecommunications Services.

High tech buildings provide landlords and tenants with an innovative and cost efficient means of managing or obtaining communications, information, and other building and office services. No two high tech buildings are alike. Yet, such buildings often involve certain common elements, including a communications network within a building and probably a private branch exchange (PBX) that provides both small and large tenants access to a wide array of office automation services. Among these services are voice communications, word processing, electronic mail, facsimile, telex, stock exchange reports, and copy printing.

High tech buildings also frequently involve energy management, alarm services, and building transportation systems. Other systems incorporated in high tech buildings include not only HVAC (heating, ventilation, and air conditioning) but also PLEC (power, lighting, electricity, and communications), BMS (building management systems), energy control systems, UPS (uninterruptible power supplies), and LANs (Local Area Networks). These buildings provide enhanced and integrated services, are energy efficient, and are capable of responding quickly to the special needs of each occupant.

As a result of developments in satellite and microwave technologies, high tech buildings can be enhanced in a number of additional ways to the benefit of tenants and landlord/developers. Tenants can take advantage of a broad range of new technologies at a lower cost than they would pay if they attempted to procure these services on an independent basis. Similarly, high tech buildings have been accepted with enthusiasm by landlords and developers, who find that the availability of an integrated electronic office communications system is an important factor in increasing the demand for and in selling office space.

Closely related to the concept of high tech buildings is the teleport. Teleports are essentially real estate developments wherein the property owner or manager incorporates telecommunications and computer services and facilities (e.g., satellite earth stations) primarily for long-haul voice and data transmission, the cost of which can more efficiently be shared by a large set of users. By packaging access to these technologies, developers afford both their tenants and off-site users within a particular region flexible access to services that otherwise would be too costly or difficult to secure individually. Teleports permit developers to establish previously untapped profit centers and boost the intrinsic value, profitability, and versatility of their properties. Teleports also offer advantages over rooftop satellite antennas. In general, an antenna can access only one satellite at a time, and there is a limit to the number of antennas that can be placed on a single rooftop. Thus, the number of satellites that can be simultaneously accessed by the tenants in a building is severely limited if reliance is placed solely on rooftop antennas.

The teleport promises to provide less expensive access for small- and medium-volume users who might not generate enough demand for satellite and other efficient transmission facilities, and for large-volume users who prefer to have a turnkey operation rather than invest the time and effort necessary to develop a private telecommunications system. Teleport facilities equipped for multiple remote access also promise to solve problems for users in cities where existing telecommunications services prevent downtown construction and operation of additional microwave and satellite services (e.g., frequency congestion) or where available services do not satisfy particular needs.

These technological and regulatory complexities have brought a surprising number of new disciplines to the task of making an office building technologically compatible or of designing a teleport for multiple business users. These disciplines include engineering; architecture; construction; land-use planning; and legal, regulatory, real estate, and financial services. Of course, many other groups such as users, lenders, and service and equipment suppliers will be interested in high tech buildings.

Given the relatively recent vintage of high tech buildings, many professionals are only vaguely aware of the particular requirements and characteristics of these structures. Moreover, most professionals are generally familiar with high tech buildings only through their own disciplines. Real estate professionals, although experts at financing, many be baffled at private branch exchanges and local digital networks. Similarly, telecommunications professionals, adept at analog and digital technologies, may not understand the real estate applications of technology or of the traditional practices of the real estate industry.

This book provides a primer on telecommunications and related technologies employed in high tech buildings. Drawing on the experience of the well-recognized experts in this growing field, the authors discuss marketing, designing, maintaining, operating, insuring, powering, financing, and structuring high tech buildings and teleports. The book also addresses the revenue opportunities for landlords and nonowner service providers, as well as the cost and service advantages to tenants. Many of the topics are addressed more than once, but each time from the perspective of different professions and parties in interest. The reader can draw his or her own conclusions in evaluating the different viewpoints.

Chapter 1

For a comprehensive multidisciplinary book such as this, an overview of the topic of high tech real estate is essential, and Roy Layton and his colleagues from Sears Communications Company have ably provided just that in Chapter 1. A perfect overview, this chapter introduces many topics that are developed in greater detail in subsequent chapters.

Chapter 2

For real estate developers and other professionals, the technology and terminology of telecommunications is potentially intimidating and is also a barrier to comprehending the potential of telecommunications-enhanced real estate. In Chapter 2, Dr. Stanley Welland of Merrill Lynch & Co. and Glenn Pafumi of Dean Witter Reynolds provide a primer on the basics of telecommunications technology. This chapter provides helpful background, particularly for Chapter 13, which discusses the application of this technology in the high tech real estate environment; Chapter 27, which provides a description of the public telephone network; and Chapter 28, which describes satellite technology.

Chapter 3

Revenue, or the potential for revenue, is the driving force for real estate developers and telecommunications companies. Gardner McBride and Pamela Matchie-Thiede demonstrate in Chapter 3 the revenue opportunities that are available, and they provide a comprehensive description of services to be offered to tenants in the high tech shared tenant services environment. And, as icing on the cake, they offer their advice as to important considerations for developers to evaluate in moving forward in this area.

Chapter 4

The previous chapters have demonstrated the economic potential in telecommunications-enhanced real estate. In Chapter 4, Bill Hooton of Morrison-Knudsen discusses an example of a high tech project, the services to be offered to tenants, the parties needed to make a venture work, and the profit potential in the profiled case.

Chapters 5 and 6

Bob Baxter and Kevin McCarthy of Arthur Andersen & Co. have contributed two important chapters. In Chapter 5, they provide an introduction to and overview of important issues in high tech buildings and the trends and concerns that are driving the industry. In Chapter 6, they discuss the Arthur Andersen & Co. Delphi Study. The projections from the Delphi Study are critical to the understanding of *why* there is high tech real estate and *when* it will arrive on the scene. Developers making plans today for buildings coming on-line in 1988 and 1989 have a sound basis for making financial decisions.

Chapter 7

Bill Henry, one of Merrill Lynch Commercial Real Estate's leading real estate brokers, has interviewed the major real estate participants in high tech buildings. In Chapter 7 he supplements their comments with keen insights of his own based on his years of real estate experience. No developer thinking of entering the STS arena should miss Bill's comments.

Chapter 8

Ted Schell, president of SBS Real Estate Communications Company, in Chapter 8, provides a candid overview of the perspective of one of the original participants in the shared tenant services industry. Ted proffers some hard-earned lessons that he and RealCom have learned.

Chapter 9

A showcase of the advantages, efficiencies, and economies of telecommunications-enhanced buildings and well-designed high tech buildings is the Planning Research Corporation Building in McLean, Virginia. It is described in Chapter 9 by John Daly and Migs Damiani. They clearly demonstrate that the high tech building works; in the process, they present an interesting model for the design of corporate headquarters using shared tenant services to help in the marketing of expansion space.

Chapters 10 and 11

The eminent architect, Gene Kohn of Kohn, Pederson & Fox, reminds us in his chapter on designing the high tech building (Chapter 10) to take human factors into account in designing high tech buildings, and not to be so enamored of technology that human needs are forgotten. His coauthor, real estate developer Arnold Levy of Urban Investment, gives an overview of important factors in designing buildings for new technology from the developer's point of view. In the next chapter (Chapter 11), Piero Patri, the innovative San Francisco architect, and his partners provide insights into retrofitting existing buildings for high tech use, while giving important engineering and design insights into the planning of new high tech buildings.

Chapter 12

If anything is agreed on by all involved in this area, it is that high tech buildings need consultants, and Peter Valentine and Garrett Sutton of Comsul Ltd. tell in Chapter 12 how to evaluate real estate telecommunications consultants, what consultants should be asked to provide, and how to structure the consultant agreements.

Chapter 13

Chapter 13 is the first of a series of chapters that provide technical specifics of various technologies applicable in high tech real estate. Messrs. Stern, Weiblen, and Theodosis provide a tour de force, discussing topics ranging from building cable and wiring systems to microwave and satellite technology. These topics are addressed again and in further detail in Chapter 17 on inside wiring; Chapter 26 on cable and fiber optic networks; Chapter 27 on metropolitan digital networks; and Chapters 28, 29, and 30 on satellite networks and teleports.

Chapter 14

Although entitled Operating the High Tech Office Building, Chapter 14, by coeditor Robert F. Cushman, Theodore H. Schell, and Stewart Levine, provides more than a guide to the operation of such buildings. Because good planning and agreements are the foundation for the future operating environment, the chapter also discusses the planning and negotiation of shared tenant services arrangements.

Chapter 15

Providing energy for a building in the high tech era is not a simple matter. Energy must be provided to heat, cool, and ventilate the building, and to power building equipment, computers, office equipment, and telecommunications equipment. In addition, the power must be clean, reliable, and economical. In Chapter 15, Richard and Robert Herzog focus on the economical and efficient provision of energy, on cogeneration of energy, and on the contextual management of energy supply.

Chapter 16

Even prior to divestiture and the breakup of AT&T, finger-pointing and labor disputes in building telecommunications endeavors were common, particularly where a building tenant sought to install its own PBX in cities where real estate operations were highly unionized. Now, the division of responsibility among unions is aggravated by the division of responsibility among companies and industries. Labor lawyers William Highberger and James Sullivan provide a practical guide to the ins and outs of labor disputes relating to high tech buildings. Labor disputes are issues that lurk in the background when dealing with inside wiring, which is discussed in the next chapter.

Chapter 17

Inside Wiring for the High Tech Building (Chapter 17), by Robert Ryan of Essex Wire and Ron Symolon of Southern New England Telephone, may have more aptly been titled, Everything You Wanted to Know about Inside Wiring, and More. At one time, inside wiring was primarily the responsibility and concern of the local telephone company. This is no longer the case. Inside wiring represents a major cost to developers, requires forward-looking design decisions, may either restrict or enhance the application of technology in a building, is a regulatory nightmare, raises labor union problems, is a building management opportunity, and is an issue—if not *the* issue—of paramount concern in planning and managing a high tech building.

Chapters 18 and 19

Coeditor Alan Sugarman and New York lawyers Messrs. Berman, Goodman, and Jinnett provide in Chapter 18 an overview of the underlying legal issues involved in structuring and negotiating high tech building agreements. This chapter provides useful insights into the many varieties of agreements in a legal area that is now in its infancy. Washington lawyer Hank Levine follows up on Chapter 18 by providing his suggestions for negotiating a shared tenant service agreement for a real estate developer in Chapter 19. These chapters, together with Chapter 20 and the comments in Chapter 14, identify the essential legal issues in high tech real estate, provide practical advice, warn of the pitfalls to avoid, and offer solutions for problems presented in negotiating and structuring transactions.

Chapter 20

Telecommunications companies entering into high tech real estate ventures are intruding on traditional real estate relationships, traditions, and laws, much of which are based on 16th century English property law. In order not to be left holding a valueless paper contract with a shell corporation divested of its real estate holdings, it is recommended that the words of wisdom in Chapter 20 by lawyers Krasnowiecki and DePodesta be studied with care to learn the lessons of rights-of-way, covenants, and easements.

Chapter 21

It can come as no surprise that federal and state regulation, even after so-called deregulation, still control many of the decisions in high tech real estate. Washington lawyer Mary Jo Manning provides an up-to-date analysis of the issues in Chapter 21—from inside wiring to resale of local and long distance telephone service. Even with some deregulation in Washington, regulation continues unabated in the states.

Chapter 22

The regulatory issues in many cases derive from policies and decisions of the Federal Communications Commission; sometimes lapsed policies of the Commission live on long after their demise. The seminal FCC *Computer II* inquiry and subsequent decisions are perhaps the most important FCC actions that affect high tech real estate because of their treatment of customer-premises equipment and enhanced-transmission services. In Chapter 22, coeditor Andy Lipman and Bell Clement trace the background of and analyze the *Computer II* inquiry and its impact on high tech real estate. Even if the decision is eroded by subsequent FCC action, the effects of *Computer II* will continue to be felt for some time.

Chapters 23 and 24

A high tech building cannot get off the ground without financing, and Messrs. Herron, McKenny, and McCarthy of the Philadelphia office of Arthur Andersen & Co. discuss in Chapter 23 the financial and tax details of these ventures. Valuable guidelines are provided for developing financial *pro formas*, for ascertaining the proper financial structure, and for using tax benefits available for high tech building equipment such as raised floors and PBX systems. In Chapter 24, Brad Peery, the California investment banker, continues the subject of financing by providing an analysis of the sources of debt and equity financing for shared tenant services projects.

Chapter 25

Having invested heavily in a high tech real estate venture, the involved parties need to address the insurance coverage of the risks raised by these ventures. Coeditor Sugarman with Guy Migliaccio of Marsh & McLennan offer words of counsel that need to be understood while negotiating various high tech agreements, and that need to be heeded when planning insurance coverage.

Chapters 26–30

After covering legal, financial, and tax issues and after dwelling at length on shared tenant services, the book moves on to more advanced telecommunications topics such as metropolitan area networks, satellite communication, and teleports. The availability of these technologies to a high tech building may be an important factor in the familiar phrase "location, location, location"—for in the high tech era, one aspect of location will be finding one with access to enhanced telecommunication facilities.

Chapter 26, by Carl Gambello and Mel Van Vlack of Manhattan Cable, discusses the role of local cable and fiber optic networks in the high tech building environment. Many readers will be surprised to learn that cable television carries more than old movies and basketball games, and that today cable TV networks are being used as vital components in corporate voice and data networks.

Chapter 27

In Chapter 27, G. William Ruhl and Randall C. Frantz of Bell of Pennsylvania discuss an alternative to private cable, satellite, and fiber optic networks for providing advanced corporate digital services—the telephone company network. They describe the evolution of Bell's analog voice network to the high tech digital/voice/data/video network; that evolution is well underway today.

Chapter 28

John N. Lemasters and his colleagues from American Satellite Company have in Chapter 28 provided a succinct and clear description of satellite technology and how it is being applied to provide satellite networks for real estate developers and corporate communications users.

Chapters 29 and 30

Teleports. The word connotes the future, and it is a word that describes a variety of high tech communications facilities, as Kenneth Phillips of the Gulf Teleport describes in Chapter 29. In Chapter 30, Bob Annunziata and Dr. Stanley Welland of Merrill Lynch describe the first and largest teleport, the Staten Island Teleport, a joint venture of Merrill Lynch, Western Union, the city of New York, and the Port Authority of the States of New York and New Jersey. These authors provide an exciting description of these regional economic development projects and provide their prognosis for success. As these chapters indicate, high tech buildings are nurtured by, and in turn nurture, the teleport phenomenon.

In conclusion, the editors have structured this book as a vehicle to permit a wide array of professionals to recognize and take advantage of the significant opportunities presented by high tech real estate.

Finally, an effort this comprehensive—one that began in mid-1984 and is being published less than a year later—obviously required the effort and cooperation of many people, not the least of whom are the capable authors of the chapters. In addition to them, we would like to thank Caroline Gosse and Susan Russell, who shepherded the book in its early stages, and Diane Buxo and Donna Heffernan, our tireless assistants.

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High Tech Real Estate

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Chapter 1

Overview of High Tech Real Estate

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Outline

> "The environment that man creates becomes his medium for defining his role in it. The invention of type created linear, or sequential thought . . . now with TV and folk singing, thought and action are closer and social involvement is greater. We again live in a village."
>
> *Marshall McLuhan*

Much has been written about the evolution of Western economies from an industrial to an informational society. Just as the number of people working in industry started in the early 1900s to surpass the number of people working in agriculture, so do people in information occupations now outnumber those employed in industrial pursuits. Today we are virtually awash in Alvin Toffler's "third wave" of economic development.

It is again time, as it has been in the twice-rehearsed pattern of human history, that we set out to design, define, and fashion a better vessel with which to buoy fortunes upon the economic flood. Our quest is for a new container of commerce, a new building, and a new environment for the business of doing business.

The purpose of this book is to provide a suggested blueprint for the structural, technological, legal, financial, and other adaptations and improvements necessary to craft information age architecture from industrial age hulls. Since the implications of our pursuit, if not the very phrase *High Tech Real Estate,* may be intimidating to some, we hasten to offer reassurance.

The improvements required to create high tech real estate are little more than logical extensions of the long list of changes that have occurred in 20th century commercial real estate. While commercial land use has rotated from the horizontal to the vertical this century, commercial space use has spun from office to cubicle and to work station. Basic building utilities have surged from plumbing fixtures to atrium fountains, from stairwells to executive elevator levels, from oil lamps to fluorescence, from coal stacks to HVAC. Indeed, the structural amenities added during the industrial era span from bootscrapes to soundscapes.

Within perspective, the original novelty of these amenities rapidly dissipated among building owners and tenants alike. They were accepted and soon expected simply because of the intrinsic utility and value they brought to everyday work life. So too will it be with the communication capabilities that high tech building tenants will expect and possibly demand.

The focal point of these improvements is *information,* the key strategic business variable within the fabric of the new economy. A number of large businesses are already information based, including banks, insurance companies, investment houses, and stock exchanges. Their livelihood depends upon gathering and assimilating large amounts of data. The implication of the age, however, is that in large measure *all* businesses from the smallest shop to the largest conglomerate will revolve around their intelligent use, treatment, and movement of information.

These new information needs create new dimensions beyond those that have historically dominated industrial age architecture, design, law, and management. These new dimensions are intangibles; they are dimensions of the mind. As with knowledge in all forms, these new dimensions hold the potential to overpower all others.

In geometric terms, industrial age buildings have been designed, constructed, and operated under governing law founded in three dimensions. Traditional design defines cubic space within the three planes of height, width, and depth. Spaces are then subdivided physically and/or operationally into smaller building blocks. Finally, the rights, privileges, and limitations for each block are codified by general practice and prevailing law within the specific jurisdiction of the building's locale.

Information age officeholders will expect and demand communications with any point on the planet to perform routine activities. Once communication is established, work will be completed in concert with co-workers at many azimuths and distances. Each of these connections brings a new geometric dimension to the individual office cubicle and in sum to the structure as a whole. The new consumers of commercial real property must have many "addresses" well beyond the metes and bounds of their building's land track.

The "intelligent" building is one that stands *both* as an edifice upon its land *and* as a simultaneous location within the total communications environment or landscape. The power of this new environment may be measured by the movement of Citicorp's MasterCard transaction-processing computers and more than 17,000 employees from Manhattan to Sioux Falls during the past two years.

In addition, many people will be able to work at home connected by their telephone or cable to the office. Executives attending out-of-town business sessions, sales personnel on the road, and an army of clipboard-carrying meter readers, appliance repairers, and warehouse employees will be able to have immediate and accurate access to information systems back at the home office. Many businesses have begun to collapse travel costs through teleconferencing (voice) and videoconferencing (voice and image). It is only the beginning.

The concept of the *virtual office*—one that is in effect but not in fact—defines this new communications work environment. The concept also poses unique challenges for economic interests dependent upon people reporting to a central workplace. The response to date has applied ergonomics, or the science of human engineering, as a leading discipline to evoke increased worker comfort and productivity. It has also tightened the security perimeter required to satisfy employer concerns over the theft of valuable information. Yet such measures alone are but piecemeal approaches to the information megatrend.

As this book will explore, the high tech building provides a comprehensive solution designed to harness, as well as profit from, the communication forces

High Tech Real Estate Dow Jones-Irwin 1985
A. Sugarman, A. Lipman, R. Cushman

driving this trend. Its credentials are potent: Although fewer than 10 high tech buildings were announced within the United States prior to 1983, more than 15 are today under construction in the Dallas–Fort Worth Metroplex alone.

Projections by McLean, Virginia, based Telestrategies, Inc. show that 287 intelligent buildings will be in place or under construction nationwide by yearend 1985.

Thus we proceed with deliberate speed. The intelligent building must surpass its predecessors in facilities *and* flexibility if it is to attract and retain 21st-century tenant reliance. Yet, although it is only natural for those responsible for long-term capital growth to reach as far as proven technology avails in order to fulfill their fiscal charge, investment decisions in technology must carry positive net present value and real return. When it comes to high tech real estate, we must all be Missouri pragmatists.

It is within this context that the real estate improvements required for a high tech building have been selected.

DEFINITION OF A HIGH TECH BUILDING

Many definitions of what a high tech building is or should be are bantered about in the marketplace. This will continue to be the situation for several years until a consensus of architectural and technological values is attained.

"The Orbit Study," completed in Europe and published in the United States by Cross Information of Boulder, Colorado, provides a checklist of qualifying elements. The study recommended that building designers consult at the earliest stages with information systems experts. New and reconstruction plans should specify vertical ducts of up to 2 percent of floor area for separate power, telephone, and signal cables; floor communications cabling; CRT glare-free ambient lighting; decentralized and expandable air conditioning sized to compensate for computer heat; minimum floor-to-ceiling heights of 2.8 meters; and "cellular" rather than "open" space allocation design.

In the broader scope, high tech real estate may encompass a single building or a complex of structures arranged within a teleport environment. The benefit of a teleport is access to high bandwidth, low cost, and shared facilities. A stand-alone building or complex properly designed with fiber optics and T–1 carriers, however, can fulfill the same criteria. Thus for our purposes, the terms *high tech building* and *high tech real estate* will be used interchangeably.

Our working definition of a high tech building may be summarized as one equipped to properly *support* voice and data integration, video services, security, energy, and environmental management functions today *and* to accommodate the *migration* of these technologies tomorrow.

Before deciding what to offer in a building, the developer should evaluate the type of tenant who will lease space in the building and the types of services tenants will require. Depending on size, location, and tenant mix, a developer may want to offer only voice or voice and data or both together with videoconferencing. The offerings depend on the economics of each offering as a stand-alone business and the image the developer wishes to project.

Nonetheless, certain facilities and services are so primary to the satisfaction of the information age challenge that they mandate an expansion of our original definition:

1. On- or off-premises voice/data switching service supported by a central computer, designed to ensure profitability of shared services 10 to 20 years in the future. This system must also meet certain technical criteria:

   It must support a Local Area Network (LAN) or have the capability to support a LAN at a low additional cost. This is critical so that various types of equipment have the ability to "talk" to each other.

   It must accommodate large bandwidths to handle a number of services, such as voice, data, and videotex, at low incremental costs.

   It must use distributed processing rather than centralized processing to enable functions to be distributed should a single function or node fail. A distributed architecture is also preferred so as to contain system growth, risks, and costs.

   It must be open ended to accommodate the customized applications software a particular tenant or developer may wish to provide to achieve a competitive edge.

   It must have enough software partitioning capability to assign each tenant a portion of the system without limiting or restricting the tenants' system configuration.

2. Communication wiring systems that provide for the integration of voice, data, and even video communications as profiled in our original definition.

   Today, a major cost to tenants is associated with moving telephone sets and data terminals. Currently, the average cost for businesses to move a data terminal is $1,800, and the average cost to move an electronic telephone is $200.

   With proper design, distribution, and management of cabling-distribution frames, these costs can be considerably reduced to the tenant, while still leaving a healthy margin to the developer. In order to achieve this objective, however, a wall or floor plug-in work station with simple, patch cord routing must be employed.

3. A basic package of communications support services encompassing inter-office as well as local and long-distance access.

   Basic voice features include transfer, conference, and pickup, as well as approximately 200 other features.

Certain key features, such as centralized attendant service with messaging, are lucrative offerings. Message service allows a centralized person to take messages for the entire building rather than each tenant having a console and operator. A call-waiting light alerts the station user that a message is waiting. Voice mail, or the electronic recording of messages on a centralized storage device, can also be offered. It acts much like an answering machine, but is much more sophisticated.

In the data area, basic services would include word processing, electronic mail, and shared database access.

The telephone user within this high tech building must simply be able to dial an extension associated with word processing, record a letter, and have the information processed and distributed. Distribution may be handled by either an outside agency or by the tenant service personnel within the building.

Electronic mail is provided to tenants on the same basis. The developer supplies a centralized terminal and telephone number and electronic mail can be delivered to and from the building to other electronic mailboxes.

The extension of this mailbox concept to shared databases operated by the developer, other tenants within the building, or nearby firms is also common. The telecommunications switch within our high tech building allows tenants a direct private line to such databases rather than local or long-distance measured rate service.

Video technologies are currently being applied to provide cameras wired to on-site or remote monitoring stations for security, elevator safety, and personnel monitoring. In addition, variations of applied television techniques are presently used to provide videoconferencing for remote, face-to-face meetings.

Although individual video applications can be expensive—ranging from $50,000 to $500,000—videoconferencing systems return their investment through reduced travel costs, improved productivity, and accelerated corporate decision making. Provision of video services enhances the ability of developers to compete for business by sharpening their competitive edge.

The high tech building offers a complete menu of user services employing a spectrum of technologies within the affordable grasp of property owners and developers. Such a structure is distinguished from the routine primarily by the builder's commitment to capitalize upon the communications age.

PHYSICAL FACILITIES

"Success is a product of unremitting attention to purpose."

Benjamin Disraeli

Simply defining the logic, shape, and actions of structure (as every reader of *The Wizard of Oz* will recall) is not enough to produce a vital, living creation. The design of a high tech building, like that of the Tin Man, requires certain essentials to make it truly intelligent.

Central Processing Unit

The "heart" of the intelligent building is a central processing unit (CPU) or "switch," designed to provide temporary interconnections between work areas within and beyond the structure. Since 1871, when undertaker Almon B. Strowger patented the first automatic machine switch made of scrap metal and a collar box, users have discovered successive benefits from on-premises switching. Strowger's device allowed him to bypass the telephone operators who, he claimed, were undercutting his business with wrong numbers and busy signals.

Since then, generations of design engineers have labored to expand the repertoire of buisness-stimulating features available from such CPUs. The first generation of these mechanical switches came to be called Private Branch Exchanges (PBXs) and lasted until the mid-1970s before they gave way in numbers to switches that replaced relays with transistors.

Third-generation switches, which operated under the control of programmable microprocessors, came on-line in force at the beginning of the 1980s. Some of these systems have been modified to switch data. At middecade during 1985, a fourth generation of switches, designed from the ground up for integrated voice and data switching, promises to make obsolete even the most sophisticated devices of the early 1980s.

As with any high-growth industry, the switch market is fragmented with major suppliers vying for a dominant share. A profile of the industry was prepared by Northern Business Information based upon 1983 PBX shipments. Table 1–1 lists the segments given in the profile.

TABLE 1–1
Share of 1983 PBX Shipments

AT&T	23.7%
Northern Telecom	16.8
Rolm	14.1
Mitel	11.1
NEC	6.1
GTE	4.3
Others	25.9

The focus of this competition is the central processing unit, which will fully integrate the historic transmission economy of voice communications with the control inherent in data communications. The analog telephone systems originally designed only to transmit the critical frequencies of the human voice are yielding to systems adapted to transmit crisp, square-edged data pulses.

Machines that think in terms of millions of bits per second have suddenly emerged and overtaken the number of analog telephone sets in businesses within the past nine years. Most of the digital devices—ranging from mainframes, to mini- to microprocessor-equipped copiers and cash registers—have communications capability. Not all such devices will be heavy telecommunications users, but their cumulative communications muscle wields considerable leverage on any company's bottom line.

Consequently, firms marrying computing to communications technology are placing business needs ahead of technological infatuation and planning their communications architecture with an advanced central processing unit. More than $3 billion in PBX equipment was sold within the United States during 1984, and observers project a 10.3 percent average market growth over the next five years.

Local Area Network Wiring

The modern office, shopping, or manufacturing complex may be sheathed in chrome and glass, but to be more than a Tin Man, the intelligent building also needs a circulatory system. Wires and cables radiating from the central processor provide the circulatory system of an intelligent building and collectively form one or more Local Area Networks (LANs).

There are numerous definitions of a LAN used by the more than 200 firms providing LAN technology. The definition used here is an advanced public or private transport system consisting of physical media and related software that serves a limited geographic area. The area usually covers a single building or cluster of buildings but may also cover noncontiguous buildings at distances of up to about 30 miles. Overall, the system provides for transmission at high rates and over wide bandwidths.

The need for such a central nervous system within the intelligent building of the future is clear when one realizes that the body of office communications terminals is already sized in the millions and is growing at an annualized rate in excess of 25 to 30 percent. The Orbit study, mentioned earlier, projects that one out of three office workers will be equipped with electronic work stations within the next decade. The sheer size and expense of prolific wiring snakes required to support this explosion threatens to become a boa constrictor on the bottom line of every commercial building developer.

Preinstalled or retrofitted as a capital asset of the structure, a LAN provides the opportunity for architects and their clients to preplan an integrated system in harmony with the overall building design and other basic structural systems, such as plumbing, air conditioning, electrical wiring, and HVAC. The LAN provides a single "communications utility," which combines the capabilities of separate telephone, data, and coaxial cabling and thereby eliminates the redundant space and financial waste of such separate add-on systems.

To understand LANs, it is important to distinguish between the physical, electronic, and topological properties associated with the term.

The *physical* LAN, like the arteries of the human body, is a system of communications wires, cables, and conduits running throughout the body of the intelligent building. Large capacity components are used where communications flow is heaviest; smaller branches are installed where communications flow is lowest; and each section is physically connected to the main.

The physical attributes of the LAN must be planned through the cooperative efforts of the architect, electrical engineer, and building developer to provide for vertical chase space, floor-by-floor communications closets, radial floor or ceiling workstation pathways and outlet spotting. Such components as twisted copper wire, optical fiber, and interstructure microwaves link electronic patch panels located throughout the structure.

The *electronic* LAN is composed of engineering-compatible carrier media, switch and patch racks, and individual device interfaces. Both the Institute of Electrical and Electronics Engineers (IEEE) and the European Computer Manufacturers Association (ECMA) govern wiring and rack component standards.

The benefit of electronic LAN technology is that it permits standardized electronic interfacing of communicating word processors, facsimile devices, computer-to-computer links, voice messages stored in digital format, integrated voice/data, and interfacility communication systems now available to upgrade office systems.

Advances in LAN technology are rapidly creating for communications what the United Nations provides for international diplomacy—instantaneous information exchange. LAN communication techniques bridge the several thousand computer languages, protocols, and software specifications now on record as standards.

The *topological* LAN may accomplish its goal via a number of different transmission arrangements, the most popular of which are the star, the ring, and the tree or bus. Star network systems provide for "out and back" radial communications between a CPU and individual points as typified by the traditional PBX voice-wiring configuration.

Ring topologies are constructed using points, or nodes, which recognize their own address on messages traveling around a circle, and transmit, retransmit, or absorb traffic accordingly. Deterministic network controls tell each point when it can transmit. Tree and Bus topologies permit each point to transmit whenever the network is free (statistical), using one of several message "collision detection" systems. These latter two structures are variations of the IEEE 802 standard and provide the basis for such commercial systems as Xerox, DEC, and Intel LAN systems.

LAN technology is aimed at expediting the flow of 80 percent of all the business information exchanges that studies show take place locally. As the number of desktop, workstation, mini- and mainframe computers expands, so too will the economic justification for their interconnection. LAN installations valued at $629 million in 1983 are projected to increase to $4.57 billion by 1988, according to the Boston-based Yankee Group.

Gateways

Information-age clients require as sustenance within the intelligent building the ready and ample flow of communications.

The portals through which the commerce of the information age will flow have been entitled "Gateways." They connect the intelligent building to various types of information highways.

Public telephone system. Historically, the first and still the most basic form of gateway is the familiar telephone company termination panel, occupying wall or rack space within the commercial structure.

Through this gateway are paths of predominantly twisted copper wire through which ready access is available to the 1,450 telephone companies in the United States. The telephone companies of the divested Bell System today account for approximately 77 percent of all telephone traffic; General Telephone & Electric (GTE), United Telephone, and Continental Telephone in aggregate account for the second 17 percent; and the remaining 6 percent of U.S. services is provided by local and regional telephone companies.

All five discretely identifiable parts of this consolidated U.S. telephone network—local loops, local switches, interoffice metro facilities, tandem switches, and intercity facilities—are coordinated for cohesive operation through the use of a common network-signaling protocol. This protocol, as well as the individual physical facilities composing the network, were designed and optimized through the early 1960s specifically to handle analog voice traffic. The resulting network performance has provided the United States with the world's best analog telephone service.

Economics, technological developments, requirements for increased performance, the need for new data-oriented services, and the advent of competition have driven the public-switched network into a massive rebuilding program during recent years and into a move toward the digital transmission of voice as well as data information.

The digital evolution began with the 1962 introduction of the T-1 carrier for interoffice communications, which provided up to 24 digitized voice channels using a combination of techniques known as pulse code modulation (PCM) and time division multiplexing (TDM). Subsequent channel bank and multiplexer developments satsifying AT&T's speed, spectral density, and pulse format criteria have made it possible to derive 48 or even 96 voice channels from two twisted T-1 circuit pairs at per channel costs considerably below individual voice lines.

Today, more than 70 million miles of T-1 carrier exist within the United States, and the explosive pressures of the information age have produced an entire family of high-capacity, intercity cable facilities.

Concurrently, refinements to the public-switching apparatus itself have passed a series of milestones in a massive adaptation to support services for the digital era. A brief list of just the major milestones would include the 1965 introduction of stored-program-controlled switching; the 1974 introduction of the Digital Data System and Dataphone Digital Service; the 1976 installation of Packet-Switched Signaling (Common-Channel Interoffice Signaling—CCIS); and the 1981 advent of Time Division Switching.

The tactical target of these advances is the rapid adaptation of the existing Bell physical plant into an Integrated Services Digital Network (ISDN) to provide quick, economical, and universal use of the network for simultaneous switched voice and data transport.

As Mr. Watson's successors have been responding to the call of the high tech building, so too have others. Several competitive technologies offer existing and economically alternative gateways for both intra- and intercity traffic.

Private microwave systems. A "key alternative" to the traditional telephone company facilities is private microwave, according to 1984 research reports published by the market research firm International Data Corporation (IDC).

The microwave radio systems spawned by World War II provided the broadband transmission solution for the postwar explosion of the U.S. commercial television industry. Within three years after the first microwave radio relay system became operational beween New York and Boston in 1948, a nationwide system had been erected. Indeed, microwave today accounts for more than 50 percent of all intercity communications capacity worldwide.

As the name implies, microwave radio relay systems transmit information on a point-to-point line-of-sight basis through the air using high frequency radio transmissions. High tech building owners may establish a direct gateway to the microwave highway by installing roof or window transceivers, which are in turn connected to the building's LAN.

These are some of the key considerations for selecting private microwave:

Traffic requirements: Low capacity traffic can frequently be accommodated at lower frequency bands of 350 MHz to 1.5 GHz, but higher capacities will necessitate radio links of 2 GHz and above.

Service grade requirements: Good service grades emphasize multiple path redundancy.

Location requirements: Urban radio frequency bandwidth congestion may require the use of higher frequency bands in the 11–13 GHz band.

Terrain requirements: Roof, window, or tower heights of between 70 and 120 feet will be required in flat terrain; and high-altitude remote site relays may be required to hopscotch natural obstacles.

Climatic requirements: Most commercial equipment is designed to function in the 0–35 degrees Centigrade range, but HVAC-equipped sheltering may be required in more severe climates.

Of the two basic types of microwave transmision widely used—frequency and pulse—pulse or digital signal modulation techniques best lend themselves to the integration of the voice, data, text, and video transmission forms required by business. As a result, microwave carriers have been rapidly constructing digital facilities since their perfection in 1971.

Private digital termination systems (DTS) microwave usage is estimated to be growing at the rate of 20 percent per year, spread across two types of services authorized by the Federal Communications Commission (FCC). These categories include limited carriers operating in fewer than 30 cities and extended network carriers authorized to operate in 30 cities or more.

The competitive choice grows almost daily. Of the more than 500,000 miles of microwave radio relays that crisscross the continent today, more than 60 percent have been constructed since 1975. More than 35 multicity and more than 50 overall DTS network applications have been filed with the FCC, and more than a dozen of these have been approved, so that most major U.S. cities are covered by DTS.

Optical fiber. If microwave technology has a glass jaw, its name is *optical waveguide technology.*

Although lightwave transmission is relatively new to the business communications end user, it is a technology originally conceived by Alexander Graham Bell. The concept languished until the development of lasers and materials suitable for optical transmission during the last 20 years. Economically viable since 1978, lightwave transmission promises to be the late-century wonder child of telecommunications.

From what appeared only recently to be an impractical and dubious technology, lightwave transmission now routinely conveys information in digital form either via ultrathin, extremely pure glass or plastic fibers or for short distances through the air by modulating laser light source at very high rates. The implications for developers of intelligent buildings are significant.

At a fraction of the diameter of copper wiring, lighter in weight, and circuit-for-circuit less expensive, optical fiber cable provides transmission capacities in excess of *any* conventional media. A single pair of glass strands smaller than a standard one-pair telephone wire is capable of transmitting more than 14,000 32 kbps voice conversations *or* more than 50,000 data channels, *or* a variety of voice, data, and video combinations.

In addition, six key properties of lightwave transmission are rapidly making it the preferred selection for both extremely large bandwidth video gateway (single mode) and campus and intrabuilding LAN transmission (multimode) applications. These properties are:

Broad bandwidth: Capable of handling ultrahigh transmission speeds.

Long distance: Freedom from frequency-sensitive attenuation problems associated with conventional coaxial cable.

EMP and EMF immune: Providing superior noise and interference protection from electromagnetic fields and pulses.

Small size: Permitting high-capacity cable to be installed or retrofitted in building chases and conduits with high space efficiency.

High security: Resulting from the extreme difficulty of intercepting and decoding laser transmissions.

Environmental and human safety: Avoiding grounding, voltage, and sparking problems through low-intensity, nonelectrical transmission.

Optical fiber gateways planned today will be positioned to access a broad new international optical waveguide transmission system now being installed. Long-distance networks are already operating over optical fiber strands in 20 countries. Work is starting on a trans-Atlantic optical cable. More than a half dozen U.S. firms and divested components of AT&T are now constructing multimillion dollar interstate systems. And according to AT&T and Western Electric, approximately 30 percent of all new local loop systems installed by telephone companies during 1984 were lightwave.

Consequently, such diverse property owners as the following today operate high technology buildings with installed optical links: Citibank, the Port Authority of New York and New Jersey, the University of Pittsburgh, Northwestern University, 27 buildings in the Brickell Avenue district of Miami, The Allstate Insurance Co. and its parent Sears, Roebuck and Co.

Over the decade, developers seeking ultimate reliability and performance are further expected to escalate sales for lightwave loop, LAN, and CATV components, further increasing manufacturing economies and lowering costs. Gnostic Concepts of Menlo Park, California, projects that 1983 optical fiber sales totaling $12 million will catapult to $407 million by 1990.

Satellite. Once the exclusive domain of common carriers, satellite transmission is now readily available to business end users, who can justify its expense with a major communication concentration. Enter the high building.

Satellite transmission is a specialized form of microwave transmission that uses earth stations as transmitters and receivers and satellite transponders as repeaters. Satellites, depending upon their launch date and type, typically carry between 10 and 20 transponders and revolve 22,500 miles in space. Each transponder is capable of receiving, amplifying, changing the frequency, and retransmitting a unique signal "uplinked" to it from earth. The average capacity of each transponder is in the 50 million bits-per-second range, representing massive communications capabilities by any terrestrial media standard (with the exception of optical fiber).

Commercial communications by satellite was officially launched during April 1965 when INTELSAT I, or "Early Bird," was boosted from Cape Kennedy and established the first space link between the United States and Europe. ANIK, which was launched by Canada, opened the North American domestic satellite era during November 1972 and was followed two years later by WESTAR I as the first U.S. domestic satellite.

Although the initial years of satellite transmission were lean indeed for carriers faced with multimillion dollar launch investments, the information explosion has brought a surge of demand and a responsive deluge of launch applications to the Federal Communications Commission within the past five years. At this writing, the U.S. commercial market is served by 356 transponders, which are provided by six systems: RCA, Western Union/American Satellite, Comstar (COMSAT), Galaxy (Hughes), SBS (Satellite Business Systems), and Telstar (AT&T). Assuming FCC approved launches take place, the U.S. will be served by 647 transponders by 1985 and 883 by 1988.

As might be expected, this tremendous growth in the demand and availability for satellite services has resulted in a severe congestion of the U.S. coverage arc for both of the current transmission frequency bands, C band (4–6 GHz) and Ku band (12–14 GHz). The FCC, in response, reduced the satellite orbital spacing criteria during April 1983 from 3 to 2 degrees. The decision further accelerated satellite development plans—particularly for new Direct Broadcast Satellite (DBS) services offered by eight domestic firms that beam news, information, pay television, and other forms of entertainment on a one-way basis directly to homes and offices.

The high tech building may access this geostationary communications belt via an on-premise antenna or may be connected to an off-premises antenna by a dedicated or shared broadband communications link such as coaxial cable, optical fiber, or microwave. Located on a concrete pad at grade level or on a roof-mounted load frame, the antenna needs only a clear angled, line-of-sight view of the equatorial arc and solid moorings to compensate for sail-effect wind loadings. High tech building developers may be the first in their industrial complex with an antenna, but they will be in expanding company. Nearly 1,500 commercially licensed transmitting satellite antennas and 10,000 receive-only satellite antennas are registered with the FCC, in addition to at least 40,000 unregistered backyard units being used primarily for TV reception.

A low-noise amplifier (LNA) cable is the umbilical cord from the antenna to electronic equipment located within the building. Although major private clients may utilize single-access electronics, the majority of high tech building developers install either Time or Frequency Division Multiple Access (TDMA or FDMA) electronics. These are in turn connected to the building switch, internal LAN, and to other antenna sharers in nearby buildings to whom service is provided.

Since C band satellite transmission operates within the microwave bandwidth and requires a clear "look angle" to the satellite arc, the number of suitable antenna sites within any high-density commercial region are finite and are dwindling with each new microwave build. As a result, per-square-foot values of suitable ground and roof sites that can be licensed with the FCC have soared by 300 percent during 1983 and 1984, according to industry experts. The financial implications of this final point should be apparent for high tech building architects, real estate professionals, and developers seeking to establish an on-premises space gateway.

Teleports. The severity of "satellite congestion" was among the principal forces behind the advent of a new form of carrier gateway during 1984—The Teleport. Sited strategically for a clear physical and electronic "view" of the satellite arc, teleports are designed to provide for satellite transmission what airports accomplished for air transportation.

Teleports are being developed in a variety of sizes, shapes, and features, but all are constructed around a central common element. The element is an antenna "farm" that is graded to provide optimal drainage, has secure pad moorings, and usually has a surrounding earthen embankment to reduce wind tunneling and to provide shielding from stray microwaves.

Intelligent buildings are connected to the teleport via one or more broadband transmission media, such as CATV coaxial cable, optical fiber, point-to-point microwave, and T-1 carrier. Teleport developers usually operate these gateway services either directly or through joint agreement with a common carrier.

Users of the gateway install their own satellite earth station and/or pay for shared access to another within the complex. All transmission costs between the teleport and the end user's premises are additional.

Private and carrier satellite gateways are projected by International Resource Development Inc. to account for a $837 million market by 1985 and a $1.222 billion market by 1987. Within these estimates, approximately 43 percent of the traffic will be voice, 40 percent data, and 17 percent video.

Building Control Center

A building control center is required as a central nerve center from which all of the facility's newfound communications assets may be monitored and managed.

Aside from protection of the capital investment in switching computer, internal wiring, gateway, and videoconferencing enhancements, there are pragmatic reasons for the design and installation of a building or campuswide control center. Tenants, particularly those whose businesses depend upon reliable information processing, will expect and demand a high degree of service. The immediacy of their needs for routine and special services, moves, maintenance, and repair give the premises developer the opportunity to package these services. However, that same immediacy also demands a new level of response.

Perhaps to understand why, it may be helpful to review the four stages of a typical telecommunications service interruption. Naturally, Stage One begins with some condition that impedes the communications of a system or combination of systems. Since this may occur over time or during off hours, the problem may actually exist for some time under normal conditions before it is detected. This delay period represents Stage Two of the interruption and carries a high potential for lost system operator revenues due to unanswered inbound communications.

Once detected, the problem enters Stage Three, in which the system operator juggles user complaints and maintenance staff or subcontractor activities. We call this phase the isolation period. With complex multiple-component communications systems interconnected both within and beyond the high tech building with additional third-party systems, just locating the precise reason(s) for the outage may be an enormous task.

The problem is finally isolated and corrected, and the communications environment returns to normal operations during Stage Four. Whether such problems are within or beyond the developer's control, they directly impact usage-sensitive revenues within the high tech building. Consequently, the control of one or more of the phases can reduce the service interruption time and minimize the revenue loss.

Simply stated, the intelligent building control center compresses the out-of-service interval within each phase and reduces user inconvenience, system downtime, and costs for all concerned. Through a set of specialized hardware and software products, an automated control area may be economically constructed. The space required for the control center can be an area as small as twin workstations. Such a control center is capable of "predicting" system failure *before* it takes place, and repairs can often be accomplished without the user's awareness that a malfunction occurred.

When combined within a central real estate management office with systems optimization, customer service, communications, logging, and billing functions, the control center provides the necessary cost-justified management tool to intelligently guard returns to the owners of high tech real estate.

SERVICES

"Companies don't make purchases; they establish relationships."

Charles S. Goodman

Although the primary focus of this text is to provide readers with a baseline for understanding intelligent real estate, a forward view of the migration path open for their future investment growth is only appropriate. In addition to the shared voice, data, video, internal, and gateway communications and control services already profiled, the physical plant erected within a high tech building will position developers to enter the information industry at the ground floor.

Videoconferencing

Among the first high-growth opportunities will be the extension of audio, image, and videoconferencing services. The international frontier may be opened merely through contractual arrangements with additional carriers. AT&T-British Telecom's International Video Teleconferencing Service, SBS-British Telecom International's "Interlink," and Intelmet's (Intercontinental Comsat) "PMS-like" service are three of the current U.S.-anchored systems with announced plans. In most cases, all the developer of a high tech building equipped with conferencing must do to provide international service is make arrangements with one or more of the international carriers. Costs are then billed to users on a usage basis with the appropriate markup.

Videoconferencing enables companies to hold internal meetings and external customer sessions without expending time and money for long-distance travel. For the high tech building, videoconferencing enables developers to retain their existing tenants while attracting tenants from surrounding developments to their premises. If teleconferencing reduces travel, what about the travel industry? The answer for more than 15 major chains in the hotel industry now establishing teleconferencing facilities is, to paraphrase a popular slogan, "Don't leave home to get it."

In background, videoconferencing began with firms who pioneered audioconferencing. They used "meet me" bridging capabilities and gradually enhanced their peripheral equipment to include real-time graphic whiteboards, facsimile, or digitized graphics pads to permit audiographic conferencing with graphic stills. Other firms, with or without mainframe networks, made increased use of computer conferencing with graphics capability in the wake of the personal computer explosion.

The spinoff effect of audio and computer conferencing, however, has often been an increased demand for full-motion, interactive video conferencing. This demand occurred simply because there is nothing more distracting to the flow of a meeting than waiting for a computer to regenerate graphics or a photograph.

The "vision" of the intelligent building then is its on-premise facility for videoconferences using either one-way or two-way full-motion technology. One-way conferencing is best suited for such special events as educational training, CEO speeches, and product announcements. It provides closed circuit one-way video and controlled two-way audio feedback via an integrated analog satellite system to receiving dishes at each conference site. Holiday Inn's Hi-Net, Atlanta's VideoStar, the 210 Public Broadcasting Station (PBS) system, Private Satellite Network (PSN), Robert Wold, and the Public Service Satellite Consortium are among those who provide such capabilities at prices ranging from $800 to $35,000 for a 10-site conference. According to The Yankee Group, private one-way conferencing was expected to grow from a $1.3 million to a $14.7 million revenue industry between 1984 and 1986.

Full two-way videoconferencing is the business equivalent of what has been seen for several years nearly every evening during the network news—a live video and audio exchange between two or many participants. Microphone- and camera-generated 4.5 MHz signals have been typically digitized, compressed to 1.544 Mbps, and decompressed on opposite ends of a satellite or other broadband link via devices known as codecs, then displayed at the receiving location.

In addition to individual equipment suppliers, such as Compression Labs, GEC-McMichael, NEC Corporation, Widcom, and Avelex, the following firms are among those offering consultation or complete turnkey systems: American Satellite, AT&T Information Systems, Centro Corporation, ISA-Comm, SBS, and Sears Communications Company.

A survey by The Yankee Group of the 95 private videoconferencing rooms in operation during 1984 provides the following checklist of common features:

Excellent acoustics.

Voice-switched microphones and cameras.

"User friendly" control panels.

Multiple-angle cameras for viewer perspective.

Real-time picture/document transfer peripherals.

Prices range from $60,000 to $500,000 per videoconferencing site, depending on equipment quality and whether transportable room facilities are installed. Gateway carrier charges are dependent upon the transmission speed and medium employed. New developments in "quasi-full motion" technology, however, are providing compression to 56 kbps and inter- and intraframe coding. At least one electronics firm plans to introduce a *personal* video workstation in the $10–15,000 price range.

The videoconference market overall is projected by the San Jose, California, based research and consulting firm of Creative Strategies International to catapult to $6.4 billion in total revenues by 1988, with a 100 percent compound annual growth rate in public videoconferencing rooms.

Data Processing Services

Falling hardware prices, better business software, and rising transmission costs have shifted the cost dynamics of the data time-sharing market and opened new opportunities for building developers who sell space to tenants with similar or vertically linked businesses. The Association of Data Processing Services Organizations (ADAPSO) statements indicate that time-sharing industry revenues increased at an annual rate of approximately 47 percent through 1979, but 20.5 percent in 1980, 24.4 percent in 1981, and 15.7 percent in 1982.

As a consequence, major time-sharing houses—such as Comshare, Xerox, Litton Computer Services, and D&B—have begun to diversify to provide specialized software and systems on licensing agreements. Under these arrangements, customers contract for on-premises, rather than off-premises, use of the firm's proprietary equipment and software. Many small and medium offices cannot cost-justify even such streamlined contract services, however, unless provided on an on-premises shared basis. Astute developers equipped with buildingwide data communications are ideally positioned to provide word processing, payroll support, general accounting, and other specialized time-sharing services to tenant terminals.

Facilities Management

At Disney World Village Plaza in Orlando, Florida, the Hilton has a fully integrated communications and control system straight from the "Tomorrow Land" of intelligent real estate. The building's entire energy management and security system is operated through the structure's central wiring system. Every push-button telephone is equipped with microprocessors and connected to a PBX switch.

When a guest enters a room, the system is energized—the room environment conditioned—and the smoke detectors located in the telephones are sensitivity-adjusted by the central monitoring post to prevent false alarms. A phone-mounted speaker will alert guests in the event of fire anywhere in the hotel. Guests may adjust their own heating, air conditioning, and even the television by using the handset buttons. Naturally, all of the room's utilities are automatically adjusted to energy efficient levels when a guest leaves a room.

Videotex

Finally, no trip into the near future of intelligent real estate would be complete without mention of a technology that Booz Allen & Hamilton predicts will be a $34 billion industry by the mid-1990s.

Videotex began as the CCITT-endorsed term for an interactive computer/communications technology. A close cousin, Teletext, referred to similar one-way technologies. Subsequent broad usage in Europe and the United States, however, has broadened the meaning of these terms within the videotex generic to include a variety of packaged information services, transmission systems, and techniques still in flux. For the layperson, it may prove helpful to merely think of videotex as an entirely new media offering the detail of print, the immediacy of radio, the control and accuracy of data, and the power of television.

Videotex began with a 1973 prototype demonstration of "viewdata" by Samuel Fedida and 1974–76 United Press International (UPI) development and deployment of "NewsShare," an on-demand information retrieval system providing an all-electronic newspaper. In 1977 the Apple II personal computer was introduced; Dow Jones offered the first ADCII videotex service; and the British field tested another version using the Prestel standard.

By 1979 the French had unveiled the Antiope, the Canadians the Telidon standards, and the first commercial videotex service for PC owners (entitled "The Source") was operational by Telecommunications Corporation of America (TCA) from McLean, Virginia. There are approximately 1,900 public access data bases available today through 80 videotex operators reporting 1984 revenues totaling $67 million. The long list of U.S. firms actively establishing the new media at an estimated 78 percent annual growth rate include: ADP, Atex, AT&T, Centel, Dow Jones, Honeywell, H&R Block's Compuserve, Knight-Ridder, News America, Times-Mirror, and Trintex—the new joint venture between CBS, IBM, and Sears, Roebuck and Co.

Building owners have to date played host to this massive development but in most cases without business participation. The list of videotex consumer applications awaiting profitable developer involvement includes electronic time-temperature-message signs; automatic teller machines; kiosks in hotels, office buildings, and shopping mall foyers that provide information about local restaurants, entertainment, and shopping; and checkout lane terminals that eliminate credit authorization delay.

In addition, terminals providing full-motion video product demonstrations are appearing on American retail counters to expand the opportunity. In France more than 30,000 telephones and 70,000 retail businesses have already been equipped to accept microcomputer-imbedded "smart cards" for cash-free shopping.

Within executive suites, the terms *electronic banking, electronic shopping,* *what-if spreadsheet analysis,* and *electronic handshake* are remapping the business vocabulary.

The 4.9 million American white-collar workers using personal video terminals during 1984 are expected to increase to more than 50 million by 1990 according to Electronic Industry Association (EIA), and more than 20 million of the new units will be sold with communications and videotex capabilities.

Moreover, independent studies conducted by the Gartner Group tally 1984 U.S. corporate mainframe, software, and applications purchases for videotex applications at $329 million and project that the 1987 market will reach $2.1 billion. To support the new electronic office, Gartner reports that American business spent $170 million during 1984 and will spend $800 million during 1990 for connect charges alone.

The developer of the intelligent building has the opportunity to be a partner in these developments in the business videotex market, representing 72 percent of near term revenues for the videotex industry as a whole. The facilities profiled in our definition of the high tech building are central pathways through which videotex services may be delivered between outside information providers, retail and business office space holders, and their customers.

ENVIRONMENTAL TRENDS

> "A wise man recognizes the convenience of a general statement, but he bows to the authority of a particular fact."
>
> *Oliver Wendell Holmes, Jr.*

Leaving the comfort of Oz means that the high tech building must function in the wide environment of forces and megatrends that shape its opportunity and pose threats. These forces represent uncontrollables in the economic, social, governmental, and technological spheres, which are the root causes of the present high tech real estate opportunity.

Economic

Based upon 12 years of publishing *The Trend Report* for corporate clients, John Naisbitt recently documented the status of the American "megashift" from an industrial- to an information-based economy in *Megatrends: Ten New Directions Transforming Our Lives:*

1. During the decade of the 70s, the total labor force increased 18 percent, but the number of managers and administrators increased 58 percent. Sixty percent of the U.S. work force either produces or processes information, and only 13 percent remain employed in manufacturing.
2. Public reactions to high tech developments prompt business to soften

products and services with "earth," or human, values. *High tech* is counterbalanced by *high touch.*

3. The United States is losing its dominance as an economic power and moving toward global interdependence. Japan leads the world in productivity, challenged not by the United States but by Singapore, South Korea, and Brazil.
4. American management values are shifting from short to long term.
5. Corporate structure is decentralizing, building from the bottom up.
6. Self-reliance is being reemphasized.
7. Workers and consumers are demanding greater voice in government, business, and the marketplace.
8. Computers are replacing corporate hierarchies with networks. Access to information is power.
9. Workers have moved from frostbelt to sunbelt. Buffalo, Cleveland, and St. Louis lost almost 25 percent of their population during the 1970s to opportunity cities: Albuquerque, Dallas, Tampa, and Tucson.
10. Demand favors variety over one-size-fits-all. Only 7 percent of the population fits the traditional family profile—working father, mother at home, two children.

Viewing these trends within the framework of the commercial real estate market leaves little wonder why developers of commercial real estate are confronting clients with a greater understanding of their needs. More demanding and vocal than their predecessors, moreover, clients are looking for developers tuned to their need to conserve capital and human capital resources needed to achieve other competitive ends.

During the past decade, the United States fell behind other industrial nations in several key measures, as shown in Table 1–2.

The American economy would have produced $16,128 worth of output per capita in 1981 had 1948–67 productivity growth rates continued but it fell 26 percent short by actually reaching only $12,780. By comparison, the 1981–82 recession reduced per capita output by only 4 percent.

"The consequences of reduced productivity growth for our standard of living over the long run are greater than those of any other current economic problem," according to the *Economic Report of the President: February 1983.* "The risk is that productivity growth in the United States will continue to stagnate at low levels, and that American workers will have to accept a lower growth rate in their standard of living than their foreign counterparts."

"Increasing the productivity growth rate by 2 percentage points annually," the report concluded, "would more than double our material standard of living by 2020."

The high tech building provides the means for space suppliers and demanders to synchronize these economic trends with their respective needs. This common ground exists for Class A-equivalent properties because develop-

TABLE 1–2
International Investment—Productivity Comparison

Country	*Gross Investment*	*Gross Fixed Investment*	*Net Fixed Investment*	*Output Growth Rate per Hour Manufacturing*
France	24.2	22.9	12.2	4.8
Germany	23.7	22.8	11.8	4.9
Italy	22.4	20.1	10.7	4.9
Japan	34.0	32.9	19.5	7.4
United Kingdom	19.2	18.7	8.1	2.9
United States	19.1	18.4	6.6	2.5

* Investment as a percent of Gross Domestic Product (GDP).
Source: Organization for Economic Cooperation and Development.

ers elect to enhance *and* clients decide to "buy" space on the same basis.

Both apply the "human capital" concepts (detailed by Don Bellante and Mark Jackson in *Labor Economics: Choice in Labor Markets*) to calculate whether the discounted present value of future productivity gains or office savings equal or exceed the present cost of building amenities, which make such gains possible.

Investment = Productivity Decision Formula

$$C < \sum_{i=1}^{n} \frac{VMPP_i^a - VMPP_i^b}{(1+r)^t}$$

where

C represents the cost of the enhancement to the owner, developer, or tenant.

$VMPP^b$ and $VMPP^a$ represent the values of the space or office marginal physical product before and after.

i is the year in which the benefit is received.

$i = 1$ is the first year of occupancy.

n is the number of years of occupancy.

r is the opportunity rate of return to the firm, or rate of return it can receive on its best alternative investment.

t represents the number of time periods, which in this example is the same as n.

The intelligent building balances the equation and, thereby, supplies a vital link between capital formation and productivity improvement in the transition to the information society.

Social

Compiled reports published within the *Statistical Abstract of the United States* detail America's long-range social trend of equal magnitude in the form of a massive demographic shift.

The world population totaled 4.4 billion in 1980 and is growing at the rate of 1.8 percent per year toward 6.2 billion in 2000 A.D., but the baby boom has been replaced by a "birth dearth" in the United States. The American population is expected to grow by less than 1 percent during the 1980s and from 233 million to 264 million over the last 20 years of the century.

The average life expectancy is now 74 years, representing a 20-year increase since 1920. The increase in life expectancy coupled with an extremely low birthrate will push the median U.S. age from its present age 30 to a projected age 35 by the year 2000. And there will be age dislocations across the scale, as shown in Table 1–3.

The expanded U.S. work force at the center of the chart will be competing within the exploding global marketplace with its wits. Sixty-six percent of Americans over age 25 today have high school degrees, and the 16 percentile with college degrees continues to rise annually. Of the 97.3 million Americans in the work force during 1980, 9 percent *more* were white-collar workers, 5 percent *fewer* were blue-collar workers, and 5 percent *fewer* were farm workers than their 1960 counterparts.

The impact, according to Bureau of Labor Statistics projections, will be heavy growth in the occupational categories shown in Table 1–4.

If the profile of this information age job growth appears highly correlated with the tenant profile of the high tech commercial real estate market, further attention may be warranted to underlying trends among employers participating in both the labor and commercial real estate markets.

The number of jobs in Japan has grown 10 percent from 51 to 56 million, and the number of jobs in Western Europe has actually shrunk by 3 million since 1974, but the number of jobs in the United States increased nearly

TABLE 1–3
U.S. Demographic Changes

Age Group	*Projected Change (percent)*	*Increase/Decrease by 1990*
15–24	17	Decrease
25–34	14	Increase
35–54	25	Increase
55–64	2	Decrease
65+	20	Increase

TABLE 1–4
Leading U.S. Occupational Growth Categories

Engineering	Science
Medicine	Computers
Social sciences	Buying
Selling	Construction
Refrigeration	Health services
Personal services	Protection

50 percent from 71 to 106 million during the past 20 years. More than half of this American growth has taken place since the oil shock of 1973.

With government expansion at a standstill since the early 1970s and the Fortune 500 cutting a total of 3 million jobs during the past five years alone, the growth in the U.S. job market has surged from new small- and medium-size companies. In 1950, 93,000 new businesses were started; today 600,000 new businesses are forming each year.

The renaissance of entrepreneurial and innovative businesses (in spite of their statistical 80 percent five-year failure rate) parallels the aforementioned economic trend by large conglomerates toward smaller management units. Documenting these twin trends, the business best-seller *In Search of Excellence,* by Thomas J. Peters and Robert H. Waterman, Jr., detailed eight attributes typifying innovative U.S. management. They are listed in Table 1–5.

The application of these techniques by the management of U.S. businesses, large and small, is a trend of infectious proportions. The chairman of the largest merchandizing firm on the Fortune 500 has taken a leadership position to renurture what he calls "The Corporate Entrepreneur." Newly minted

TABLE 1–5
Attributes of Corporate Excellence

1. A bias for action.	5. Hands-on, value driven.
2. Close to the customer.	6. Stick to the knitting.
3. Autonomy and entrepreneurship.	7. Simple form, lean staff.
4. Productivity through people.	8. Simultaneous loose-tight.

Source: Thomas J. Peters and Robert H. Waterman, Jr., *In Search of Excellence.*

and downsized divisions of major corporations are being created daily to compete with the entrepreneurial challengers. Indeed, the pervasive trend in American business, as in much of American society, is a sweeping fitness drive toward a more aggressive and productive work-lifestyle. The obvious impact of more entrepreneurial ventures on real estate is more tenant demand for office space, and smaller units which will need the information and communication services offered in a high tech building.

Governmental

For 100 years, benchmarked in 1987, the federal government has influenced the prices and conditions for entry in the financial, transportation, and communications sectors of the U.S. economy through what are often called economic regulations. This phrase is used to distinguish such controls from government social regulation designed to protect public health, safety, or the environment.

The first broad body of economic regulation was established by Congress with the Interstate Commerce Commission (ICC) to resolve the increasing controversies between the railroads and shippers in the late 1880s. Most regulation of other sectors was enacted by the end of the 1930s with agencies legislated along a similar pattern.

Often a dispute between several groups spurred Congress to delegate to an independent agency the authority to resolve the dispute. The agency was empowered typically by a "public convenience and necessity" citation. In many cases the initial legislation founding these agencies was later expanded to encompass new competition, for example, the expansion of FCC controls to encompass the microwave, satellite, and cable television industries. See Table 1–6.

Whatever historical purposes were served by economic regulation, an apparent consensus that much of the resulting federal intervention may no longer serve contemporary America has resulted in its relaxation or elimination during recent years.

TABLE 1–6
Federal Agencies with Major Impact on the Business Climate

Interstate Commerce Commission	Federal Trade Commission
Food and Drug Administration	Federal Communications Commission
Federal Power Commission	Civil Aeronautics Board
Consumer Products Safety Commission	Environmental Protection Agency
Securities and Exchange Commission	Office of Consumer Affairs

Finance

The financial service sector has been among the most heavily regulated areas of the economy. Both the banking and securities industries have experienced pervasive price regulation, entry restrictions, and portfolio regulation.

The Banking Acts of 1933 and 1935, revisions to the Federal Reserve Act, and interest regulations imposed by the Federal Reserve Board and Federal Deposit Insurance Corporation are among the major instruments. This extensive regulatory framework adapted slowly to economic changes of the past two decades.

Beginning in 1978, however, interest rate ceilings on selected deposits have been progressively removed. Partial deregulation of depository institutions is proceeding under provisions of the Depository Institutions Deregulation and Monetary Control Act of 1980 and the Garn–St. Germain Depository Institutions Act of 1982.

On the nation's stock exchanges, transactional commission rates, which had been fixed and approved by the Securities and Exchange Commission since the 1930s, were gradually dismantled between 1968 and the Securities Acts Amendments of 1975. The Securities Exchange Acts of 1933 and 1934 required financial disclosure by all publicly traded corporations seeking to raise capital through the issuance of new securities, but the SEC exempted corporations with less than $3 million in assets and 500 stockholders during 1983.

Further debate continues toward relaxation of the McFadden Act of 1927 and Douglas Amendment to the Bank Holding Company Act of 1956 to exempt automatic teller machines from existing geographic restrictions on commercial branch offices and of the Glass-Steagall Act to permit bank holding company subsidiaries to sponsor and underwrite mutual funds.

As the relaxation of regulatory controls continues, we will see a continuing growth in communications-related transactions between geographically dispersed locations. The financial industry tenants of high tech buildings will have an increasing need for advanced communications capability.

Communications

Economies of scale provided the original rationale for making, and most recently breaking, the regulated monopoly of long-distance telecommunications within the United States.

For the broadcasting technologies, it began with the Wireless Ship Act of 1910 subjecting the then experimental and noncommercial use of the radio frequency spectrum to licensing by the Secretary of Commerce and Labor. For telephony, it began with a letter on December 19, 1913, shortly after France and England nationalized their phone companies. The American Bell

Telephone Company wrote the attorney general saying it would accept government regulation in exchange for not being nationalized.

All U.S. interstate and foreign communications by wire and radio were brought under the regulatory authority of the Federal Communications Commission under the Communications Act of 1934. Although educational and other noncommercial applications for telecommunications technologies had evolved, the genetic code of the industry had become clear: It would be commercially supported, politically active, and intensely competitive.

By the end of 1982, some 4,668 AM, 3,380 FM, 1,079 television, and 5,000 cable television stations and systems were operating within the United States with combined revenues of $16.6 billion. The 1,400 telephone companies had grown through local, long distance, yellow pages advertising, WATS, and customer hardware and software services into an $86 billion industry. Meanwhile, the commerce in communicating mainframe, mini-, and microcomputers was building a $87.5 billion industry with a 20 percent annual growth rate.

The convergence of data processing and telecommunications technology had diluted the natural monopoly characteristics and created an industry with combined revenues exceeding the $187.4 billion 1982 budget for national defense. A 1982 appeals court affirmed the FCC's power to deregulate where technological change outmodes regulation. Building upon 1981 FCC initiatives in deregulating most commercial broadcasting, Congress passed legislation reducing the number of FCC commissioners from seven to five, effective during June 1983. Deregulation was fully underway in the early dawn of the information age.

The year 1984 became known as "Year One A.D." within the U.S. communications industry, representing *at dawn* to most data and broadcast professionals and *after divestiture* to those in telephony.

Approval by a U.S. District judge of a 1982 settlement between AT&T and the Department of Justice transformed U.S. long-distance communications into a competitive marketplace. The world's largest corporation divested, American Bell and 22 operating companies were compressed into 7 regional holding companies.

Beneath the mist of divestiture confusion, equal access to local facilities, which is the cornerstone of the deregulation settlement, establishes *competition* as the substitute for the regulation of interstate services. Thus the forward trend in U.S. telecommunications is toward the availability of alternative, cost-effective transmission capabilities in any location and in many forms.

Alternate U.S. commercial services already include Allnet, American Satellite, Argo, GTE, RCA, Satellite Business Systems, Sears Communications Company, and Western Union. The alternative providers offer a variety of terrestrial and satellite communications resources for the commercial consumer. In addition to the above carriers and enhanced service providers, Advanced Business Communications, Hughes Communications, Rainbow

Satellite, and United States Satellite Systems have won FCC approval for their own satellites.

Technology

Perhaps the most dramatic force shaping 20th-century Western economies is technology. It has released wonders, horrors, and mixed blessings with a force of creative destruction so powerful that there are few individuals whose attitudes or job skills remain unaffected.

Each new technology causes dislocation within older technologies and accelerates the overall economic growth rate. Cable television has impact on commercial television, just as network programming has affected the movie industry. Electronic information storage and retrieval affects electrostatic copying, just as xerography had impact on the carbon paper business. Future change faces potential opposition from voices calling for a technological assessment of new technologies before their commercialization.

Nonetheless, Alvin Toffler's *Future Shock* sees an accelerative thrust in the invention, exploitation, and diffusion of new technologies. Ninety percent of all the scientists who have *ever* lived are alive today, and the time lag between idea, implementation, product introduction, and peak is collapsing.

Abraham Lincoln did not know automobiles or the electric light; John F. Kennedy never knew of personal computers, digital wristwatches, videorecorders, or cable television.

Toffler's later book *The Third Wave* forecasts that the cost of installing and operating telecommunications equipment in the home will fall below that for the traditional office building, and an economy of "electronic cottages" will evolve. As seen by Toffler, a closer family work unit will also enjoy more home-centered entertainment and activities that will revolutionize American business, marketing, and consumption patterns.

DRIVING MARKET FORCES

> We are all continually faced with a series of great opportunities brilliantly disguised as insoluble problems.
>
> *John W. Gardner*

The environmental trends we have discussed can be translated directly into the present and growing market demand for tenant services by both developers and tenants.

Tenant Demand

Data processing and office automation have forced American business people in the simplest of jobs to use some form of technology to maintain a level of effectiveness, profit, and competitiveness within their environment.

For the small- or medium-size business, this can be a treadmill. Although costs are dropping, it is still expensive to maintain state-of-the-art hardware and software, yet not doing so means falling behind. Equipment becomes obsolete so quickly that it may be uneconomical to purchase the equipment and safer to lease equipment. The used equipment market does not put much value on equipment for resale. The fast growth or reduction in the size of a company, moreover, often necessitates moving in and out of buildings with the wrong capacity in equipment—at still additional cost.

The final piece of the equation for the tenant is the high cost of managing and maintaining a telecommunications system. It has become increasingly costly and difficult to find and retain qualified employees and will continue to be difficult as the demand severely exceeds the supply.

A 1984 survey of telecommunications managers representing a cross section of industry, business size, and geography showed interest in high tech building services to be directly related to the size of a firm's communications budget. Some 14 percent of firms with budgets below $50,000 per year responded favorably, and some 43.5 percent of firms with budgets in excess of $10 million indicated interest.

The survey, with an overall 18.8 percent respondent interest rate, provided the *positive* interest profile shown in Table 1–7.

Owner and Developer Demand

For these reasons, flexible systems offer great advantages. Systems must be available at a competitive price, or at a reasonable price with value-added services, such as remote diagnostics and call detail recording, as enhancements.

The demand by developers for amenities to enhance the rentability of their buildings created a market for tenant resellers. The economy in recent years has cooled the demand for rental space. In many areas, space is being leased at no cost for a year or more on long term leases to encourage occupancy. Therefore, any amenity that could enhance one building over another has been eagerly pursued. Telecommunications was the next logical amenity.

Developers profit from the telecommunications market through enhanced image, hence higher rates per square foot, higher occupancy percentages, and participation in the tenant resale revenue stream.

Developers are not in the telecommunications business, however, which is why most have selected partners with telecommunications expertise to share in the venture. In most cases, the developer will be required to share up-front costs to cover the start-up project costs. This ensures the telecommunications provider that the developer has a vested interest to act as a marketing agent to potential tenants.

TABLE 1–7
Tenant Interest—High Tech Building Services

Professional Category (percent)		*Geographic Region (percent)*	
Diversified financial	40.9	NYNEX	35.8
Commercial banks	37.5	Ameritech	21.8
Wholesale/retail	22.5	Bell South	21.0
Manufacturing	21.4	Bell Atlantic	20.4
Insurance	21.1	Southwest Bell	19.4
Utilities	14.3	U.S. West	19.2
Health	9.3	Pacific Telesis	18.5
Government	7.7	Other	14.0
Education	0.0		
Other	22.8		

Source: The Yankee Group, July 1984.

KEY PLAYERS AND THEIR ROLES

Plans are nothing; planning is everything.

Dwight D. Eisenhower

The key players in this environment, then, are the developer, the tenant, and the communications provider. The communications provider may be a direct PBX manufacturer, a communications company, or a developer's own staff. All of these arrangements are currently used in the marketplace, and there are various advantages and disadvantages to each.

The PBX manufacturer may deal directly with a developer who has very extensive holdings. In this case, all service and support come from the manufacturer, and pricing may be negotiable. The drawback to this scenario, however, is that the developer will still require a staff to manage the project and will thus incur all operating expenses and headaches. In addition, many developers wish neither to be nor to be seen as communications providers.

The Yankee Group has recommended a complete support team exclusive of computer mainframe staff for the typical 300,000-square-foot high tech building. Their July 1984 studies produced the following table of organization:

Tenant manager: Oversees day-to-day operations.

Data specialist: Manages broadband transmission and computer processing facilities.

Service adviser: Handles equipment and billing records.

Installation staff: Executes moves, changes, etc.

Maintenance staff: Monitors PBX and other shared equipment.

Currently, most developers are aligning themselves with communications companies.

The obvious advantage of this approach is that it reduces the financial and image risks to the developer. Communications companies will market, operate, bill, and manage the project, while sharing equity and/or revenue participation with the developer. The developer is taken out of the telecommunications environment, and the skilled communications company can do what it does best.

There is a fourth player emerging in this market, the local operating company. It is clear that shared local service represents a basic offering to tenants.

WEIGHING THE RISKS

> "There is an old saying in Spain: To be a bullfighter, you must first learn to be a bull."
>
> *Anonymous*

Up to this point, we have discussed the benefits of shared tenant services. As we all know, however, in any business enterprise where there is high reward, there is corresponding risk. The prime areas of risk to be considered include hardware, service and support, tenant demand, and the regulatory environment.

A large capital investment is required to start a tenant resale business. The developer or reseller is making a calculated estimate on the capture rate and occupancy rate of the project to justify this expenditure. Occupancy rate is the rate at which tenants contract for space, whereas capture rate is defined as the percentage of tenants who contract for on-premises telecommunications services. The minimum capture rate of tenants on many shared telecommunications systems is 60 percent for a break-even. The 60 percent capture rate must be attained over a 12- to 18-month period.

It is interesting to note that the developments offering tenant services to date report capturing 70–90 percent of the tenants on the shared PBX. Since one can accurately predict neither tenant receptiveness to shared systems nor occupancy timetables, both constitute major risks.

Hinged upon this risk factor is the capital commitment for the switch and internal wiring. For many PBX vendors, the significant portion of the switch cost must be borne up-front, regardless of the number of system users. In addition, all wiring is installed in anticipation of future usage. This investment can be in the million dollar range for a 1,200-station system. The recovery lag to profitability may be several years, and thus the control of operating expenses is a critical priority. Cumulatively, these financial considerations constitute entrance barriers for small developers wishing to penetrate the shared tenant services market.

Many developers and communications companies have signed long-term, 3- to 5-year commitments with PBX manufacturers for $25 to $50 million of product to qualify for distributor wholesale pricing. Discounts are normally contingent upon specific contract performance. If a discount is lost, the additional cost may be retroactive, covering all systems purchased. Such an event can virtually eliminate all profitability to the developer/supplier.

A second major risk area is service and support both to the developer/supplier and to the tenant. In most developments today, an on-site maintenance person is assigned to the project. This person is factory trained and should be able to handle the majority of service problems.

However, with the complex design of the PBXs and the potential diversity of equipment connected to the PBX, ongoing maintenance should and can become an area of major concern. It is critical that manufacturers dispatch repair personnel from a near-site location and that manufacturers give full support when problems need correction. Obviously, the larger the base of installed PBXs of a single vendor, the stronger the leverage that can be used on the manufacturer. Strict PBX performance specifications should be built into all contracts. A single-source vendor approach may also be applied, which facilitates equipment movement between projects.

Finally, the regulatory environment presents an element of business risk. As tenant resale becomes more prevalent, state utility commissions are being asked to address the effects tenant resale has on the telecommunications environment. In several states the local Bell operating companies have filed for injunctions to prohibit resale of local services. The basic argument is that resale of local service takes income away from the local operating company, which then may have to increase rates to maintain service levels.

IMPLICATIONS

> "The middleman is not a hired link in a chain . . . but rather the focus of a large group of customers for whom he buys."
>
> *Phillip McVey*

The intelligent building and tenant resale syndrome will predictably remap market shares in several related industries. The most significant impact may well be experienced by small- to medium-size manufacturers, local telephone service providers, and long-distance carriers.

Small PBX manufacturers and small- to medium-size long-distance carriers will be unable to offer the capabilities required to support large tenant developments. Developers will prefer to deal with vendors who have substantial

R&D capacity in order to maximize service flexibility and minimize obsolescence.

Manufacturers of large-capacity switching systems should fare very well in the tenant resale environment because they will be able to support a large client mix. The shared tenant services market will permit the installation of many private PBX switches in installations requiring support for more than 1,000 voice lines.

The implications of shared communication services for tenants will be profound. Many will gain use of an advanced communications system they would not be able to afford on their own.

The features gained by tenants from the economies of scale produced through large-scale service sharing include: reduced circuit acquisition requirements; computerized switching to provide the most economical routing of long-distance calls; reliable maintenance, quality, and security; cost containment on hardware; and a greater variety of calling options at competitive prices. These features may be translated into the following distinctive tenant benefits:

One-stop shopping, again. Divestiture has forced tenants to deal with a confusing and time-consuming array of vendors.

One-stop billing. A convenient and less costly means of billing for the tenant. Instead of receiving a series of bills for service, one bill is received.

Call detail recording. Even for the smallest tenants, calls will be broken down for auditing and payment ease.

Twenty-four hour maintenance, move, and on-site service. Everything is on-site—accommodating correction of the simplest problem of air temperature, to expanding office space, to a change in voice or data requirements and/or equipment.

The central implication for tenants will be reduced costs and increased productivity.

Communications companies offering low-cost long-distance service will fare very well in the tenant resale environment as well. The comparative youth, business agility, and reliability of competitive interstate networks will present attractive business partnerships for developers.

Finally, it is clear that owners of intelligent buildings and developers of tenant resale projects will become benefactors. Their capital returns will be measured by:

Enhanced image.

Higher tenant attraction and retention rates.

Added operating revenues from telecommunications.

Increased rental value per square foot and increased profit.

Improved property and resale values.

TRANSITIONAL CHALLENGES

"Nothing in this world is so powerful as an idea whose time has come."

Victor Hugo

The thesis of this chapter is that high tech real estate is squarely at the crossroads where long-term environmental trends meet the information-age technological expectations of tenants within our society. It is at once a survival adaptation by commercial real estate to the challenges posed by sagging occupancy rates, an anticipation of the proliferation of electronics throughout the cottages of the new knowledge work force, and an application of new tools to build new businesses. As such, the intelligent building succeeds the industrial building of another time.

High tech real estate is more than just an idea whose time has come as it faces the challenges of the transition to the information age.

A Time for Definition

At both the federal and state levels, discussions are continuing, and further legal definitions can be expected to evolve. Additional legal definitions are needed for:

The extension of property rights to encompass communication.

The application of telecommunications-commodity precedents to intrastate transmissions.

The state regulation of bypass and intrastate or LATA toll completion and substitution of measured service for flat-rate trunks.

The rights of tenants to access local Telcos.

A Time for Preparation

Mature architectural, electrical, and ergonomic standards designed to support a paper-based economy will need to be updated with fresh specifications. Within the present development environment, the lack of consensus between professional disciplines fosters confusion that invites regulatory intervention. Architect-preferred approaches may please neither owner nor manager within the present subjective atmosphere. Pure engineering and ergonomic solutions, moreover, may generate losses for management or discomfort for employes. Many states are considering human engineering legislation on the basis of public health and safety issues.

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New interdisciplinary professional standards are needed for:

Communications wireways, closets, trenches, cells, and raised floors. Nonglare window and lighting treatment. Storage facilities for computer records.

Connection and communication standards for local area networks.

HVAC standards that incorporate human and computer loads.

Mechanical utility management standards to provide for economical, secure, and safe controls for such elements as fire doors, sprinklers, lights, thermostats, and elevators.

Ergonomic standards for office furniture and work stations.

A Time for Innovation

The vitality of the venture capital boom needs to be channeled into the development of business plans that capitalize upon the creation of the first free market in American telecommunications history.

Innovative new business systems are needed for:

Joint development of high tech real estate, using communications technologies as tools to further the strategic goals of owners and developers as well as communications concerns.

Tactical application of intelligent building techniques to expand the economy.

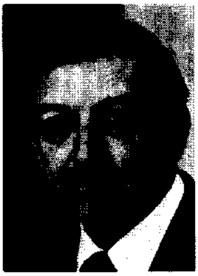
Effective representation of information economy providers within the social and political environment.

New business practices, processes, and procedures to serve the tenant community.

All business must take risks to grow. Taking well-defined chances is an American pioneering tradition reborn in 20th-century entrepreneurial denim and pinstripe. "The future is not the way of the secure . . . the comfortable . . . the timid . . . the inflexible . . . the indecisive . . . the selfish. It is the way of those who will put their judgment on the line . . . and their leadership at risk," challenges Sears Chairman Edward R. Telling, "It is also the way of those who are more concerned about where their company will be in 10 years, rather than where they are today."

Opportunity has knocked on the door of the industrial age for nearly two centuries, yet that door is closing. In today's information age, opportunity phones first. High tech real estate is up and running to answer the call.

Authors



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Chapter 2

A Primer on Telecommunications and Related Technologies

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Dean Witter Reynolds
Dr. Stanley M. Welland
Merrill Lynch & Co.

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Outline

The purpose of this chapter is to explain how voice, data, and video communications are transmitted over conducting media and through the ether. We have taken an approach that will first examine the basic transmission mediums in use today, from a pair of copper wires to the more complicated coaxial cable, microwave radio, optical fiber, and satellite systems. In addition, the difference between analog and digital communications is discussed as well as an introduction to bandwidth, multiplexing, and digital systems.

The intent of this chapter is to focus on the engineering and telecommunication fundamentals in order to prepare the reader for the discussion, later in this book, of applications and technologies.

BASIC COMMUNICATIONS CONCEPTS

In 1876 Alexander Graham Bell patented the first telephonic device that converted voice signals—sound waves—into electrical signals—electrical waves. Since that time, devices have been developed that convert other types of information, such as data, images, and moving pictures into electrical signals. In a communications system, basic information, regardless of type, is transformed into electrical information by a sending terminal, whether it be a telephone for voice, a computer-like terminal for data, or a teletype device for telegrams or record-type communications, such as telex. The electrical information, or signal, is modified (in technical terms, *modulated*) by a sending device into a form suitable for transmission at a specific sending frequency. The modulated signal is then transmitted, or more properly propagated, by either a wire, radio, or video broadcast system. Finally, the propagated signal is demodulated or transformed at the receiving end back to the original information signal and the original basic information.

Transmission starts with the modulated signal being connected to a wire pair, a coaxial cable, a waveguide, an optical fiber, a microwave radio relay system, or an earth station (which transmits signals to a satellite). Most basic signals are concentrated at low frequencies and have to be modulated, since their lack of isolation from interference from nearby signals of the same frequency and their propagation (transmission) characteristics make them generally unsuitable for transmission in their existing state. Baseband (unmodulated) transmission employs wire (wire pair) channels, such as those used for local telephone loops or circuits. Baseband is used for the great bulk of short-distance communications and accounts for a large part of local telephone transmissions. However, with radio and other forms of longer-distance transmission, and in order to get greater capacity out of certain existing transmission facilities, it is usually necessary for the basic information signal to be transformed to higher frequencies that are suitable for electromagnetic propagation and can use the total capacity of the transmission facility.

The reader should note that the term *baseband* as applied to local area networks has a somewhat different meaning, and in general applies to a network that has a single carrier frequency.

Converting Speech to Electrical Impulses

Sound and electrical impulses are transmitted through a medium in wave form. A wave has three basic properties: amplitude, frequency, and phase.

In the basic sine wave, shown in Figure 2–1, the amplitude refers to the height of the wave. The amplitude represents the property of loudness in sound or the voltage level of an electrical impulse. Frequency, measured in cycles per second, or hertz, represents the number of times per second a wave completes a 360-degree shift in phase. Phase, measured in degrees, or radians, is the slope of a wave at a given instant in time. Frequency concerns the property of pitch. A sensitive human ear can detect frequencies of from about 30 hertz (or 30 cycles per second), which is a deep bass tone, to about 20,000 hertz, which is a high-pitched squeal. Most good quality high-fidelity stereos will reproduce sound over that same bandwidth. Bandwidth is the range of frequencies between the upper and lower limits of a transmission medium.

Ordinary speech usually covers a frequency range, or bandwidth, from 100 to 8,000 hertz. Good quality speech, however, can be transmitted over a bandwidth of from 300 to 3,400 hertz. Therefore, the typical telephone voice-grade channel, or subdivision of a circuit, has been designed to transmit only those frequencies that are between 300 and 3,400 hertz. That is why a person's voice over the telephone can have a slightly flat sound.

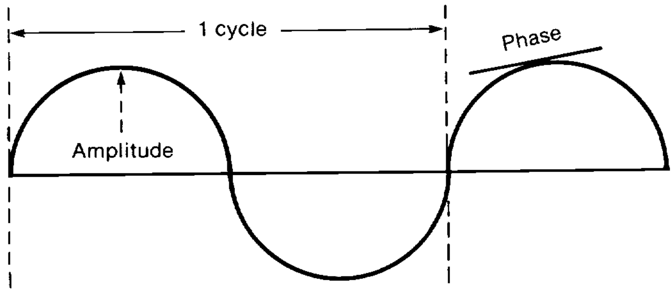
The Telephone Transmitter and Receiver

The telephone transmitter, or mouthpiece, is the ear of the telephone. In the transmitter, sound waves are changed into electrical waves or impulses to enable them to be sent over a telephone line to a distant receiver. The basic mouthpiece of the telephone consists of a diaphragm and a chamber filled with carbon granules.

Carbon has unique physical properties in that it is the only nonmetallic substance with electrical resistance that is low enough to allow its practical use as an electrical conductor and with a resistance that declines under pressure. This is shown in Figure 2–2.

When a person speaks into a telephone, the diaphragm in the telephone's mouthpiece vibrates at the frequency of the speaker's voice. The vibration alternately compresses and decompresses the chambers behind the diaphragm, varying the pressure of the carbon granules. The varying pressure on the granules varies the resistance of the granules. As a result of that varying resistance, the voltage level in the circuit that passes through the granules

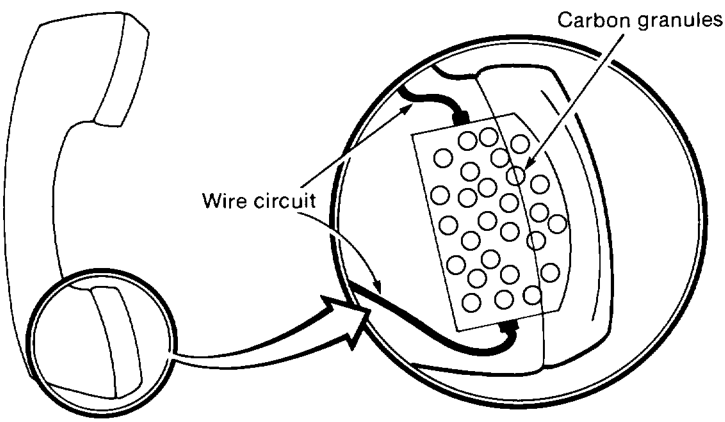
FIGURE 2–1



fluctuates. Therefore, the number of times the diaphragm vibrates determines the frequency of the electrical signal going through the transmitter. The varying resistance of the granules sets the voltage level and the amplitude of the electrical signal going through the transmitter. The telephone receiver is the speaker of the telephone. It reverses the process of the transmitter and produces sound waves from electrical impulses.

The frequency and amplitude of the electrical current running through

FIGURE 2–2

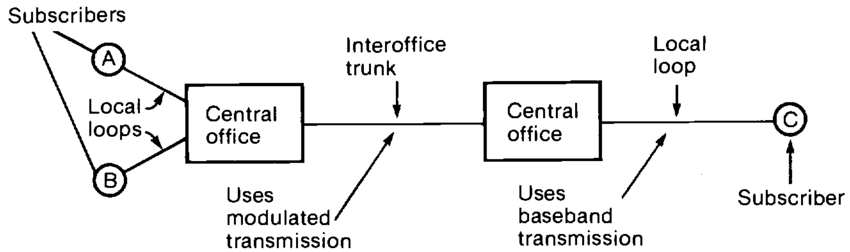


the speaker causes the speaker to vary its vibration frequency (pitch) and amplitude (loudness) by the variation in the current. The vibration of the speaker reproduces the sound waves induced into the originating transmitter. The electrical signal (wave) is continuously changing in amplitude and frequency. It is referred to as an analog signal, in that it is an analog of the originating waveform, such as those produced by sound.

For most local communications, baseband transmission is used. That is, the transmission of electrical signals occurs at their originating frequencies. A pair of ordinary wires can easily handle a bandwidth of three kilohertz or 3,000 cycles per second. Thus the voice-carrying electrical signals (or current) that pass through the normal telephone are transmitted through the local telephone network to the receiving telephone unmodulated (unmodified).

The path of a typical phone call would be as follows. The electrical signals emanating from the telephone are carried over the local loop to the central office. The local loop consists of a pair of wires (usually referred to as a twisted wire pair) from the subscriber's phone to the local switching office. Subscribers not on party lines have their own dedicated pair of wires to this central office. In the central office, the call is connected to the party being called and then is sent to the called party via the called party's local loop, assuming the called party was connected to the same central office as the calling party. The transmission occurs in the baseband. If the call were being sent to a party connected to another central office, then baseband transmission would probably not be used over the entire transmission path. Instead, the call would be routed over an interoffice trunk (a circuit between two central offices) in a modulated form (see Figure 2–3). Obviously the local loop transmission would still be in the baseband. Only the trunk transmission between central offices would occur in modulated form. The next section deals with modulation.

FIGURE 2–3
Modulated Transmission



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Modulation

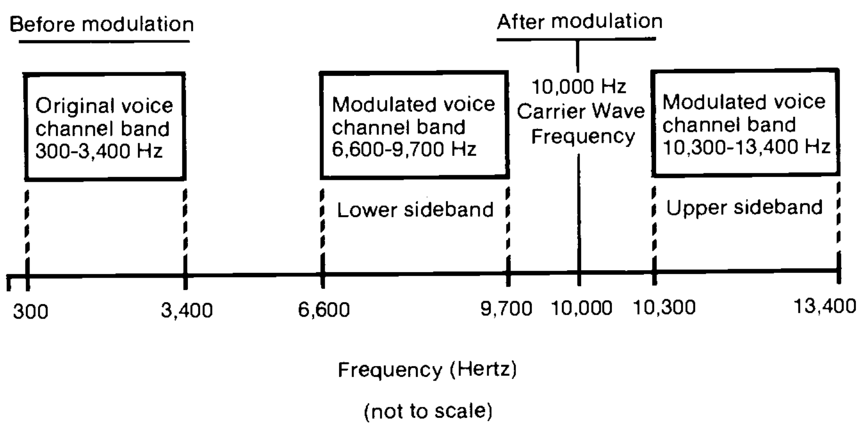
One type of modulation is the process of superimposing a voice frequency (VF) channel on a carrier wave (a wave of constant frequency) so that a frequency shift can occur. For instance, a voice channel can be superimposed upon a carrier wave of 10,000 hertz (Hz) to shift its frequency range, or bandwidth, from a range of 300–3,400 hertz to a range of 10,300–13,400 hertz, as shown in Figure 2–4.

With demodulation, the reverse process is performed. The 10,300–13,400 Hz modulated voice channel band is superimposed on a 10,000 Hz carrier to recover the original 300–3,400 Hz voice frequency (VF) channel. The modulation process produces three components: the inserted carrier frequency and the two bands resulting from the superimposed frequencies. The sum of the carrier frequency and the voice channel frequencies produces the upper sideband. The difference of the carrier frequency and the voice channel frequencies produces the lower sideband.

The addition of a voice frequency (VF) channel to the 10,000 Hz carrier would produce the following signals:

Carrier + VF Channel	=		= *Carrier and sidebands*
10,000 Hz + (300 to 3,400) Hz	=	10,300 to 13,400 Hz	= Upper sideband
10,000 Hz	=		= Carrier frequency
10,000 Hz − (300 to 3,400) Hz	=	6,600 to 9,700 Hz	= Lower sideband

FIGURE 2–4
Modulation



Since the carrier frequency contains no information, and the lower sideband is redundant (has the same information as the upper sideband), the carrier wave and the lower sideband can be filtered out with the result that only the upper sideband is transmitted over the interoffice telephone line (or interoffice trunk). This is known as single sideband transmission (SSB). When the upper sideband is received, the demodulation process requires that the carrier frequency be reintroduced. This process produces the resulting sidebands:

Signal received	= 10,300 to 13,400 Hz = Upper sideband transmitted
Carrier frequency	= 10,000 Hz – carrier frequency introduced
Resulting upper	= (10,300 to 13,400) Hz + 10,000 Hz
sideband	= 20,300 to 23,400 Hz
Carrier frequency	= 10,000 Hz
Resulting lower	= (10,300 to 13,400) Hz – 10,000 Hz
sideband	= 300 to 3400 Hz

The final stage in demodulation is to filter out the upper sideband and the carrier wave. The signal recovered from the lower sideband, which has been received from the interoffice trunk, contains the original information signal from the originating 300 to 3,400 Hz voice frequency (VF) channel. It is then routed over local transmission facilities, in unmodulated or baseband form, to the called telephone.

Multiplexing

Multiplexing is the process by which more than one voice or data (or, for that matter, any communications) messages can be transmitted or modulated over one physical communications transmission link or facility. There are three basic types of multiplexing techniques: space-division, frequency-division, and time-division multiplexing.

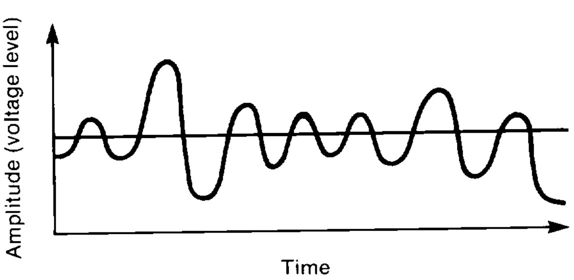
The simplest type is space-division multiplexing. Let us say we want to route 12 conversations, or telephone calls, over one transmission facility simultaneously. We could take 12 pairs of wires and group them into one large cable. That would be space-division multiplexing. Each conversation would occupy a separate wire pair or physical circuit (path). In actuality, wire pair cables are constructed to contain up to many hundreds of wire pairs. Such cables are placed in conduits under streets of cities or along roadsides and are used for subscriber local loop purposes and for short-distance interoffice trunks.

Frequency-division and time-division multiplexing are methods that have been developed to share one physical circuit, or path, among many conversations. Frequency-division multiplexing (FDM) uses the modulation technique previously described and is a natural in the world of analog signals and transmission (analog communications). Analog signals are signals, like sound, whose amplitudes and frequencies change continuously (see Figure 2–5).

Frequency division multiplexing. With frequency division multiplexing (FDM), many analog channels can be loaded onto one transmission circuit. As we said, a standard voice frequency channel generally runs from 300 to 3,400 Hz, or a bandwidth of 3,100 Hz (3.1 kilohertz). To prevent interference (crosstalk) among adjacent voice channels, the actual channel bandwidth, including spacing, used for a standard voice-grade channel is 4,000 Hz (4 kHz). Now, let's say we want to multiplex 12 voice channels over one transmission circuit. The 12 channels are multiplexed using the modulation technique just described. In the following example, for simplicity, assume single sideband (SSB) transmission is used.

Voice channel 1	= 4 kHz bandwidth
Voice channel 2	= 4 kHz bandwidth
•	
•	
•	
Voice channel 12	= 4 kHz bandwidth
Carrier frequency 1	= 100 kHz
Carrier frequency 2	= 104 kHz
•	
•	
•	
Carrier frequency 12	= 144 kHz
Voice transmission channel 1	= 100–104 kHz band

FIGURE 2–5
Analog Signal



Voice transmission channel 2 = 104–108 kHz band

•

•

•

Voice transmission channel 12 = 144–148 kHz band

Thus as one can see, if we have a transmission facility that has a bandwidth, or capacity, of from 100 kHz to 148 kHz, then we can send 12 voice channels over that one high-capacity (bandwidth) facility (see Figure 2–6).

Time division multiplying. Time-division multiplexing (TDM) is an entirely different concept in the simultaneous transmission of signals. Whereas FDM is a natural for analog communications, time-division multiplexing (TDM) is a natural for digital communications. Digital signals are signals, like data, whose amplitudes change in discrete levels. Digital information consists of bits (binary digits). In digital, the intelligence consists of a 0 or a 1, or an *on* or an *off* as shown in Figure 2–7.

In TDM the time available on a circuit is divided into slots, with each slot carrying one bit of intelligence, either a 0 or a 1. Only one channel occupies the circuit at any instant in time. The basic time-divided circuit is broken up into 24 channels. The first channel occupies the circuit long enough to enter a bit of information, either a 1 (a pulse or bit), or a 0 (which is the absence of a pulse or bit). Then the second channel enters a bit. This process continues up to the 24th channel and then starts all over again. In actuality, in telecommunications networks each channel enters eight bits of information before passing the circuit to the next channel.

In the basic DS–1 (digital signaling) rate, the collective 24 channels each contribute 8 bits of information or 192 bits. The entire process takes place in 1/8,000 of a second, or 125 microseconds. As shown in Figure 2–8, channel 1 submits eight bits. Then channel 2 submits eight bits. The process continues until channel 24 submits its eight bits, and then the cycle begins again. All bits are sent on the DS–1 transmission line and are received in turn by channels 1 to 24 on the receiving end. The entire process is governed by a clock (at the top of Figure 2–8) so that the gate of channel 1 on the sending end of the transmission line coincides with the opening of the gate of channel 1 on the receiving end of the transmission line. The clock governs the opening and closing of all the gates for all 24 channels attached to the transmission line. (The use of a clock on both ends of the transmission line is known as synchronous transmission.) The process of sending 8 bits per channel for all 24 channels plus 1 bit for synchronization (totaling 193 bits) takes 1/8,000 of a second.

As shown in Figure 2–9, each frame consists of 193 bits,with 24 channels of 8 bits each (24 × 8 = 192 bits) plus a 193d bit used for synchronization. Note that in our example, only the first seven bits of each eight-bit word

FIGURE 2–6
Multiplexing

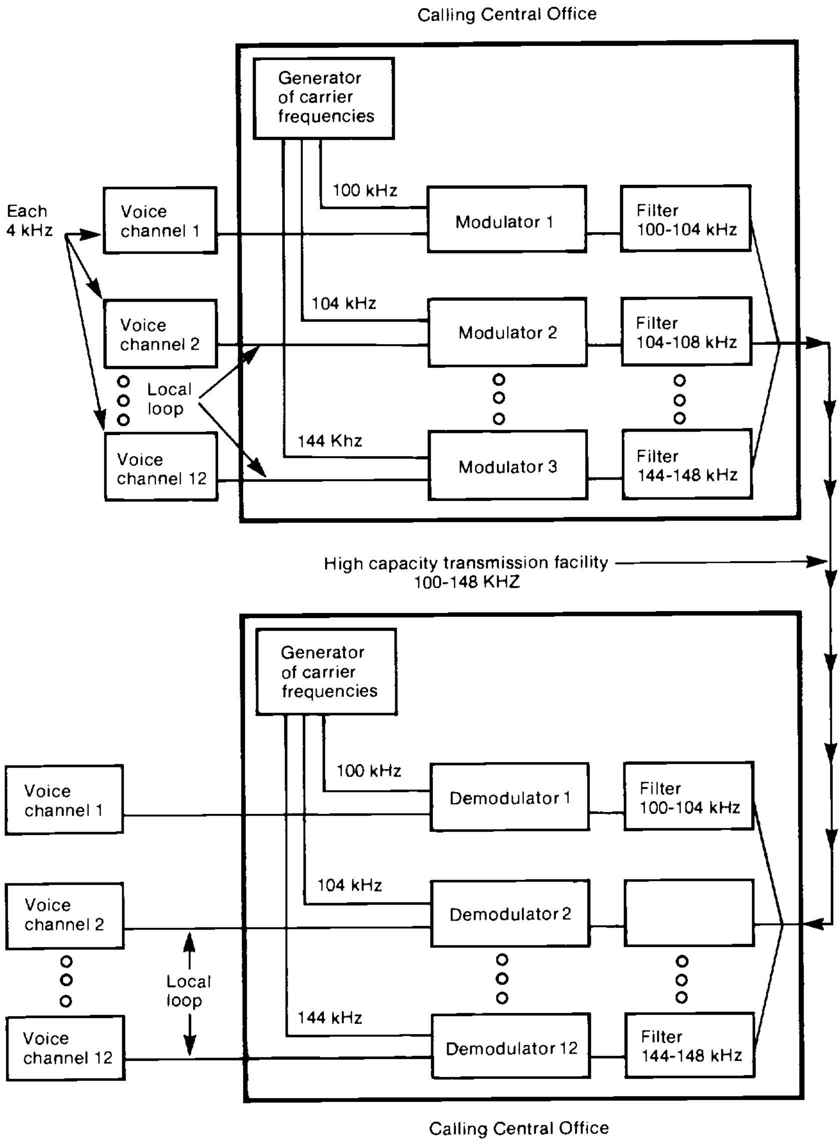
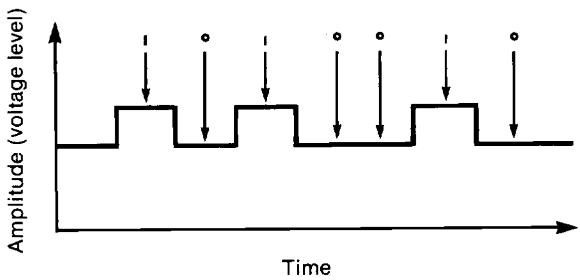


FIGURE 2–7
Digital Signal



carry information, either a 0 or a 1, since the eighth bit of every word is used by the network for signaling and supervisory information. There are more efficient techniques employed today, but it would not serve the purpose of this chapter to describe them.) As we said, the entire process or frame takes 1/8,000th of a second to complete and is repeated 8,000 times a second. This is how we arrive at the DS–1 signaling rate of 1,544,000 bits per second or 1.544 megabits per second.

$$8{,}000 \text{ frames/sec} \times 193 \text{ bits/frame} = 1{,}544{,}000 \text{ bits/second}$$

Time-division multiplexing (TDM) is ideally suited for digital signals. It permits many digit (bit) producing machines, like data terminals, computers, and so on, to share a single transmission line by interleaving the bit streams of more than one terminal over one transmission device. However, analog signals can also be sent over digital transmission lines. But to do so, they must first be converted to digital signals. The first step in the process of converting analog signals into digital form is *quantizing.* The method used to encode the quantized signals is *pulse code modulation.*

Pulse Code Modulation

With pulse code modulation (PCM), a telephone voice becomes a bit stream that looks like digital data. A codec, for *co*der-*dec*oder, converts the analog signal to digital form. Ironically, the trend in the communications industry is via a codec to convert the more prevalent analog signals (such as voices) so that they may travel over digital lines. Whereas in the computer industry the trend is to convert less prevalent digital signals, such as data, via a

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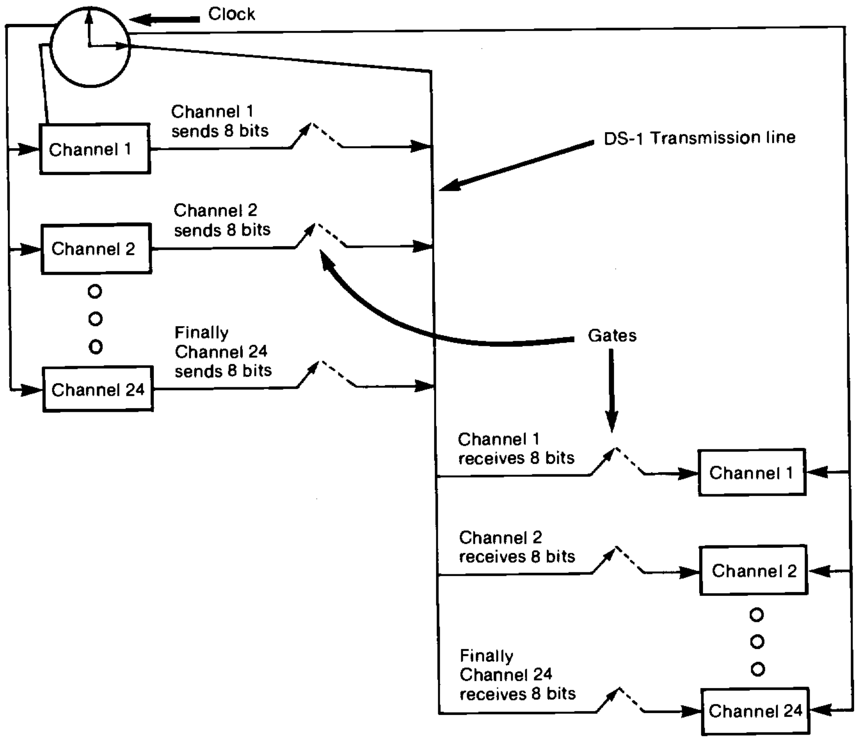
FIGURE 2–8
DS–1 Signaling Process

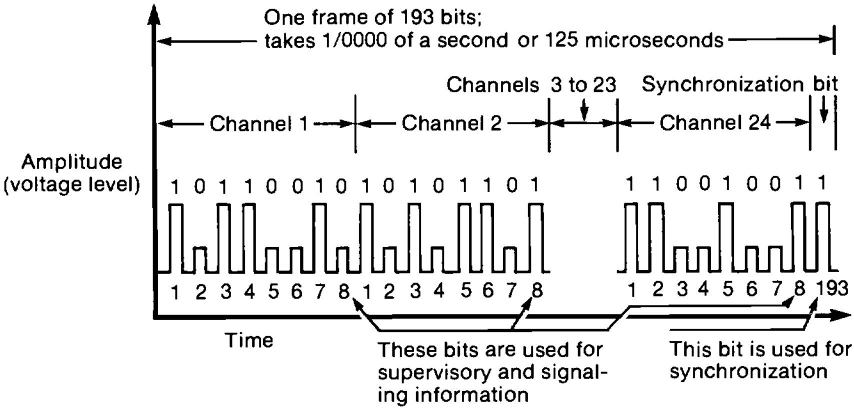


The process illustrated constitutes one frame which is repeated 8,000 times a second and produces the DS–1 signaling rate of 1,544,000 bits per second. A look at the signal going over a DS–1 transmission line is shown in Figure 2–9.

modem (short for *mo*dulator *dem*odulator), to travel over analog telephone lines.

To convert an analog signal, such as a voice, to a digital signal, or pulse train, it is required that the circuit over which the analog signal travels be sampled (measured in amplitude) at periodic intervals. The simplest type of sampling (measurement) would produce pulses that are proportional to the amplitude of the sampled signal at the instant it is sampled. This process is called *p*ulse *a*mplitude *m*odulation (*PAM;* see Figure 2–10). The pulses in Figure 2–10 still carry their information in quasi-analog form, since the amplitude of each pulse can take on an infinite number of possible values

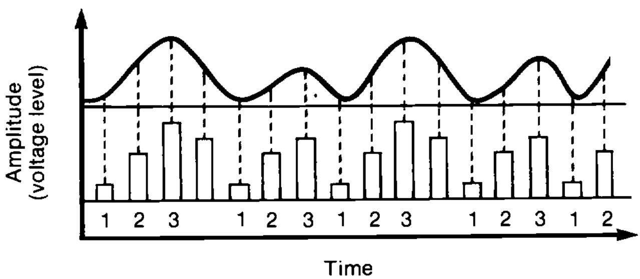
FIGURE 2–9
PCM Frame



Note that the 0 bit is shown as a bit of lower amplitude than the 1 bit. However the 0 bit could have also been the absense of a bit or pulse while the bit the presence of a bit or pulse.

from zero to the maximum amplitude of the wave passing through the circuit. However since we want to digitize the voice samples, or the amplitude modulated pulses, a second process is employed that converts the PAM pulses into unique sets of equal amplitude pulses. The receiving equipment then needs to detect only whether a bit or a pulse is a 0 or a 1. The absence of

FIGURE 2–10
Pulse Amplitude Modulation (PAM)



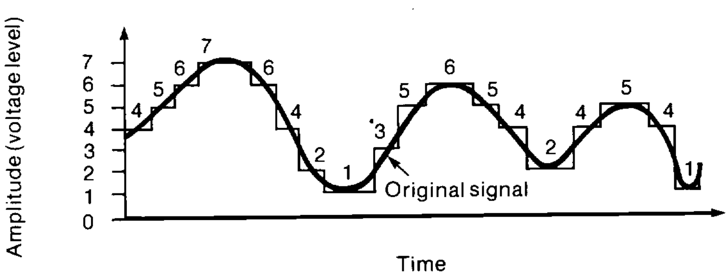
a bit is interpreted as a 0 and the presence of a bit as a 1. The amplitude of each individual pulse is not relevant since, at least in theory, it is constant.

As we said, the amplitude of a PAM pulse can take on infinite number of possible values from zero to the maximum amplitude of the wave passing through the circuit. However with pulse-coded types of modulation, it is normal to limit the number of possible amplitudes to a limited set of discrete values. The process of dividing an infinite range of possible amplitudes to a finite set of discrete amplitudes is called quantizing. The process is illustrated in Figure 2–11.

The next question becomes how many samples are needed. It has been mathematically proven that if the highest frequency in a channel is limited to a bandwidth of X cycles per second, then a sampling rate of $2X$ cycles (samples) per second is sufficient to carry the signal and completely reconstruct it. If the sampling rate drops below twice the bandwidth of the signal being sampled, then the signal cannot be reproduced without distortion (noise). If the sampling rate is greater than twice the bandwidth, then redundant sampling occurs.

Since a voice-grade channel has a maximum frequency of 4,000 cycles per second (4 kHz), the sampling rate should be 8,000 samples per second. Indeed, when we discussed the frame in Figure 2–9, we said that the frame samples 24 channels in 1/8,000 of a second. Thus each voice-grade channel, sampled 8,000 times a second, produces 8,000 PAM pulses per second. Since each PAM pulse is converted into a 7-bit code, a 4 kHz standard voice-grade channel uses 8,000 times 7, or 56,000, bits per second (bps). An eighth bit is added to each sample for signaling and supervisory purposes, adding 8,000 bits per second (bps). Thus a standard voice frequency channel that carries voice, signaling, and supervisory information operates at 56,000 bps

FIGURE 2–11
Quanitizing



(for voice) plus 8,000 bps (for signaling and supervisory data), or 64,000 bps.

The DS–1 (*d*igital *s*ignaling) rate transmits 24 voice channels. Thus its frequency, or bit rate, is 24 × 64,000 bits per second (bps), or 1,536,000 bps. Since 1 bit is added to each frame for synchronization purposes, 8,000 bits per second are used for synchronization. Thus the DS–1 rate becomes 1,536,000 bps (for 24 voice channels) plus 8,000 bps (for synchronization), or 1,544,000 bps (which equals 1.544 megabits per seconds—1 megabit equals 1 million bits).

Bandwidth Requirements for Various Types of Signals

Thus far we have based discussions on the standard voice frequency channel. This has been done for the following reasons: (1) The predominent use of today's telecommunications links is for voice communications; (2) most of the design of today's telecommunications systems have been based on voice frequency channels; (3) voice will continue to account for the great bulk of the usage of telephone lines for many years to come; and (4) most future telecommunications systems will be designed considering the constraints of voice transmissions first. However, voice is not the only type of communication that can be sent down a telecommunications link. Telegraph signals, data, low-fidelity sound, high-fidelity sound, still images (facsimile), and moving pictures (Picturephone and television in both black and white and color) can also be transmitted over a telecommunications medium. All of the signals can be transmitted in either the analog or digital mode.

However, different types of signals require different amounts of bandwidth, or capacity, to transfer the information they carry. Table 2–1 indicates the amount of bandwidth that is required to carry each type of analog signal in the analog mode. Next to the analog bandwidth requirement is the sampling rate per second needed to convert the analog signal into a stream of pulse amplitude modulation (PAM) pulses. Regardless of the signal source, a sampling rate equal to twice the bandwidth of an analog signal will permit an analog signal to be reproduced accurately. Next to the sampling rate is the number of discrete quantizing levels required to make the quality of the signal acceptable and to reduce quantizing noise to tolerable levels. (A voice frequency circuit's PAM pulses are quantized into 128 or 256 discrete levels.) The following column indicates the encoding scheme used to convert the PAM pulses into a digital bit stream of 0 or 1 (on or off) pulses, or pulse code modulation (PCM) bits. (A voice PAM pulse is converted into a seven- or eight-bit code to permit and identify each of 128 or 256 discrete quantizing levels—$2^7 = 128$; $2^8 = 256$). An n-bit encoding scheme would permit 2^n discrete quantizing levels. The last column in the table indicates the bit rate required to carry the particular analog signal in digital form. At the bottom

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TABLE 2–1
Analog and Digital Signal Equivalents

Type of Analog Signal	*Analog Bandwidth Requirement (BR)*	*Sampling Rate PAM Pulses (2×BR) (samples/second)*	*Number of Quantizing Level Desired (2^n bits)*	*Number of Bits Needed to Produce Required Quantizing Levels*	*Bit Rate†*
Telephone voice	4,000 Hz	8,000	128 levels = 2^7	7 bits	56,000 bps
			256 levels = 2^8	8 bits	64,000 bps
Lo-fidelity music (AM radio)	4,000 Hz	8,000	1,024 levels = 2^{10}	10 bits	80,000 bps
Hi-fidelity music (FM radio)	15,000 Hz	30,000	1,024 levels = 2^{10}	10 bits	300,000 bps
Picturephone meeting service	1,000,000 Hz	2,000,000	8 levels* = 2^3	3 bits	6,000,000 bps
Color TV	4,800,000 Hz	9,600,000	1,024 levels = 2^{10}	10 bits	96,000,000 bps
Still picture-video telephone	4,000 Hz (or higher)	8,000 or higher	8 levels = 2^3	3 bits	24,000 bps or higher
Still picture on television screen	40,000 Hz	80,000 or higher	64 levels or higher = 2^6	6 bits or more	480,000 bps or higher

Type of Digital Signal	*Bit Rate*
International telex	50 bps
TWX (teletypewriter exchange)	110 bps
Dataphone Digital Service (DDS), offered by AT&T	2,400; 4,800; 9,600 56,000; 1,544,000 bps
Low-speed data	less than 1,200 bps
Medium-speed data	1,200 to 9,600 bps
High-speed data	over 9,600 bps
Videotex (Viewdata)	1,200 bps

* In reality, a wider bandwidth with data compression is used to obtain the 6 million bps rate.

† Number of PCM bits per second (bps) needed to carry analog signal (sampling rate × bit rate) $8{,}000 \frac{\text{samples}}{\text{second}} \times 7 (\text{or } 8) \frac{\text{bits}}{\text{sample}}$.

of Table 2–1 some digital signals and speeds are included for comparative purposes.

Analog versus Digital Communications: Why Digital?

Analog communication generally utilizes less bandwidth (capacity) than digital communication of the same information. A standard analog voice frequency circuit has a bandwidth of 4 kHz, whereas a digitized voice signal can require 64,000 bits per second of digital data, which can utilize up to 64 kHz of bandwidth. In addition, for the foreseeable future the bulk of communications will be provided for analog signals (voice and TV) and not data. So the question becomes Why digital?

The Bell System introduced digital PCM communications, via the 24-channel T-1 carrier system, in 1962. Digital communications made economic sense in short-haul applications. AT&T had many wire pairs under city streets, and instead of using each of them to transmit one analog voice, they could each be used to transmit 24 digitized voice channels, provided that an investment in electronics was made at each end of the wire pair. This idea proved economical, since digital electronics, using time-division multiplexing (TDM) were cheaper than analog electronics using frequency-division multiplexing (FDM); and bandwidth limitations on a pair of copper wires over short distances did not present a problem. Also, a TDM receiver only had to distinguish between a 0 or a 1, whereas an FDM receiver would need to determine the amplitude and frequency of an incoming signal, requiring a much higher quality signal and a more expensive receiver. In addition, analog FDM allowed crosstalk (interference) to occur among adjacent voice channels; digital TDM did not. On the other hand, in typical long-haul, high-density transmission systems, especially microwave radio systems, the availability of bandwidth is usually very critical, and digital PCM neither provided sufficient economical improvements nor technical improvements over analog techniques to justify its use in long-haul systems. This is still true today, but is becoming less so as time goes on.

There are two trends that make digital appear to be the way to go in the future. The first is that more telephone company central offices are becoming digital and are switching voice traffic digitally. Thus, even if digital transmission is more expensive than analog, it may pay to use digital transmission facilities between adjacent digital central offices, since a telephone company can then save the investment in channel banks, or analog-to-digital and digital-to-analog converters, at both ends of the interconnections. Second, since digital repeaters regenerate a new signal instead of amplifying an analog signal, signal quality can be better. A digital repeater only emits 0s or 1s, so that as long as it can distinguish between a 0 or 1 incoming signal, it can produce a new 0 or 1 outgoing signal. An analog repeater only amplifies an analog signal, so it amplifies the noise as well as the original signal. Thus the signal-to-noise ratio deteriorates after each successive analog repeater. Third, the cost of digital electronics is dropping rapidly, thus making digital transmission facilities less expensive. Since digital electronic devices are generally simpler than analog devices, digital devices lend themselves more to large-scale integration (LSI) than do analog devices. Therefore unit costs of digital equipment are expected to continue to decline in cost over time. At the same time, the amount and value of installed digital hardware continues to increase as more digital central offices are installed each day. Therefore a continued transition from analog to digital transmission facilites is expected over time.

TRANSMISSION SYSTEMS

This section will discuss various types of transmission systems, both analog and digital, their historical place in the telecommunications network, and what we anticipate their future use to be.

Wire Pairs

The oldest and simplest type of transmission systems are open wire and twisted wire pairs. With open wire pairs, two uninsulated wires are strung in parallel, as on a telephone pole, and not too close together (at least 6 inches apart), to complete a communications circuit. With twisted wire pairs, adjacent pairs are insulated and can be spaced relatively close. Since wire pairs are generally bunched together to form a larger cable, they are twisted together in pairs to avoid inductive interference, which creates crosstalk among adjacent wire pairs.

Coaxial Cable

Coaxial cable was developed to counter the severe attenuation, or loss of signal strength, that occurs at higher frequencies. As the signal frequencies become higher, the electrical current tends to flow more on the outside edge of a wire. This is known as the "skin effect." The current uses an increasingly small cross section of the wire during propagation; therefore the effective resistance of the wire during higher frequency propagation increases, causing increased attenuation or signal loss. Also, at higher frequencies an increasing amount of the signal's energy is lost by radiation from the wire (the wire gives off more heat). Still, it is desirable to transmit at as many high frequencies as possible so that as many separate signals, or channels, as possible can be sent over the same wire transmission facility. However, the skin effect limits the higher frequencies.

Coaxial cable can transmit signals at higher frequencies than can wire pairs. A coaxial cable consists of a hollow copper cylinder (perhaps woven copper filaments), or other cylindrical conductor, surrounding a single copper wire conductor. The space between the cylindrical shell and the inner conductor is filled with an insulator. At higher frequencies the cable is relatively immune to noise, and there is virtually no crosstalk or interference between adjacent coaxial cables because the current tends to flow on the inside of the outer shell and the outside of the inner copper wire. Because of this shielding from noise and crosstalk, the signal can be transmitted at higher frequencies and can be dropped (or suffer degradation) to a lower level before amplification is required and still retain most or all of its information content. Thus the reason for higher capacities in coaxial cables, relative to wire pairs, is that signal loss, or attenuation, does not become severe until very high frequencies.

The first coaxial cable telephone system was installed in the Bell System in 1941. It was a relatively low density system compared with today's standards; it could only carry 600 voice channels per coaxial cable and included only four cables per sheath. Thus each sheath could handle only 2,400 one-way voice channels.

Terrestial Microwave

The main contender with coaxial cable systems or bulk transmission is microwave radio, a technology somewhat newer than coaxial cable and developed from radio detection and ranging technology (RADAR), which was first designed by the U.S. Naval Research Laboratory in 1934 and perfected during World War II. Microwave radio was introduced into the Bell System network in the early 1950s. Unlike high-frequency or longer-wave radios that bounce signals off the ionosphere—such as AM radio or short wave radio transmitters—a microwave radio beam employs line-of-sight transmission, and the antennas used in each microwave radio relay station are all on towers within sight of one another. Since relay towers are normally spaced every 20 to 30 miles because of the curvature of the earth, on a long-distance transmission via microwave the signal must be picked up every 20 to 30 miles and retransmitted.

One advantage microwave radio has over coaxial cable is that it requires amplifiers only every 20 to 30 miles verses every 1½ to 4 miles for coaxial cable systems. (Another advantage is that microwave does not require cables in trenches or on telephone poles in areas of rough or mountainous terrain.) The disadvantage of using too many amplifiers, as in coaxial analog-type cable systems, is that a slight defect in any one of the amplifiers is cumulative, and analog amplifiers amplify the noise as well as the signal. Thus the more amplifiers one uses, the greater the signal degradation. As a result of its characteristics, microwave radio is used to carry about 70 percent of all interstate long-distance telephone calls in what was the Bell System. There are about 410 million circuit miles in the microwave radio relay network of the former Long Lines department of AT&T (now AT&T Communications).

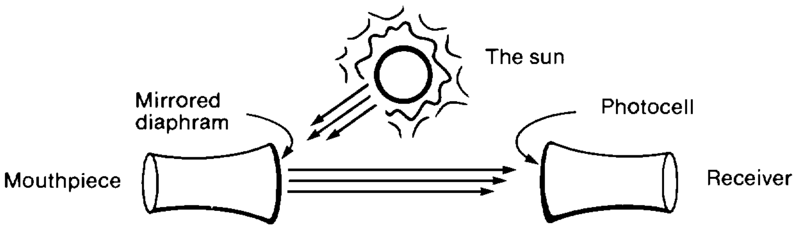
The analog microwave radio industry is relatively mature, and unit growth is generally less than long-distance traffic growth in terms of complete systems. The major manufacturers of analog microwave radios are Western Electric, GTE Lenkurt, Nippon Electric, the Farinon division of Harris Corporation, and the Collins Transmission Systems division of Rockwell International.

Optical Fiber

Lightwave communications date back to the 1870s. In fact, Alexander Graham Bell invented the photophone before he invented the telephone. He considered it to be his greatest invention. The photophone used sunlight to modulate an electric current (see Figure 2–12). Talking into the photophone mouthpiece would make the diaphragm of the mouthpiece oscillate at the frequency and amplitude of one's voice, the same way a speaker's voice makes the diaphragm and electric current oscillate at the frequency and amplitude of his or her voice in a normal telephone. On the opposite side of the diaphragm was a mirror. The angles and the frequency of the changes in the angles of the light waves hitting the mirror on the backside of the diaphragm would coincide with changes in the position of the diaphragm, which was vibrating due to the speaker's voice. The photocell of the receiver could pick up the intensity of the angle and frequency of the changes in the angles of the light waves hitting it. The photocell could then convert these vibrations into changes in an electric current it would produce in the receiver, which would operate a speaker and reproduce the speaker's voice. The obvious problem with this system is transmission. Nothing could interfere with the light waves between the mouthpiece and the receiver. Fog was a real problem. Thus Bell abandoned the photophone and went on to invent the electricity-powered telephone.

In the mid 1960s an ITT scientist presented a paper discussing the practicality of lightwave communications. To solve Alexander Graham Bell's problem of fog and other forms of atmospheric interference, he theorized that lightwave signals could be transmitted over fibers of ultrapure glass. Optical fiber technology was originally expected to become of commercial significance after the turn of this century. The telephone industry expected microwave waveguide pipes to become the next major advance in transmission technology. A microwave waveguide pipe is a hollow tube through which microwave radio signals are transmitted. It functions like a microwave radio whose path is guided by a metallic tube. Because the radio path is shielded from weather and other obstacles, waveguide pipes can operate at higher frequencies and can carry more traffic than can normal microwave radios and without running into the fading and other reliability problems microwave radios generally experience. However, microwave waveguide pipes never really got very

FIGURE 2–12
Simplified Photophone Schematic



far past the experimental stage due to the quicker-than-expected development of optical fiber systems technology. By the mid-1970s, it was obvious that optical fiber systems technology had arrived, and experimental systems were built and tested by AT&T, General Telephone & Electronics, and others. By 1980, optical fiber systems were becoming cost competitive with coaxial cable systems and, because of their potential capacity, they were beginning to be installed not as experimental systems but as regular commercial equipment.

Optical fiber systems in concept are similar to coaxial cable systems except that optical fiber transmits light and coaxial cable transmits microwaves. Light can be considered to be electromagnetic radiation with very high frequencies and very short wavelengths, while microwaves are somewhat lower in frequencies and longer in wavelengths. Optical fiber systems are essentially made up of three principal elements: (1) a source or a transmitter, which converts electrical energy into light energy; (2) an optical fiber cable, or optical waveguide, which is used to carry the light signals from the transmitter to the receiver; and (3) a receiver or detector, which reconverts the light energy, or photons, back into electrical energy.

Optical transmitters. There are two basic types of lightwave communications—guided and unguided. Guided systems employ optical fiber cables (hair-thin fibers of transparent glass or plastic) as a conduit to guide the light beams from the source to the detector. Unguided systems do not utilize fiber optic waveguides but instead rely on a direct beam of light from the source to the detector. Because they have problems similar to the photophone, we do not see many applications of unguided optical systems, and thus we have concentrated our discussion on guided optical systems.

In a guided optical fiber system, the transmitter converts an electrical signal into light energy. In digital systems, the light energy is modulated into bursts of light that represent an information code. For example, in the code utilizing the binary number system, the basis of all digital communications (recall pulse code modulation), a burst of light could represent a 1, and the absence of a burst of light could represent a 0. (Obviously we are discussing a clocked or synchronous operation.) Then the modulated light energy is transmitted (guided) through an optical fiber to the receiver (detector). At the receiver the light energy is reconverted into an electrical signal and decoded. The signal then continues to be transmitted as a flow of electrons or radio waves. An additional component, called a repeater, is used on long-distance links in order to amplify and reshape photon streams weakened by attenuation, or loss of signal strength, over a certain distance.

There are several parts to the transmitter device. It is designed to encode the signal, drive the light source, emit the photons, and couple the emitter to the fiber. The primary electro-optical component is the emitter. There are two general types of emitters (light sources): (1) incoherent (out of phase) light-emitting diodes (LEDs) and (2) solid-state injection laser diodes. (A diode is a two-electrode semiconductor device that transmits current more easily in one, and usually only one, direction. *Laser* stands for light amplification by stimulated emission of radiation.) Both of these devices can be modulated at very high speeds. For example, the transmission bandwidth for infrared LEDs can be as high as 150 MHz and that of solid-state lasers as much as a few GHz. In comparison, the transmission bandwidth for most telephonic coaxial systems is less than 100 MHz, and in some systems it is much less.

In terms of the theoretical potential, LEDs are inferior to injection laser diodes because they cannot concentrate as much light into the fiber and because they cannot be modulated as rapidly. Still infrared LEDs do meet the requirements for many optical fiber transmission applications today. Over the longer term though, the higher potential capacity of solid-state injection laser diodes, combined with their declining cost and increasing reliability, could result in their utilization in most future optical fiber systems.

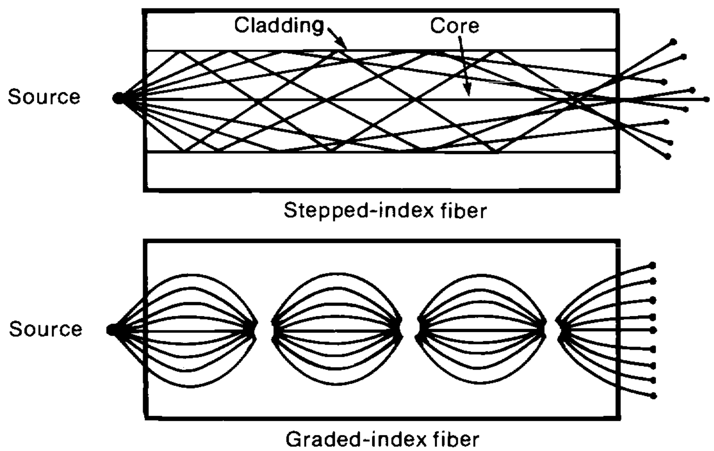
Types of optical fibers. The optical fiber cable is composed of one or more optical fiber waveguides. The individual fibers are made in hair-thin strands in order to provide a flexible cable. There are two basic types of optical cable: bundled-fiber cable and isolated-fiber cable. The bundled-fiber cable is composed of a group of individual fibers bundled together and sharing a common source of light. This type of cable is normally used in short-distance applications and is well suited for LEDs because the bundle provides an aperture large enough to collect the noncoherent (out of phase) light of the LED. The isolated-fiber cable is also composed of a number of individual fibers. However, each fiber transmits its own signal, different from that of the fiber next to it, because each fiber uses its own separate light source.

Isolated-fiber cables are generally used with injection laser diodes in both short- and long-distance applications.

Of the types of optical fiber waveguides in use today, the two most important are the stepped-index fiber and the graded-index fiber. Figure 2–13 illustrates how these two types of fibers guide the waves of light through the emitter. The stepped-index fiber, usually made from plastic, is composed of a central core and an outer cladding. Since the index of refraction (or reflection) of the core is higher than that of the cladding, light striking the core-cladding interface is reflected into the core. (The core-cladding interface acts like a mirror.) Thus light is propagated through the fiber following the path of the cable. Graded-index fiber, usually made of fused silica (glass), uses a gradual variation in the refractive (reflective) index that forces the light rays to propagate along the fiber in a wavelike manner. This wavelike movement lessens pulse broadening, which can distort signals over a long distance. Thus the stepped-index fiber is generally used in shorter-distance applications, and the graded-index fiber is used mainly for longer-distance communications.

Short-distance optical fibers systems can use plastic instead of glass for the composition of the optical fiber cable. Advances are being made with plastic optical fibers as well as with glass ones. In fact, Nippon Telegraph and Telephone Public Corporation (NTT), Japan's national telephone company, has developed a new plastic optical fiber that will extend short-distance

FIGURE 2–13
Optical Fiber Waveguides



light communications by some 30 times over current levels. The new fiber reduces the loss of light passing through it to one third of the loss of today's best fibers. This new fiber transmits as far as up to 300 meters. Present conventional plastic fibers do not permit light signal transmission of more than 10 meters in length.

The fiber, which is made of an acrylic resin, has the added features of being less costly to produce and more pliable to work with than its glass fiber counterparts. NTT envisions using the fiber for intrabuilding and factory communications systems. NTT expects to have the fiber ready for practical application within the next year or two.

Characteristics of optical fiber. An important characteristic of optical fibers is their loss factor and attenuation characteristic. Losses in the fiber result in attenuation or weakening of the light signal and limit the length over which a fiber optic transmission system can operate without the need for signal repeaters. Losses are caused primarily by light absorption and scattering. Absorption losses are caused by impurities present in the fiber. The most significant loss factor is due to the scattering or dispersion of light by the molecular structure of the fiber. This type of loss can be minimized by optimizing the relationship between the characteristic wavelengths of the emitter and the molecular structure of the fiber.

Since glass is noninductive, fiber optic transmission is immune to lightning, inductive crosstalk, electromagnetic effects induced by such things as nuclear explosions, and generally all types of conventional electromagnetic interference. This characteristic is one of the two most important advantages of optical fiber transmission. (The second is the large available bandwidth.) For example, in computer interconnections it is extremely important that data be transmitted accurately. Electromagnetic interference can distort signals during transmission and thus lead to the transmission of data with a significant number of errors.

Another advantage of fiber optic transmission is its inherent large bandwidth. The wave oscillation frequencies of light are so rapid that the rate of signal transmission is limited by the modulator, and not the available frequency spectrum in the optical fiber. Thus, as the trend toward faster modulation rates continues, the attainable rate of signal transmission will rise. The bandwidth advantage is of considerable importance to many potential users of fiber optics, particularly the telephone industry. For example, Bell Labs has indicated that a single optical fiber as thin as a human hair can transmit as many phone conversations as a bundle of copper wires as thick as a man's arm. As a result of the bandwidth advantage, optical fibers are very small and lightweight, in comparison with the bundles of copper wire required at equivalent transmission rates. Also, as faster modulation devices are invented, the electronics of an optical fiber system can be replaced to increase transmission speeds without "digging up the streets" to install a higher capacity optical fiber, since the optical fiber already has greater bandwidth capabilities than are being utilized in today's optical fiber systems.

Optical fibers are also potentially very inexpensive, since glass is a common substance. The raw materials for glass are as abundant as sand (silicon dioxide), whereas copper is in increasingly short supply. This economic incentive could be particularly important to the telecommunications industry. For example, we believe that AT&T and its formerly affiliated companies account for almost one fifth of domestic copper consumption. During the next couple of years, fiber optic networks may be priced such that the newer technology will be less than half the cost of the conventional technologies.

It is also important to note that optical fibers are generally unaffected by moisture and temperature so that cable pressurization is not required. For example, underground telephone cable is jacketed and pressurized in order to protect the wires from moisture. The maintenance of pressure throughout the cable can be an expensive process. Also, fiber optic transmission presents no short-circuit hazard as do copper wires and cable. This can be important for control applications in potentially hazardous environments, such as a control system at a chemical refinery or an electric utility power plant. In fact, electric utilities have already begun to use optical fiber systems for communications purposes at power plant facilities.

Historically, one of the most important factors impeding the progress of fiber optics was the high unit costs, which stem from insufficient production volume for the component suppliers. The technology is in place today to design affordable optical fiber links, but the current lack of commercial volume tends to maintain a relatively high unit cost on the optical components, although unit prices have been dropping over time.

Another problem had been field maintenance and installation. Connecting and terminating an optical fiber involves significantly different techniques than conventional wiring. However, just about all of the problems involving the installation and the splicing of optical fibers have been solved.

The telephone industry represents the largest near-term potential market for fiber optic cable. (Longer term, the cable TV industry could employ optical fiber systems to distribute television signals.) It is believed that the domestic telephone industry installs about 200 million feet of coaxial cable annually. In addition, its total U.S. consumption of noncoaxial exchange wire is about 400 billion conductor feet. The initial application of fiber optics in the telephone industry has been short-distance central exchange interconnection, via the underground conduits in large cities. Presently the conduits in metropolitan areas (such as the Chicago site of an AT&T optical fiber experiment) are overcrowded and significantly limit the telephone industry's ability to handle increased telephone calling volumes. Since fiber optic cable can displace large bundles of copper wire pairs, this technology can alleviate that situation.

The emergence and acceptance of optical fiber transmission equipment

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for digital trunking applications and the fact that several systems are in service today have increased the options for transmitting information. Comparison of fiber optics with conventional cable or microwave radio technology is usually required before a transmission system is selected.

Communications Satellite Systems

The concept of a communication satellite is relatively simple. It is, in essence, a microwave radio relay station in the sky. Signals are sent to it from ground stations, are amplified within the satellite, and are sent back to earth. The value of a communications satellite lies in the fact that it can handle a large volume of traffic and can send it almost anywhere on earth. The cost of satellite channels is dropping rapidly, and their capabilities are improving.

Like a microwave radio relay station, a satellite receives a radio signal at a certain frequency, changes its frequency, amplifies it, and then retransmits it. The equipment that performs this function is called a transponder. The radio signals have a high bandwidth (typically 36 MHz), which is important because the information-carrying capacity of a signal is proportional to its bandwidth. Most commercial communications satellites use the same radio frequencies (RF) as terrestrial microwave relay systems. The main difference between microwave radios and satellites is that microwave radio stations are typically spaced 20 to 30 miles apart, and satellites are 22,300 miles up in space.

A significant problem with satellite communications is the delay that occurs between a signal's transmission and its reception. A one-way transmission takes about 270 milliseconds (thousandths of a second), so that a round-trip communication, like a conversation, takes about 540 milliseconds (more than half of a second) to complete (see Figure 2–14). This results in the talker's voice being returned as an echo. This problem can be overcome through the use of echo suppressors (long used on any land circuit exceeding 1,500 miles) and the newer echo-cancellation devices. The delay particularly affects data streams. As a result, a technique called forward error correction (FEC) has replaced the older "wait for acknowledgement" form of digital transmission.

Satellite frequency bands. Like a terrestrial microwave radio system, a satellite uses different frequencies for the reception and transmission of signals. Without this arrangement, a powerful transmitted signal would interfere with a weak incoming signal. Table 2–2 lists the radio-frequency (RF) bands designated for all forms of radio communications. Most communications satellites use the UHF and SHF frequency bands; commercial communications satellites use the SHF band exclusively and will continue to do so for the foreseeable future.

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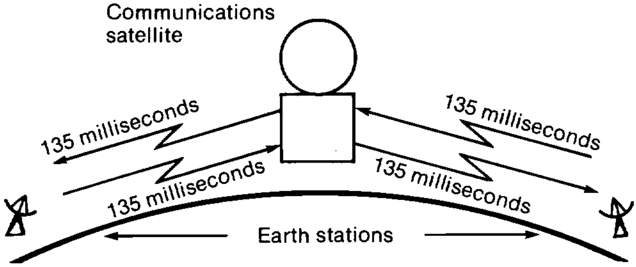
FIGURE 2–14
Travel Time in a Satellite System



Frequency bands are also given letter designations. Commercial communications satellites use three RF bands, the C band (4 and 6 GHz), the Ku band (11 or 12 and 14 GHz), and the Ka band (20 and 30 GHz). The lower frequency of each band is used for the downlink; the higher frequency for the uplink. Many designations follow the signal path. Thus 14/12 or 6/4 GHz is often found.

Most commercial satellites use the C band (4/6 GHz). However, since these are the same frequencies used by terrestrial microwave radio systems, newer satellites are beginning to use the Ku band. The Ka band will probably not be used, except for experimental purposes, until the 1990s.

TABLE 2–2
Radio Frequency (RF) Bands

Band Number	*Band Name*	*Frequency Range*		*Wavelength*
4	VLF—very low frequency	3–30	kHz	Myriameters (10^4m)
5	LF—low frequency	30–30	kHz	Kilometers (10^3m)
6	MF—medium frequency	300–3,000	kHz	Hectometers (10^2m)
7	HF—high frequency	3–30	MHz	Decameters (10 m)
8	VHF—very high frequency	30–300	MHz	Meters
9	UHF—ultra high frequency	300–3,000	MHz	Decimeters (10^{-1}m)
10	SHF—super high frequency	3–30	GHz	Centimeters (10^{-2} m)
11	EHF—extra high frequency	30–300	GHz	Millimeters (10^{-3} m)
12		300–3,000	GHz	Decimillimeters (10^{-4} m)

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Table 2–3 gives a comparison of the radio frequencies allocated by the FCC for terrestrial microwave and satellite communications.

Some of the newer satellite systems will operate in the Ku band. The advantages of the Ku band are:

1. The band is currently less heavily used for terrestrial common carrier microwave radio relay stations, so 12/14 GHz earth antennas can operate on the rooftops of buildings in cities. Large corporate locations can operate their own antennas. In congested areas there may be one earth station serving many local users who are linked by short line-of-sight packet microwave radio systems, such as those proposed by M/A-COM and others 10.55–10.68 GHz (RAPAC—radio packet), or coaxial cable (CAPAC—cable packet) networks, possibly supplied by the cable TV companies. In fact Local Digital Distribution Company (LDD), a subsidiary of M/A-COM, plans to offer such services to be used with the Satellite Business Systems network.
2. The beamwidth from a 12/14-GHz earth station antenna of a given size is less than half of that for a 4/6 GHz satellite. It is inversely proportional to the frequency. Therefore, many more Ku band satellites could be operated without any increased signal interference among adja-

TABLE 2–3
Common Carrier Radio Frequencies

Band	*Terrestrial Frequency Bands (GHz)*	*Commercial Satellite Frequency Bands* — *Downlink (GHz)*	*Commercial Satellite Frequency Bands* — *Uplink (GHz)*	*Bandwidth (MHz)*
S band	2.11–2.13			20
	2.16–2.18			20
C band	3.7–4.2	3.7–4.2		500
	5.925–6.425		5.925–6.425	500
Ku Band	10.7–11.7			1,000
(frequencies of		10.95–11.2*		
the new		11.45–11.7		500
generation of		11.7–12.7		500
satellites)			14.0–14.5	500
Ka band	17.7–19.7			2,000
		17.7–20.2		2,500
			27.5–30.0	2,500

cent satellites, thereby reducing potential congestion in the equatorial orbit.

3. A satellite antenna of a given size and weight can be made more directional by using a higher frequency. Multiple-spot (searchlight) beams to or from the satellite could therefore be made to operate at the same frequency. The satellite could then transmit more signals than a 4/6-GHz satellite without exceeding the 500 MHz radio frequency bandwidth allocation. Also, when using small three-meter earth-station antennas, Ku band satellites can be spaced at 2 degrees apart in orbit and still be able to transmit an intelligible signal, instead of the 3 degrees that may be required to transmit to three-meter earth-station antennas from satellites that operate in the C band.
4. When the 4 GHz downlink is used, there is a lower power limitation imposed on the radiated power of the satellite to prevent interference with terrestrial common carrier systems than is imposed on the 12 GHz downlink. Again, the higher the radiated power of the satellite, the smaller the earth-station antenna required to receive and be able to understand the signal.

Note, though, that the higher frequencies also have some disadvantages. With very heavy rain, the received signal's strength falls, and the noise the signal picks up increases. Also, most 12/14 GHz links need to be designed to avoid low angles of earth-station antenna elevation where the path through any rain is long.

Satellite orbits. What makes a satellite stay aloft? A satellite stays in orbit because centrifugal force caused by a satellite's rotation around the earth exactly balances the earth's gravitational pull. The satellite's velocity would pull it away from the earth if gravity did not exist. However, the earth's gravity exactly balances the effect of the satellite's velocity.

The closer a satellite is to the earth, the stronger is the earth's gravitational field, and the faster a satellite must revolve around the earth to avoid falling to earth. Low-orbit satellites travel at about 17,500 miles per hour and revolve around the earth in about one and a half hours. Communications satellites travel at 6,900 miles per hour and revolve about the earth in the period of earth's own rotation, 23 hours, 59 minutes, and 4 seconds.

A low-orbit satellite revolves about the earth at a height of from 100 to 300 miles and is in the line of sight of an earth station about 15 minutes or less. A medium-orbit satellite revolves at from 6,000 to 12,000 miles and is in sight of an earth station from 2 to 4 hours. A geosynchronous satellite, one that revolves about the earth in a sidereal day, revolves at an altitude of approximately 22,300 miles. Since a geostationary satellite revolves around the earth about every 24 hours, the period of an earth day, it appears stationary to the observer on the ground, or geostationary. It is always in a consistent line of sight of an earth station looking at it. Geostationary satellites orbit the earth above the equator.

The geostationary orbit offers many advantages in satellite systems engineering:

1. The satellite appears almost stationary in orbit relative to the earth-station antennas, so that the cost of computer-controlled tracking of the satellite is avoided. A nonmovable antenna can be used that may need only minor occasional manual adjustments.
2. There is no necessity to switch or transfer from one communications satellite to another as one disappears over the horizon and another one appears.
3. There are no regular interruptions in transmission. A geostationary satellite is permanently in the view of an earth station communicating through it.
4. Because of its distance above the earth, a geostationary satellite is in the line of sight of more than 40 percent of the earth's surface (38 percent if angles of elevation below 5 degrees are not used). The areas not covered are the polar regions and the other sides of the earth. A large number of earth stations can see, or look at, the same satellite and therefore can intercommunicate.
5. Three satellites can give total global coverage with the exception of the North and South Poles. The INTERSAT system uses three groups of satellites (in the Atlantic, Indian, and Pacific Ocean regions) to provide coverage of most of the world's population.
6. For most applications there is no noticeable Doppler shift in the radio signal, that is, the change in the apparent frequency of the signals going to and from the satellite. The Doppler shift is caused by the motion of the moving satellite as it approaches and passes the earth station. Satellites in elliptical orbits have different Doppler shifts for different earth stations, and this increases the complexity of the receivers, especially when large numbers of earth stations intercommunicate. Geostationary satellites do not appear to move relative to the earth station. Thus no (or a very small) Doppler shift arises.

Disadvantages of geostationary satellites include these:

1. Latitudes greater than 81.25° north and south (or 77° if angles of elevation below 5° are excluded) are not within sight of the satellite's radiation at the longitude of the satellite (lower for other longitudes). Fortunately, there is not much more than polar ice at these latitudes.
2. Because of the altitude of the satellite, the received signal power, which is inversely proportional to the square of the distance and frequency between the earth and the satellite, is extremely weak. Also, the signal propagation delay is about 270 milliseconds for the combined uplink and downlink in one direction.

3. There are a limited number of orbital slots available over the equator in any given frequency band. Geostationary satellites using the same radio frequencies and covering the same areas of the earth cannot be placed too close together because their signals will interfere with each other. Today, C-band satellites are placed 4 degrees apart in orbit. The FCC has recently approved 2-degree spacing, although this would require using larger earth-station antennas. Satellites may be colocated if they use different frequencies or serve different nations with nonoverlapping beams—North and South American countries, for example.

Satellite in-orbit spacing depends upon many factors, including the design of both the space segment and the ground segment. Spacing is affected by the beamwidth of the transmitting earth station. The beamwidth varies with the size of the antenna's aperture and the frequency band used. The width of a beam from the satellite is inversely proportional to the width of the satellite's transmitting antenna. The same holds true for the earth station. The wider the antenna, the narrower the beam (and vice versa). Reason: A larger antenna can more precisely focus a beam, like a searchlight. One might think that the trend toward smaller earth-station antennas is contrary to narrower spacing between adjacent satellites. However, the use of higher frequencies (Ku and, eventually, Ka bands) will actually permit the operation of more satellites for two reasons: (1) A new radio frequency (RF) band will not interfere with existing ones, and (2) the beamwidth is inversely proportional to the frequency. The higher the frequency, the narrower the radio beam for a given antenna size.

The uplink is generally operated at the higher frequency, in any band. The downlink is operated at the lower frequency, since the higher frequency emits a narrower beam radiating into space. Use of the lower frequency to downlink is important since satellites have limited antenna diameters and power for the transmitters, but earth stations do not. The use of a lower frequency in the space-to-earth direction means lower path losses and allows the use of a lower transmitter power in the satellite.

The usable equitorial orbital arc that exists over the United States runs from 58° west longitude to 143° west longitude, or an arc of 85 degrees. At 4-degree spacing, about 21 satellites in a particular RF band can be accommodated; at 3-degree spacing, about 28 satellites. However, some orbit slots must be set aside for Canada, Mexico, and so on.

DATA TRANSMISSION CODES

Thus far we have discussed encoding and modulation techniques for analog communications. Digital communications also employ codes. These codes are used in the transmission of characters and numerals.

Baudot

Baudot is the simplest and slowest of all the major codes in use today. Baudot is a 5-bit code that yields 32 combinations or possible characters ($2^5 = 32$). The first 26 combinations are used for the letters of the English alphabet. The 27th and 28th combinations are used as control characters. The 29th combination designates a downshift to lowercase, which indicates that 5-bit codes 1 through 26 represent letters. The 30th combination designates an upshift to uppercase, which indicates 5-bit codes 1 through 26 represent either number or punctuation symbols. The 31st combination represents a space, and the 32d combination is not used.

The Baudot code is used for national and international Telex communications, such as those domestically provided by Western Union Telegraph, and the international record carriers, such as ITT World Communications and RCA Global Communications. Baudot is also used in most teletypewriter devices (TTDs) for the deaf.

The Baudot code is usually transmitted at 50 bits per second, or 66.67 words per minute, or about 6.7 characters a second, which equals 7.5 bits per character. Five bits per character are used for the code, and 2.5 bits per character are used for control purposes. Of the 2.5 bits used for control, 1 bit signals the start of a character, and 1.5 bits signals the end of a character.

ASCII

The ASCII code (pronounced askee) is a seven-bit code (ASCII stands for American Standard Code for Information Interchange). With seven coding bits, 128 combinations are possible ($2^7 = 128$). However, ASCII is an eight-bit coding system. It uses a seven-bit code to encode the character plus an eighth bit for a parity check. In computer terminology, each eight bit is called a *byte*. A parity check is the additional of noninformation bits to data, making the number of ones (1s) in a grouping of bits either always even or odd. This permits detection of bit groupings that contain single errors.

In such public communications systems as Western Union Telegraph's TWX (teletypewriter exchange) service, data transmission generally occurs at 110 bits per second or 100 words per minute. (There are five characters in the average teletype word. With one character for spacing, the average word is six characters. In general, x words per minute equal $x/10$ characters per second.) The 100 bps works out to 10 characters a second or 11 bits per character. Seven bits encode a character, one bit is used for parity and error checking, and three bits for control (start-stop) purposes. One bit signals the start of a character, and two bits signal the end of a character. Don't forget this is asynchronous transmission and start-of-character and end-of-character signaling is required.

EBCDIC

A third encoding scheme is called EBCDIC (extended binary coded chemical interchange code). EBCDIC is an eight-bit coding system, was developed by IBM for use on IBM computers, and is an example of a proprietary encoding scheme, although widely used. It allows up to 256 combinations ($2^8 = 256$). EBCDIC has been used for a long time in computers. Whereas Baudot and ASCII are used principally in teletypewriter operations, EBCDIC is used principally with business computers and in computer-to-computer or computer-to-data terminal types of systems. EBCDIC uses eight bits (256 combinations) to operate printing devices with up to 256 graphic characters or to transmit eight-bit bytes of computer data. However, the ASCII code is widely used in microcomputers and is the de facto standard for microcomputer communication and public and consumer data bases and services such as Compuserve, Dialog, and so forth.

MODES OF TRANSMISSION

There are three basic modes of transmission in data communications: simplex, half duplex, and full duplex. With simple transmission, data can be sent from point A to point B but not vice versa. The direction of data transmission can be in one direction only, much like a commercial radio station can broadcast music but not receive it.

Half Duplex

Half duplex allows transmission in either direction but not in both simultaneously. Half duplex is like citizen's band (CB) radio. One person talks and then listens. One cannot talk and listen at the same time on CB radio because as soon as the microphone is turned on, the speaker cuts out. Releasing the microphone button returns the speaker to operation. Half duplex is generally used in data communications systems where only a two-wire circuit is available. The same circuit is used for both directions of communications, and thus the entire bandwidth of the channel is devoted to the transmitter by only allowing one direction of traffic at a time. The other side can only transmit when the first side is idle.

Full Duplex

Full duplex allows transmission in both directions at once. Full duplex usually requires a four-wire circuit, a complete circuit for each direction of transmission. Full duplex can be performed over a two-wire circuit by dividing the circuit into two separate frequency bands. (Obviously neither direction of transmission can use the full available bandwidth of the channel if it has to share it, as it does in full duplex.) One frequency band is used for transmission in one direction and the other band for the opposite direction. Keeping two signals separated in frequency prevents them from interfering with each other. Also both directions need not have the same bandwidth or bit speed. Some videotex systems, such as Viewdata, receive data at 1,200 bps but transmit at 75 bps. However, full-duplex transmission over a two-wire circuit limits the maximum speed in any single direction to something less than the maximum speed capable of the channel if half-duplex transmission were used, due to the sharing of the channel and the guard band needed between each direction of signal transmission.

Asynchronous

Another aspect of data communications is synchronous and asynchronous transmission. Asynchronous transmission is often called start-stop. A single character is sent at a time. As with Baudot and ASCII codes, each character begins with a start signal, or bit(s), and ends with a stop signal, or bit(s). With start-stop transmission, there can be a varying interval between one character and the next. When one character ends, the receiving terminal sits and waits for the start of the next character. The transmitter and the receiver begin operation together with the start bit of a character, they remain synchronized while the character is being sent, and end operation together with the stop bit(s) of the character. Asynchronous transmission is used in most teletypewriter applications.

Synchronous

Synchronous transmission is used when the communicating devices transmit to each other with regular timing. When devices transmit to each other continuously, synchronous transmission can give the most effective line utilization. With synchronous transmission, the bits of one character are immediately followed by the bits of the next character. There are no pauses and no start or stop bits between characters. Groups of characters are divided into blocks, which are sent down the communications pipeline at equal time intervals. The transmitting and receiving terminals have to be exactly synchronized for the duration of each block, so that the receiving device knows which is the first bit of each character, and thus knows which are the other bits of each character. Synchronous transmission is normally used in applications where a computer is at either or at both ends of the transmission facility (or line).

MODEMS

In many environments, the terminals and computers are separated by several hundred feet or, in some cases, more than a mile. For these short distances,

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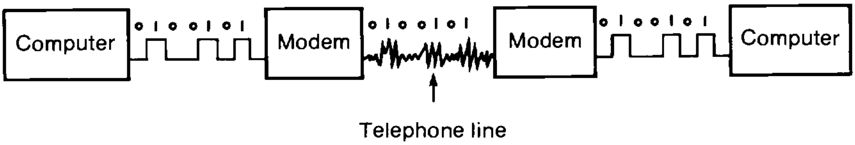
FIGURE 2–15
Modem or Data Set



a direct wire connection is possible using copper wire pairs or coaxial cable. Signals are transmitted digitally, eliminating the need for modems or acoustic couplers. In terms of expense, hardwiring is usually the lowest-cost data transmission line available. Digital signals cannot travel more than 50 or so feet over wires or cables before they become unintelligible. However, they can travel thousands of miles when converted to the analog mode by an acoustic coupler or modem and sent over telephone lines.

An acoustic coupler converts a serial bit stream of data from a terminal or computer into audio tones. It then sends the tones over the phone line via a telephone handset. At the destination, the audible tones are reconverted into the original serial-bit stream of data. Acoustic couplers are used in applications with terminals that operate at 1,200 bps or lower.

Whereas an acoustic coupler converts digital data into audible tones, a modem also converts the data directly into electrical signals. As we said, telephone companies use the term *data set* to describe this device. (In fact the word *modem* is rarely, if ever, used in telco marketing brochures.) Modem is a contraction for modulator-demodulator. Modems are also called data sets by the Bell System, and their application is to prepare computer or data signals for transmission over a telephone line. A data set, or data modem, prepares a digital data signal for transmission over an analog telephone line. Figure 2–15 gives an illustration.

Modems connect the digital world of data communications to the analog world of the telephone line. If one compared the data signal spectrum to the band of a standard voice-frequency channel, it would show that it is impossible to directly transmit digital signals through an analog channel. To get around this problem, a modem translates the frequency band of the digital signal to a band that can be transmitted through the analog channel.

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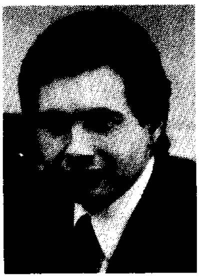

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Glenn R. Pafumi's primary responsibilities for Dean Witter Reynolds include investment research of the telecommunications industries, both the common carriers and the manufacturers. Previous positions include vice president and group manager, Telecommunications Planning, for Merrill Lynch & Co., and vice president, Securities Research Division, for Merrill Lynch, Pierce, Fenner & Smith, Inc., its brokerage subsidiary. Pafumi has a B.S. from the University of California at Berkeley and M.S. and M.B.A. degrees from New York University. He is a chartered financial analyst (CFA) and a member of the Financial Analysts Federation, the New York Society of Security Analysts, the American Institute of Aeronautics and Astronautics, and the Institute of Electrical and Electronics Engineers.

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For 11 years Welland held assignments in the following Exxon organizations: Exxon Office Systems Company; The Mathematics, Computers, and Systems Department; the Office of Management Information Coordination; the Headquarter's Administrative Services Department; and Exxon Enterprises (Information Systems Division). His work experience encompassed the management of a broad range of projects involving the solution of technical and business problems encountered in many of the functional areas of the Exxon Corporation and its worldwide affiliates. He was the Qyx product manager assigned to Exxon Office Systems Company and a senior adviser for the Exxon Enterprises Information Systems Division, where he was responsible for developing, evaluating, and recommending strategic and tactical plans for the growth of Exxon Enterprises' business activities in the communications systems area.

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Chapter 3

Revenue Opportunities for Owners of High Tech Buildings

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Outline

The increase in new construction of office space in the early 1980s has resulted in high downtown vacancy rates. On October 12, 1984, *The Wall Street Journal* reported a 1984 vacancy study by Real Estate Research Corporation showing a national vacancy rate of 13.5 percent. If the economic recovery that brightened the same period slows down, this could go even higher before demand begins to catch up with supply.

The competition for tenants to occupy these new buildings spawned a fierce leasing battle. Developers began to offer free rent periods and other rent incentives. The search for still other creative ways to enhance the desirability of their office space was most exhaustive in cities with the highest vacancy. One solution given a great deal of attention was the emergence of the shared service building as a means of spotlighting a property.

THE SHARED SERVICE BUILDING

A shared service building is a composite of equipment and services that respond to the individual tenants' needs. In those cases where the provision of equipment or service is measurable, it is possible to charge according to volume of use. This generates a revenue stream beyond the original rent base, which can become income to the owner or be reinvested in additional labor-saving devices for tenant use, further increasing the value and desirability of the building. If one believes the projections, it follows that both the rent rates and the occupancy of such a building will improve with the use of a successful shared-services project. These benefits may outweigh the value of any net revenue from the sale of measured services. For example, if the existence of shared services in a building will allow the owner to lease up the building even a few months sooner, the real advantage may be in avoiding construction period interest costs rather than a long-term secondary revenue stream.

TENANT SERVICES

The composite of equipment and services that compose a shared service building includes such items as low-cost local and long-distance telephone service. Ordinarily, a small business is able to negotiate for quality, labor-saving features on its telephones, or a discounted rate, but not both. In an intelligent building the business can have the benefit of both, since the front end costs of the computerized telephone equipment to provide those features can be amortized over many uses. In the shared service building, a wide variety of services are available. Several are explained here:

Least-Cost Calling

Small businesses can have their calls routed automatically over the least expensive long-distance service available at that moment, allowing them to enjoy lower overall rates than they could negotiate on their own.

Automatic Dialing

Telephone numbers can be dialed at the touch of a button through a feature commonly known as speed dialing. Repetitive dialing patterns can be remembered for the executives who feel like they spend most of their lives dialing the phone.

Automatic Callback Calling

Some telephones will call another telephone back when a conversation is ended and the party becomes available for another phone call.

Managed Service

Tenants will appreciate the advantage of a full-time telecommunications manager at their disposal. A small office often spends an inordinate amount of time choosing and administering its telephone system, since the person who assumes that responsibility is often ill-prepared to do so. It is common for an office manager to spend 60 to 80 hours just learning the language and the technology to appreciate the price and feature differences of a system and making a choice. The advantage of having access to a telecommunications manager who speaks the tenant's language (and not telephones) eliminates up-front learning time investments and contributes to ongoing economies. The telephone needs of the business can be referred to their "telecommunications staff."

Message Center

Additional staff can act as a primary or secondary receptionist to answer calls and take messages. This staff can reside in retail space to accentuate the promotion of the shared services system, or they can office out of low-cost space.

The message center can double as a directory service for names and telephone numbers of persons in the building, saving tenants the expense of reprinting their company directory. Names are easily available, and changes can be incorporated by entering the information into the computer in the ordinary course of business.

Electronic Mail

Electronic mail can be defined as the transfer of messages, letters, and documents from one computer terminal to another without the need for someone on the receiving end to interact with the person sending the information. Electronic mail and similar services greatly improve productivity by eliminating the game of telephone tag and by permitting information to be reviewed and edited at leisure which frees time for other, more productive, projects.

Centralized Word Processing

Centralized word processing combines the computer terminal used for electronic mail and the flexibility of dial dictation to support the typing requirements of building tenants. A typing pool is made available to tenants on a project or ongoing basis. For a one-person office not having the volume of work to employ 100 percent of a receptionist's or secretary's time, the combined services of centralized word processing, dial dictation, and message center eliminate overhead and yet provide that tenant with a professional image to display to clients.

Voice Mail

As an alternative or a supplement to the message center, a shared service system can offer voice mail, sometimes known as voice messaging. This service, which acts as a high tech answering machine, allows callers to leave lengthy, confidential messages or choose to speak to a live receptionist. This service also allows a person to record a message or memo and broadcast it to others who have the voice mailbox feature, which saves typing and dialing time. Conversations can be kept short, improving the productivity of the individuals who use the service.

Dial Dictation

Dial dictation is simply a variation of voice mail. Subscribers can dictate from remote locations using ordinary pay phones or their home telephones. Since time of day is unimportant, the executive who wakes up in the middle of the night with a creative thought can easily produce it in a usable format.

Data Base Access

Companies are beginning to use data base services in increasing volume. These services are available through a computer terminal and a telephone line. They provide such data as research information for attorneys, the latest stock market quotations, and a reference of magazine articles pertinent to a particular subject. Their advantage lies in the time they save a user who needs information but doesn't have time to do the research. Certain data base services can be purchased on a bulk basis and can be resold to tenants at a profit, much the same as long-distance service is resold. The data base service can be used through the same equipment that supports word processing and electronic mail, maximizing the investment in equipment and making the service easier for the tenant to buy, since it can be provided through a usage-sensitive arrangement. Providers of data base services indicate that the usage curve rises substantially as the user becomes familiar with using the service.

Electronic Conferencing

An electronic conference facility provides the tools to conduct a meeting with persons in a distant city as though they were seeing you face to face. The components can include video teleconferencing, high-speed facsimile, an electronic blackboard, and data transmission. The electronic conference facility recreates the environment that each party is working in by allowing them to share the same documents and to see the process of modification or creation of an idea as it occurs.

Video teleconferencing has been in existence for 50 years or more. It has not become widely popular because of the high cost of the equipment to transmit and receive the TV picture and the cost of the telephone lines. AT&T had projected the cost of a video conference room to be in excess of $100,000. The cost to conduct a meeting has been reported to be well over $2,000 per hour. Technology is being offered that requires substantially less initial and ongoing costs, although the quality of the video picture is somewhat less.

Facsimile. Facsimile machines, especially high-quality, high-speed equipment, will transmit a picture of a document over telephone lines and reproduce a high resolution copy of that document at another machine in the distant city in a matter of seconds. This service replaces overnight mail services that require a document to be packaged, scheduled, picked up or dropped off, and then delivered 12 hours later. Facsimile is delivered almost instantaneously and can be done at a fraction of the cost, especially where the transmission consists of one or two documents. An overnight package may cost $11 or $12, whereas the facsimile can be provided at approximately $1 per page, including a profit margin. (Keep in mind that the fixed costs of the machine must be recovered by guaranteeing a minimum number of hours, and the profitability of this service depends upon guaranteeing that minimum volume, plus some.)

Electronic blackboards. A person using an electronic blackboard can draw or write information on an electronically sensitive blackboard that recreates the image on one or more television screens. The televisions are connected to the blackboard over telephone lines and instantaneously reproduce the diagram. This technology is an excellent tool for educational programs, such as those required by architects, and for meeting between engineers and designers to share the creation of form and design.

Direct text editing. To round out the electronic conference facility, the ability to transmit data between personal computers is desirable. This technology is best utilized when comparing and modifying spreadsheets or lengthy documents that have been preprepared and require joint editing and analysis. The computers are connected by telephone lines and can receive or transmit information in a matter of minutes. A final copy can be printed at either location when the modification is complete.

The services in an electronic conference facility can be sold separately, or as a package. Most centers charge a rental fee plus an incremental fee per service used, which considers the location of the distant conference facility.

Developers who own buildings in multiple cities can offer this service more inexpensively to their tenants on a shared service system by designing their networks to include as many usage-insensitive long-distance circuits as possible. The high cost of these circuits requires an extremely high volume of calls to allow enjoyment of the low rates.

Telemarketing Centers

A similar service to the Electronic Conference Facility, a Telemarketing Center, provides a totally equipped facility for conducting a telemarketing program. This center can be reserved by tenants wishing to conduct a telemarketing program, organizations conducting fund-raising activities, or a political candidate's staff whose volunteers are "getting out the vote." The center would be totally equipped with telephones, local or long-distance lines, and call detail equipment that could calculate the average length of a call, number of calls, and costs to analyze the viability of the project.

As each new study reports a higher cost for an average sales call, businesses are searching for more economical sales methods. Telemarketing, when properly designed and implemented, has become a widely accepted supplement, and sometimes an alternative, to traditional selling methods. It provides much of the personalization of face-to-face selling at a fraction of the time and expense. The use of telemarketing is expected to quadruple by 1990. Before any program is fully operational, a test of that program must be conducted. From that test a business will decide whether and in what capacity the program can be implemented. A turnkey telemarketing center that allows a business to run a trial of their new venture with minimal commitment is a service that could gain wide acceptance by both tenants and nontenants of the building.

The services that we've discussed to this point are applications of technology. Some discussion about the various technologies employed to create these revenue-producing services is important. Such a discussion must include the potential use of fiber optics, satellites, microwave, infrared, and other communication transmission media.

HOW NEW TECHNOLOGIES CAN MAKE SERVICES AFFORDABLE

Fiber optics is a term that has become synonomous with *high technology.* It is quite simply an alternative to copper wire. Sheathed in a polyvinyl or teflon coating, the glass or plastic fiber is a fraction of the size of the copper wire it replaces and can cost less per line to install. Transmission is accomplished by flashing laser beams through the fiber strand. An advantage in addition to its small size is the fiber's capability of carrying many conversations over a single fiber compared with the limited number of conversations carried over copper wire. It is capable of transmitting information at incredibly fast speeds and does so without the noise interference that accompanies metal wire. Fiber optic cable, since it is so small, can sometimes be strung in riser conduit that is nearly full, eliminating the need for installing additional conduit. It is a totally secure transmission system, since an attempt to tap the line will break the connection and cause the light wave to "leak out." This safety factor becomes more important as computer thefts continue to increase.

The disadvantage of fiber optic transmission is in the cost of the laser equipment to transmit the information and the equipment that decodes the laser signals. However, the trend in technological developments has been an increase in the technology's performance at a decrease in cost. There is evidence that this trend is occurring with laser technology.

Satellite systems are used as an alternative to traditional wired line carriers. They are most price effective on long-haul transmissions and easily support multiple channels and broadband communications. Satellites are expensive to build and to launch; but once in place they tend to stabilize long-distance calling costs. Being relatively stationary in a position thousands of miles above the earth, they transmit and receive communication through land-based earth stations. Because of the high startup cost, most satellites are funded by large corporations, such as Satellite Business Systems, AT&T, and Western Union. Channel availability is limited and is dedicated to specific subscribers. Major users of satellite systems include specific television broadcasting companies, transmission carriers, and insurance companies.

REVENUE SOURCES

Shared Tenant Services

The concept of revenue-generating shared services equipment is attractive at first, and often at second and third glance. Yet meaningful application requires the developer to clearly define objectives. Often, the initial expectation of the building owner is that large royalties are available in return for granting a shared services organization the opportunity to do business in a building. The amount of such a revenue stream must obviously be determined on a project-by-project basis, but the short-term advantages of requiring diversion of a portion of the revenue streams to the building owner must be evaluated against the long-term strategy for the property. Especially at startup, the net revenues from a shared service system will be minimal to nonexistent. In addition, the telephone system itself will most likely be of a plain vanilla variety, having few enhanced features, although it will compare favorably with alternatives available to the tenants. As tenants become familiar with the system and as their needs expand, more enhanced features can be added and additional fees charged. If royalty payments are mandatory, the purchase of enhanced features may be preempted to enable the payments to be made. This may not be in the best interest of the long-term health of the project.

The tenant-attracting potential of a shared services environment may be much more appealing than the revenue-producing potential of the service for the developer. The competitiveness of the leasing market, as evidenced by high vacancy rates and the variety of amenities offered by competing properties, will have an influence on determining the objective. If local vacancy rates are excessively high, it may be critical that a building be differentiated over others just to reach the minimum projected cash flow. As an incentive to prospective lessors, a developer might decide not to collect revenue tied to the performance of the shared system.

Rooftop Income

Another revenue stream to consider is rooftop exposure for TV, microwave, or satellite equipment. Those buildings with the greatest potential have typically been the highest structures in town, or those on the perimeter and located in the direction of the next microwave station, since the signal from the towers must be transmitted from one microwave tower to another without physical interference. Today, interference is still a consideration, but for some applications it is minimized with the introduction of cellular technology and direct broadcast satellite technology.

Cellular equipment. Cellular technology employs a relay strategy wherein a geographic area is divided into small territories and a signal is transmitted from a tower in one territory to a tower in the next, in order to follow a moving receiver. This effectively frees the air waves in the cell left behind for other users, making it possible for more conversations to occur at simultaneous frequencies in the entire grid of cells. It also calls for additional receiving and transmitting equipment in any city licensed to offer cellular radio technology. Since cellular equipment is generally installed on the tops of buildings, it is in the developer's best interest to see cellular technology promoted and widely accepted to provide another revenue stream for the building.

Direct broadcast satellite. Direct broadcast satellite technology (DBS) operates on the same principle as the pay-TV movie stations. Many residences have a satellite dish to receive signals transmitted via satellite instead of through the cable-TV hookups. Instead of use for entertainment, this same technology can be employed for one-way transmission of educational programs, seminars, and business meetings. The dish on the rooftop receives the signal and carries the signal to users in the building or other subscribers in the city.

Rooftop antennae. The perimeter of the roof has suddenly become a valuable location for antennae space. Cellular and satellite dish equipment sit out in the open and command higher square-footage rents than do office and retail space. In addition, the penthouse space is a prime location for housing the electronic cabinetry that accompanies the outdoor equipment. The penthouse is sectioned off and locked to maintain the security of the electronic equipment.

The taller buildings with direct line of sight to microwave towers are still the most attractive properties to transmission vendors in downtown metropolitan areas and can command the highest rent per square foot for antennae space. Television and radio stations, for example, will pay a premium related to how much additional coverage they can get over their existing site.

Suburban office parks are also becoming attractive to transmission vendors. Since the land is often free from blockage by other buildings, there is less negotiation with neighboring buildings and less chance of causing or encountering interference with other signals.

Uncleared land in some office parks can be used as sites for satellite sending and receiving equipment necessary to create a teleport. This concept is commanding a lot of attention, of late, especially in such densely populated areas as New York City, where the airwaves are jammed with microwave and radio signals. The teleport receives the telephone traffic from densely populated downtown areas via a high-speed fiber optic highway. The ability of access to low-cost, long-distance service from a downtown area unable to keep up with the demand for the service may prevent some businesses from leaving their existing office space. As communications and their associated costs become more crucial, alternatives to existing service, such as those provided by a teleport, become attractive.

The market for antennae space and teleports will vary by geography, demographics, and competition between both transmission vendors and building owners. However, owners of buildings that were not telecommunications oriented in the past will find both a market for additional rental revenue and a demand by the tenants that a building provide access to this technology. It becomes necessary to survey the opportunity in each marketplace in which one is involved to determine an acceptable anticipated revenue rate. Then space can be put out for bid to the most attractive rooftop tenant.

For those who prefer not to market the rooftop and penthouse space on their own, there are companies that provide specialized leasing programs for the rental of roof space for electronic and telecommunication equipment.

SHARED TENANT SERVICES: THE DEVELOPER'S SHARE

If the developer chooses not to provide shared tenant services directly, an obvious additional revenue (or cost) stream is the rent or subsidies charged to a shared services administrator if a third-party administrator is used. Regardless of whether the space is office, retail, or mixed-use space, the rent strategy employed is important to the success of the shared services project. The options range from straight rent, to a percentage of the revenues, to developer investment in the shared services project. Each has advantages and disadvantages and should be considered in light of the overall objective of the developer.

Straight Rent

The straight rent option is generally the highest fixed cost option. A straight rent does not consider the success of an operation (or lack or it) and provides the shared services administrator with a stable forecast of expenses. This arrangement requires no audit of revenues and, therefore, requires the least amount of administrative work for the developer. Omitting the percentage-of-income revenue in favor of straight rent makes an administrator more likely to provide low-margin, high-risk services, such as video conferencing. Tenants find these services attractive. These high-risk services may come sooner in the life of the system if the tenants' additional gross income is not automatically reduced by a set percentage payable to the building owner.

On the other hand, if income generation is the primary motivation, a straight rent limits the amount of income a developer can realize to the rent only. In addition, if shared services is unsuccessful in the building, it can result in turnover of the administrator. This is especially true if the rent or fee becomes a significant percentage of the total net revenues, which puts undue strain on the administrator.

Straight Rent plus Percentage

A second option, use of a moderate rent amount combined with a small, minimum percentage of the revenues allows a stable rent base for the developer and still capitalizes on a successful business venture if the shared services operation does exceptionally well. This arrangement should be worded to provide an environment in which the shared services operation could still operate in the event of an unstable period. A strategy to encourage provision of high-risk but desirable services might be to rebate the revenue percentage as a subsidy for the operation as a way of assuring financial health and to retain an option for sharing in potentially high profits.

Conversely, any percentage rent requires the owner to audit the tenants' revenue streams to ensure compliance with the rental schedule. This auditing creates overhead for the developer and reduces income. Most important, the developer must recognize that the use of a percentage of revenue formula, no matter how moderate, will detract from the operator's desire to provide desirable low-margin enhancements to the system. A third-party shared services administrator is more likely to provide high-risk, low-margin services that require a royalty to the developer, only after the fixed expenses are recovered and the risk is carefully calculated to give the desired return. If the administrator is not required to pay a royalty on the revenues, profits can be reinvested into services that tenants may find extremely attractive—an added incentive to choose the property that provides them.

Percentage of Revenues

A third option is to charge no fixed rent to the administrator but rather to charge a percentage of all revenues. This is the most aggressive income generator for the building and meshes well with a developer whose primary objective is to generate as much revenue from the building as possible rather than to concentrate on providing the greatest variety of shared services features.

The argument against such an arrangement is that it further depresses the desire to provide low-margin, high-risk system features that tenants may require unless a subsidy by the developer is present. This option also requires the most administrative overhead for the building, since the business must be audited closely to provide an accurate rent stream.

Franchise Charge

Option four adds a franchise charge per month in addition to the straight-rent option. This is a way to generate additional income to the property that recognizes the fair market rent of the space is different from the business opportunity of shared services.

The disadvantage is that, since a franchise fee is not rent, it will not be given the same weight in the income valuation for that property. This option also limits the provision of low-margin services, since it is another expense that an administrator must cover in the operation of the business—although it avoids the very negative penalty that occurs when a percentage charge exceeds a thin margin for the shared service provider.

Joint Venture

The final option is for the developer to actually invest in the shared services endeavor for his or her building, either through capitalization or regular subsidy. This option would be chosen by a developer only when the services are necessary to achieve the desired rent but either the risk is too great or the margin too low to attract outside investment. Experience in the market will permit the developer to assess how important shared services is for future of the building.

The subsidy option puts the developer in a different line of business. If tenants become aware of the developer's intimate involvement in the intelligent systems for their building, they may choose to hold the developer responsible for any perceived problems, and this could adversely affect the primary revenue for the building, the rent stream. Problems could range from disatisfaction with performance of a system to disatisfaction with the administrator. Should the administrator be unable to run the business capability and be removed from the property, the developer might have to provide an unprofitable service to placate tenants.

OTHER CONSIDERATIONS FOR DEVELOPERS

It is crucial to the success of any shared services venture that the developer decide the primary objective for the building before choosing a rent strategy. If that objective is to attract tenants as quickly as possible, a rent subsidy during the leaseup period might be most desirable. For example, a developer who wishes to attract tenants in one building who will interact with tenants in another building in a distant city may decide to subsidize long-distance lines to that city to permit low rates to the tenants. That incentive might be enough to sign a prospective tenant.

On the other hand, the developer must always recognize that the productivity-improving services of a fully configured intelligent building may justify higher rent for a property. Increased rents of $1 to $1.50 per square foot have been estimated by some shared services providers. In some cases, these providers will wish to participate in the increase in value through imputed equity if a percentage rent or fee is charged to recover their cash invested in the building. The crucial question is whether income from rent is more desirable than income from business operations. What criteria will present the building in the most favorable light? The circumstances seem to argue for the minimum amount of rent charged to a shared services provider to allow for the maximum amount of shared services features in most cases. This can only positively affect the balance of rental space by increasing the overall rent base and positively impacting the income evaluation for a particular property.

CABLE AND WIRING MANAGEMENT

Prior to 1984 ownership of building cable was not an issue of much concern for a building developer. For the most part, the local telephone company would forecast the requirements of a new buildings vertical riser cable and would install it in the building at no initial cost to the building or tenant. Granted, the telephone company might not have been responsible for the hookup of all telephone equipment if the tenant chose an alternative equipment vendor, but it represented the most stable provider of cable within a building, particularly with regard to the riser system. Since the beginning of 1984, however, the fate of the riser cable within a building has become unclear. With the breakup of AT&T and the Bell Operating Companies, it has become necessary to determine where AT&T's responsibility for the equipment begins and where the BOC's responsibility for the tenant receiving access to the network ends. This end point is called the demarcation point.

Responsibility for Installing and Maintaining Cable and Wire

To date, there is no single location of the demarcation point. In some instances it is the point at which the cable enters the building; in others it is the wire closet on the floor of the building in which the tenant resides. In still others, it is argued that the demarcation point should be within the leased space of the tenant. A number of factors complicate this problem, including the variety of building types and the differences among state public utility commissions. Some buildings house one tenant, and others provide space to a number of firms. Some people argue for and some against tenants having control over their cable and access to other tenants' cable, but the Federal Communications Commission (FCC) seems to believe that the building owner will ultimately be responsible for the ownership of the wire in a particular building.

For the most part, building developers are unaware of the responsibility they are being given, or at least unaware of the consequences of not having a strategy for assuming that responsibility. Telephone wiring can be considered the central nervous system of a building. Tenants rely upon it for their contact with the outside world, and often for their very business survival. Without proper supervision and the adherence to a stringent quality control standard, it is possible that they will, through no fault of their own, have their business jeopardized. Most telephone equipment vendors are paid by the job, and not by the hour, to install telecommunications equipment. In addition, since the installer may never see that system again, there is no real incentive to perform the work with artistic care. When the telephone company was the only game in town, the rates may have been high and the options minimal, but it was to the advantage of the installation personnel to install the wiring and the equipment properly, since they almost always had to live with the quality of their work.

Today, the danger to the tenant, and to the unwitting building owner, is that an overzealous telephone installer on a tight time schedule may deliberately or inadvertently damage or disconnect one tenant's telephone wires while working on another tenant's telephone system. If the wire system has suffered years of neglect, it will be time-consuming, if not virtually impossible, to reconnect the out-of-service tenant, simply because the wires will be lost. (The terms that graphically depict the condition of these wire closets include *spaghetti* and *wasp's nest.*)

Clearly, neglected wiring is potentially dangerous for all involved, and some strategy should be formulated for correcting it in any building, especially a building for which a shared service system is anticipated. The strategy should include development of standards and a policy that demands strict adherence to those standards.

New Buildings

For new buildings it is advisable for a developer to invest an average of $10 a square foot to purchase and install a comprehensive vertical riser and signal wire system. The cost of the riser system can be incorporated into the overall capitalization cost of the building. Access to the riser system should be controlled (and perhaps limited to one source), and accurate records of the design and assignment of cable pairs should be kept. These records and the quality of the riser system can have a positive impact on the value of the building at the time of resale. The cost of such quality control has been estimated at 2 cents per square foot per month.

From the riser system, the maintenance of the horizontal, or station cable should be considered. Most cities require telephone installations to adhere to electrical and fire codes that either limit use of cable to fire retardant types or at least require cable to be enclosed in conduit when used in air-return ceilings. However, there are few other quality control restrictions that telephone installers must adhere to other than their own pride in their work. The zeal with which installers approach the time limits on their tasks is reflected not only in the quality of the work provided, but also in the condition of the ceiling tiles in the tenant's space. Tiles are often chipped and stained from the dirt and oil on an installer's hands: if the age of the tiles has resulted in discoloration, it becomes virtually impossible to match the tiles. The entire ceiling will have to be replaced, or it will look like a checkerboard.

Lease Provisions

The Building Owners and Managers Association International anticipated the need for some method of quality control for telephone cable in its member's buildings. Their position was that a lease should provide for compensation for items not normally covered under a general lease: The expense for maintaining these items should be considered operating costs, not a capitalization cost, and should be recovered through a rent escalation clause. "All expenses paid or incurred by Landlord for maintaining, operating, and repairing the building, land, and the personal property used in conjunction therewith, including but not limited to all expenses paid or incurred by landlord for electricity, water, . . . telephone charges not chargeable to tenants and similar utilities services . . ." would be considered an expense of maintaining, operating, or repairing the Building.

Shared Tenant Wiring

The shared services building presents a unique cabling situation. It treats a very large building as though it has one tenant: Cable must then be run to a central point rather than distributed throughout the building. An accurate description of the riser system and the allocation or cable pairs must be developed to provide the shared system. In the case of a new building, the developer is in a position to plan for the likelihood of such a system by requesting that the riser be designed to support the extra cable needed. Even if the decision has not been made about whether or not to provide a shared system for the building, it behooves the developer to make this provision for the future, since records can be kept, and the cable can be installed as a system. It is expensive to go back to a riser system that has been neglected and inventory the thousands of cable pairs, test each one for dial tone and quality, and diagram the location of those cables.

Retrofitting Cable Systems

In fact, in the case of an existing building that will be retrofit to accommodate shared services, it is advisable that a duplication of wire be included to avoid the heavy expense associated with the inventorying process. Duplication is often necessary in such instances because the existing wire may be owned by the utility. As a rule of thumb, no wire more than 25 years old should be depended on because of the likely deterioration of insulation. When insulation starts to deteriorate, the ability of the wire to carry a "clean" signal can be affected. With the frequent and unpredictable use of data modems that read high-quality transmissions and the variable quality of entering long-distance signals, such wiring can require repairs and attention.

■ SUMMARY ■

In summary, the intelligent building and the new environment created with the breakup of the Bell System pose some new revenue opportunities for the building developer who is prepared to meet the challenge, and some consequences for the developer who is not prepared. Revenue opportunities exist in rents for shared services facilities, perhaps in the royalties to be found in shared services revenues, and in newly found revenue from rooftop space that is becoming attractive as technology advances and requires more direct satellite links or cellular systems.

The responsibility for the wire in each building will rest more and more on the building owner. Management of that cable is crucial to the quality of service and security of tenants in a developer's building and should be protected by taking control of the quality assurance of the riser and horizontal cabling for the building. The cost for the riser cable can be incorporated into the capitalization schedule, and the cost of maintaining the horizontal cabling can be recovered through a rent-escalation clause and passed onto the tenants.

The result of a proactive program to implement the shared service building concept in the appropriate property can positively affect profitability of a building under lease up by attracting tenants more quickly in a competitive leasing environment or attracting the best tenants in a good market. Ultimately, shared services can provide an attractive revenue stream to the property in one or both of two ways: (1) increasing the rent tenants are willing to pay to come to the building or (2) providing rent and/or fees from the shared services provider. The mix of such strategies will vary with the leasing market and the developer's objectives.

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High Tech Real Estate Dow Jones-Irwin 1985
A. Sugarman, A. Lipman, R. Cushman

Chapter 4

Profile of a Shared Tenant Services Project

Bill W. Hooton
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Outline

With the emergence of shared tenant services (STS), American business moves closer to Marshall McLuhan's concept of the world as an electronically interconnected global village. As administrative and other management and control functions are decentralized to avoid the congestion and high operating costs of urban environments, STS allows the economies of scale achieved through the high tech building concept to be applied to the often more diverse mix of tenant requirements found in office parks and similar campuslike environments. At the same time, it allows the communications sophistication and flexibility valued in high-density urban settings. Properly applied, it offers client and tenants the best of both the urban and suburban worlds—something the commercial real estate developer must consider to attract and retain quality tenants.

STS, briefly defined, is the concept of offering to not only large but small- to medium-size clients in operating a diverse, high-rise, or campuslike environment the ability to select from a variety of sophisticated telecommunications services that they would not otherwise be able to afford. Through STS the developer can offer, as part of the tenant package, the capabilities of an integrated digital voice and data switching system and thereby provide all tenants, regardless of size, state-of-the-art voice and data service.

BACKGROUND

Before examining the benefits of STS and what it takes to put an STS environment together, it is useful to understand its origins. There are two primary reasons for the birth of this business: the breakup of AT&T and the acceleration in the development and application of new technology. From the FCC's *Carterfone* decision in 1968 through the 1982 settling by the Department of Justice of an antitrust suit filed against AT&T in 1974, the prevailing belief has been that market forces rather than the organizational power of a single-source supplier would offer the greatest benefit to the customer. The manifestation of this concept is currently displayed in the "new" AT&T and the seven Bell operating companies.

Concurrent with this market-oriented attitude, the rapid acceleration in the development and application of new technology has provided greater access to information, more cost-effective information management tools and, more important, the synthesis of voice and data communications. This synthesis allows the realization of greater economic value in information management than was heretofore possible. STS is a logical extension of these two factors.

BENEFITS FOR TENANTS AND OWNERS

The benefits that a tenant should expect from STS are:

Lower costs for long-distance transmission of voice and data.

Access to value-added services, such as voice messaging, shared data and word processing, and specialized cost accounting reports.

Capability of on-site maintenance and repair.

Meeting of primary growth requirements by software modification rather than major hardware addition.

Elimination of modems and other costly peripheral gear for the intraorganizational transfer of information if third-generation equipment is used.

For the owner or manager, there are several benefits. These fall generally into two categories: property enhancement and revenue production.

Enhancement. The market in general is demanding greater access to sophisticated telecommunications. Those developers who offer access to such systems, all other things remaining equal, will increase their potential for attracting clients.

Revenue production. Revenue that was once diverted to AT&T can now be realized by the owner in four specific areas: long-distance service, equipment rental, installation, and moves/adds/changes. Additional revenue streams can be generated by offering value-added services. These include, but are not limited to, the following:

Format/protocol conversion capability. Switching systems providing protocol conversion allow dissimilar devices to share and exchange information, resulting in significant cost savings and flexibility. Because technology is changing rapidly in this area, a system is obviously more viable—and cost effective—if it does not make previous equipment obsolete. Beyond allowing future modifications, an advanced switching system with protocol conversion consistent with existing peripheral equipment can enhance the value of existing equipment by offering the ability to access multifunctional features.

Full-support teleconferencing. Services include full-motion video, fixed-frame video, voice conferencing, and electronic mail conferencing. These services are specifically designed to get information to sources in a timely manner, thus reducing the necessity for face-to-face meetings, travel, and associated costs.

Store and forward voice messaging. This service offers users access to recorded telephone messages, thus alleviating time lapses in contacting parties. Messages can be directed to all interested parties or directed to specific parties determined on a priority basis.

Centralized word processing. Significant cost reduction can be realized through economies of scale by centralizing word processing tasks for similar businesses. Current technology provides for the transmission and receipt of text and voice to a central point for processing or editing, after which it is electronically retransmitted to the user.

Offsite resale. The density of business-oriented call volume, which is peripheral to many developments, provides the opportunity for networking from the central PBX to additional offsite facilities. As such, significant economies of scale and additional revenue streams can be realized from the initial fixed-capital investment.

PLANNING THE STS ENVIRONMENT

In analyzing the decision-making process and the results to be expected from STS in a commercial real estate development, it is important to understand that each development must be examined on a case-by-case basis prior to implementation. Because this business is in its infancy, there are few de facto standards that can be used for across-the-board decision making.

The first step in planning the STS environment is to define the needs of the user population. Developers should consider STS when refining their awareness of the types of businesses or clients a development will attract. From a thorough analysis of this customer base, the specific mix of services required can be projected. These services will generally fall into two categories:

Baseline services. These include voice/data communications, long-distance discounts, and some type of customized cost accounting reports.

Specialized value-added services. These include baseline services plus the addition of such features as video conferencing, voice messaging, centralized word processing, text messaging, and customized data base access.

Whether or not an outside firm is retained to design, install, and operate an STS system, the developer should expect to play a proactive role in at least the planning stage of the project. Because of the developer's experience and understanding of the tenant, he/she is invaluable in defining needs and objectives.

STS Design Considerations

An STS system is composed of a central switch, peripheral gear (such as telephones and data terminals), and the interconnecting medium (the cabling network). These basic elements are described below:

The central switch. At the heart of the system is the switch. It should have the following characteristics:

Nonblocking system architecture. Switches must be nonblocking in order to best handle data traffic. A nonblocking system is defined as one that neither inhibits nor blocks a user from reaching an idle access port, regardless of the volume of traffic. If the "architecture" (the structure) of the system were blocking, response time degradation (i.e., slower service) would occur during high-traffic periods, and some data applications would not be possible.

Digital technology. Any system that will interconnect data communications devices must be completely digital in design to capitalize on cost-reducing technology, low error rates, and effective coding methods. So-called third-generation systems eliminate modems and other interface devices by digitalizing voice signals at the telephone instrument.

High-speed data and local area network capability. Although volumes of information are currently being written on the subject of local area networks (LANs), suffice it to say that a LAN is a system capable of linking diverse equipment—such as computers, terminals, and printers—so that they can exchange voice and data information. In order to capitalize on the benefits of new technologies, a switch must not merely interface with a LAN, it must be an integral part of the network. A LAN that has a switch as its center of control is said to be of star design.

Modular design. Third-generation systems are increasingly designed in modular format. This design facilitates the addition of lines and stations without requiring major central switch reconfiguration and the resulting downtime. This design also provides for cost-effective, flexible growth.

Provision of standard interfaces. System specifications should be designed to handle all standard transmission speeds. In the future, interfaces to specialized public-packed data networks will become increasingly important. In summary, because the central switch is the nucleus of the system, a great deal of care must be used in choosing the best switch for a specific environment. Another important device applicable to the system is obviously the telephone instrument. Currently, these instruments offer an extensive array of features, including abbreviated dialing, message waiting, conferencing, busy recall, and last number redial. In the not-too-distant future, the instrument will evolve into a full-service computerphone capable of handling operations that conventional personal computers and word processors do today.

The interconnect medium. The interconnect medium or cable is another important part of the system. Currently, there are three specific categories:

Twisted pair wiring. This is the typical interconnection between telephone instruments and the switch. The number of pairs of wire for each instrument will vary from one pair per instrument to one pair per push button on the specific set. Depending upon the requirements per instrument, the space required for twisted pair cabling may become a limiting factor.

Currently, there are PBX systems on the market that provide for the integration of voice and data over existing twisted pair lines, assuming appropriate technical specifications are met.

Coaxial cable. This type of cable is used to connect distributed switching modules to the switch and is comprised of a layer of insulation sandwiched between two specific conducting mediums. It is an excellent medium when significant volumes of data are to be transmitted or video conferencing is required.

Fiber optic. As in the case of coaxial cable, this medium is used to connect systems modules. Composed of glass fibers, it transmits information via light rather than electricity. Fiber optic use incorporates the following benefits:

Broad bandwidth capacity allows handling of high-speed data transfer.

Electromagnetic interference is eliminated.

Security of information is increased because it is extremely difficult to tap fiber without disrupting the quality of the transmission.

Carrying capacity of fiber per unit diameter of conduit is much greater than that of coaxial cable.

Whatever equipment and interconnect mediums are chosen, it is imperative that the future growth needs and additional services required to maintain viability be taken into consideration during the planning process. This consideration may manifest itself in the allocation of additional wiring for temperature control, security systems, or similar functions during the initial development. Consideration should be given to the design of wireways, wiring closets, and central communications plant facilities.

THE STS MANAGER

For most developers, a management group specializing in the design, installation, operation, and maintenance of an STS environment will be required. An STS management firm should be able to assist the developer in at least the following five areas:

Marketing. Because the customer establishes STS priorities, adequate pricing, innovative services, and clear definition of the eventual users of the system are mandatory. During the initial and ongoing phases of the operation, it is necessary that the STS manager and the developer work hand in hand. The developer can offer a unique understanding of the needs of the tenant, and the STS manager can price and offer services to fulfill those needs.

Technical administration. Network optimization involves administration of circuit cards, trunking systems, lines, and all the other peripheral equipment necessary to make system operation cost effective. The current economic environment is characterized by volatile rate structures and a surge of new services. Consequently, proper network optimization is mandatory for the success of the operation.

Accounts administration. The implementation of an STS system requires the administration of accurate, detailed billing on a per-customer or office basis. Invoicing must detail a number of services or options, including equipment rental, long-distance service, moves/adds/changes, and specialized reports. The actual processing of the billing is software controlled, and it is recommended that the actual delivery of the billing accompany the developer's invoice for space rental on a monthly basis.

Moves/adds/changes. The STS manager must handle the planning, scheduling, and actual movement of telephone instruments. A current guideline is that approximately 40 percent of phones installed will be moved once a year.

Installation. The STS manager must administer the installation of the central switch, cabling plant and network (if necessary), and telephone gear.

HOW IT WORKS: A TYPICAL PROJECT

Because of the variety of situations encountered, a profile of an actual project is perhaps the best way to detail the development and operation of an STS environment. The project described below is fairly typical of STS parameters in a campuslike environment. It is currently composed of four existing multi-tenant office buildings in a dense metropolitan area. These baseline assumptions are used for determining projections.

Two hundred square feet will be needed per telephone.

Eighty percent of telephone instruments are multiline.

Most existing cabling is usable as is.

Eighty percent of occupied space will be connected to the STS system.

Third-generation equipment capable of integrating both voice and data will be used.

Telephone instruments or stations in operation and capture square footages are projected to be as follows:

	1985	*1986*	*1987*	*1988*	*1989*
Stations	2,600	3,300	4,400	4,800	5,700
Square footage	520,000	660,000	880,000	960,000	1,140,000

Tenant Services

These basic services will be provided to tenants:

Full-feature voice communications.

Full-feature data communications.

Discount long distance.

Call accounting and management reports (cost and usage).

On-site maintenance and support.

Standard voice-only communications will be offered via a standard instrument, and combined voice/data capability will be handled through a multiline, integrated instrument.

These are some integrated station features:

Abbreviated dialing. Provides for a shortened dialing sequence for frequently called numbers.

Account coding. Provides for specialized entry into the system.

Authorization coding. Capability for restricting or controlling outside toll calling.

Automatic dialing. Provides for dialing a predetermined number by pressing a single button.

Conferencing. Provides for up to five-party conferencing.

Message waiting. Provides option for calling line to inform the called party to call back. At least seven messages can be left at one time.

Asynchronous and synchronous data communications. These can be supported via industry standard interconnect (RS–232C interface). Asynchronous communications can be supported up to a speed of 19.2 Kbps, and synchronous communicating can be supported up to a speed of 57.6 Kbps.

Modem pooling. This will be required for external data calls but is not necessary for transfer within the facility.

Tenants will be able to access discounted long-distance service by entering a single access number. Account codes, if necessary, will be provided by the STS operator. The tenant will also have the ability to access standard telephone company long-distance service.

Reports

The STS manager will be able to provide the tenant with a number of cost accounting reports. These reports will detail time of origination of call, user or individual account code, class of service, call duration, percent savings from local telephone company rates, and so on. This type of reporting facilitates the management of communications as a performance center rather than as just another budgetary item.

An integral part of the overall service concept will be the provision for on-site maintenance. A customer's call for support will be handled in minutes or hours rather than in days. Moves, adds, and changes will be supported and administered in a timely manner. For additional support, the third-generation system chosen for the project has several redundant components and an uninterruptable power supply.

STS Manager Functions

The developer/manager of the project has determined that an STS manager will be required to install, operate, and maintain the system needed to pursue shared services. The functions of the STS manager will be the following:

Support, in conjunction with the developer, the marketing effort required.

Administer the design, procurement, and installation of the desired STS system.

Administer the business-management tasks required (accounts receivable/payable, collections, etc.).

Administer moves/adds/changes and installation/maintenance of equipment.

Provide for user support and training.

Revenue

Tenants will be billed on a monthly basis. Each customer will receive one bill detailing equipment rental, installation, and moves/adds/changes (if applicable) as well as administration of the system. Projections for these revenue sources are shown in Table 4–1. The cost of the system is projected

TABLE 4–1

	Revenue				
	1985	*1986*	*1987*	*1988*	*1989*
Equipment	$1,017,000	$1,380,600	$1,744,200	$2,034,740	$2,317,780
Installation and moves/adds/changes	422,922	404,980	507,590	545,000	563,150
Long distance	2,998,800	4,069,800	5,140,800	5,997,600	6,854,400
Total	$4,438,722	$5,855,380	$7,392,590	$8,577,340	$9,735,330

TABLE 4–2

	Costs				
	1985	*1986*	*1987*	*1988*	*1989*
Network	$1,663,121	$2,580,000	$3,335,000	$4,197,460	$4,910,762
Five-year lease/ Equipment	1,588,000	1,588,000	1,588,000	1,588,000	1,588,000
Administration	796,000	919,169	1,069,962	1,246,280	1,344,568
Total	$4,047,121	$5,087,169	$5,992,962	$7,031,740	$7,843,330

TABLE 4–3

	Income before Tax				
	1985	*1986*	*1987*	*1988*	*1989*
Before-tax income	$391,601	$768,211	$1,399,628	$1,545,600	$1,892,000
Square footage	520,000	660,000	880,000	960,000	1,140,000
Income per square foot	$ .75	$ 1.16	$ 1.59	$ 1.61	$ 1.66

as shown in Table 4–2. Income before tax and related to capture square footage is projected to be as shown in Table 4–3.

It is important to understand that each project is different. Costs and revenue are highly variable, depending upon the specific environment and the services offered. The example above provides an outline of the methodology used to develop a specific STS project, but parameters for other projects may be quite different.

■ SUMMARY ■

In summary, the effective management of STS in large, multiuse, single-building, or campus-style environments can provide a number of benefits to both owner and tenant. Lower costs to tenants can be obtained by less expensive long-distance communcation, increased communications capability via the integration of voice and data communications, improved reporting capability via specialized call accounting reports, and improved reliability provided by on-site maintenance. By providing these enhancements, the owner/manager of a complex can increase returns on the property and, at present, can capture a competitive edge in the marketplace.

The STS concept will become even more important as American business diversifies and decentralizes. Businesses will choose less expensive and more flexible, pleasant suburban locations rather than crowded, expensive urban situations. Through STS, the benefits once thought to be obtainable only in major cities can be economically provided for office parks, high-rise buildings, and other multiuse, campuslike settings. Because circumstances—in demographics as well as in technology—are changing so rapidly in this exciting field, it is important for owner/managers to select an STS management firm at least as carefully as they choose architects or contractors.

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Mr. Hooton has more than 20 years of telecommunications and data processing experience and is presently serving Morrison-Knudsen as vice president and general manager of the company's wholly owned subsidiary, Morrison-Knudsen Technologies, Inc. Mr. Hooton's career also includes experience in such positions as corporate communications manager for Morrison-Knudsen, MIS manufacturing manager for the National Semiconductor Company, MIS marketing manager for Boise Cascade Corp., and computer operations manager for National Gypsum Co.

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Chapter 5

Economic and Technological Trends of High Tech Buildings

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Outline

INTRODUCTION

Why has the high tech building become a topic so often discussed by developers, tenants, and those involved in telecommunications? In almost every real estate or telecommunications publication, a tremendous amount of commentary can be found on the impact of high tech services on the real estate market. This predominant concern has only surfaced over the past two or three years, but many people say the shared services concept is here to stay and can benefit developer and tenants simultaneously.

This chapter will address some of the major concerns for those involved in the high tech real estate field. We will then discuss some of the major trends in the industry and some of the opportunities implicit in these trends. In our following chapter, we will focus in detail on the future of the telecommunications industry and how predicted changes will affect high tech real estate.

Developer Concerns

Many developers have asked: "Why should I risk my $100–200 million (and above) building complex on an investment in a very uncertain industry that is only worth $1 million to $2 million?" Developers are justifiably cautious when deciding whether or not high tech services fit in with the overall scheme of the design, construction, and finish of a building. After all, the overwhelming majority of developers and contractors in the real estate industry have operated successfully in the past simply by packaging the most economically beneficial deal for their clients. For the developer pondering whether or not to wire the building for high tech services, there seems to be some validity in these statements.

Tenant Concerns

The tenant also has reason to question some of the proposed arrangements. For example, a tenant could express some concern that putting the telecommunications needs of the company in the hands of a real estate developer who may have minimal experience in this area could be a very risky venture.

Of course, high tech shared services are only extentions of a history of developers and tenants in the shared services business. If *shared services* is defined as the offering of products and services within a building or building complex to tenants or groups of tenants who could not procure these same services at the same low prices, surely there are numerous examples of how shared services are successfully being used today.

For example, just 20 to 30 years ago, single-room air conditioners were used by individual tenants. Today, all tenants benefit greatly from centralized air conditioning and other centrally supplied services. In many cases, these services are not only supplied by the developer but are billed by the developer or building manager as well. Technological advances in environmental control provided opportunities for centralized service, and the mutual benefits to both developers and tenants provided the necessary marketing impetus.

So too has technology provided significant marketing opportunities for the real estate developer and marked advantages for tenants. Before the advent of high-capacity local area networks, simultaneous voice and data PBXs, and multipurpose terminals, the possiblity of a developer offering high tech services seemed remote. However, in 10 or 15 years, these types of offerings will be as commonplace as is air conditioning today. Our next chapter will discuss in detail the future telecommunications offerings and changes.

Rapidly changing technological areas present numerous opportunities for enhanced service capability. Those developers who fail to seize upon this shift in the way that they offer services will have a difficult time operating successfully in the Information Age.

For example, developers must strongly consider installing and controlling the telecommunications wiring plans of their buildings so as to control this most critical area of high tech services. Unfortunately, many developers are not even considering such steps and approach the concept of high tech real estate as if it were a move toward some irreparable harm to their organization. For those who take this head-in-the-sand approach, a rude awakening is awaiting them in the very near future. This should be true regardless of the level of high tech services the developer wishes to offer. There is then a second major trend, beyond technology, causing developers to look at high tech real estate as a major concern.

DEREGULATION

Deregulation—the word conjures up for some people images of a free and fair market and for other people it means increased prices. Deregulation in the telecommunications industry is here to stay and will represent enormous opportunities to developers in the next decade. However, with added opportunity comes a new set of decisions to be made. Those developers who do not deal with the new challenges will be left behind.

A major area of opportunity is coordinating the work of an extraordinary number of telecommunications vendors to bring a dial tone to the tenant. To the tenant this task, which was fairly simple prior to divestiture, represents an enormous burden—to the developer an enormous opportunity. Offering to remove the many obstacles to quality service that have resulted from the AT&T breakup can represent a significant competitive advantage over those developers who do not make the offer. In addition, through careful planning and identification of the tenants' needs, the developer can offer a value-added service that tenants might not be able to obtain for themselves due to the fractured approach that telecommunications vendors must take. Since there is no single source for all telecommunications needs, most tenants will welcome such a single source for their needs.

COMPETITIVE TRENDS

Many people involved in shared services believe the developer must approach high tech real estate with one objective in mind—occupancy. High tech real estate is a competitive offering if marketed correctly.

The developer must realize that marketing is at times extremely difficult. For example, in a tight real estate market, high tech services will probably not provide the incremental advantages necessary to attract tenants. However, in a soft market, the lack of these services could prove extremely detrimental to a developer. High tech real estate must be looked upon as simply another service that can be provided by developers to attract tenants, much like centralized air conditioning or centralized power supplies. It will become critical for developers to know how their tenants can best be served and what products or services these tenants view as critical.

A developer must have a keen awareness of the type of tenant mix in the development. For instance, if the floors are planned for a small number of square feet per floor (say, 10,000 or less), chances are there will be more tenants of the smaller size than if the floors were much larger. These smaller tenants seem to be prime candidates for high tech services. The majority of them cannot afford to purchase the added services and reliability, on their own, that the developer can offer. Such smaller professional organizations are expected to become prevalent in the next decade. This cottage-industry trend provides an excellent match for the services the developer can offer and the needs of these businesses.

Most professional companies today are geared toward providing services for the general public and must have access to huge amounts of information in a fairly short time. Many smaller organizations cannot afford the capital required to design, purchase, and maintain large information systems. This is precisely where the developer can fill a void and prosper. The developer can offer not only prime leasing space, but also the expertise these tenants need. Such an overall approach to tenants' problems provides the developer with an incremental service advantage that the tenant may not find elsewhere. It may take some time for such a working relationship to develop, but if this cooperation occurs, the tenant will probably remain with the developer. By identifying tenant needs and removing the problems associated with multiple vendors, the developer can offer a single source for all telecommunications needs. Such an accomplishment will not be simple for most developers. As economic and technological trends change throughout the next decade, significant amounts of resources will be required of developers and their organizations to keep up with the changes.

ORGANIZATIONAL TRENDS

However, not every developer should immediately begin hiring former telephone company personnel in order to successfully offer high tech real estate services. In fact, in many cases it will prove more cost efficient for the developer to approach this area with the idea of utilizing a third party or a joint-venture arrangement with a management or administrative organization. For the developer who does not understand telecommunications, the optimum arrangement would be to utilize outside services. However, these decisions must be made by the developer after analyzing all the advantages and disadvantages of such an approach.

A major economic factor affecting such a decision would be the approach the developer takes toward selling properties. Developers take advantages of depreciation and other tax incentives, then sell their properties after these economic incentives have been exhausted—usually after the building has been occupied for five to seven years. Implementation of a nationwide network utilizing the developer's properties as long-distance network hubs could have impact on this economic decision. For example, if a building were sold to another developer who did not want to utilize the property as a network hub, there could be significant problems for the original developer's network. Consideration of these financial possibilities must be included in the overall business decision by the developer for high tech real estate services.

From a tenant's view, similar study and consideration of these types of economic possibilities as well as technical trends are critical. A tenant who will rely on a telephone system supplied by a developer or a third party looks for adequate reliability and security safeguards in the system.

TECHNOLOGICAL TRENDS

Redundancy

One of the major trends of many systems today is that the system can be technically designed for redundancy so that only a minimum number of extensions will be inoperational should a catastrophe occur. Tenants should work with the developer, or those responsible for the telephone system, to design a system so that minimal disruption occurs after such an event. Only a few years ago many systems did not maintain a high level of redundancy.

Security

A second technical design criterion critical to both the developer and tenant is the overall security of the system. The trend in this area is, without a doubt, toward an ever-increasing need for secure transmission for both voice and data. Putting all the eggs into one basket raises serious questions concerning the overall confidence in the security of the systems. One major technological development that could reduce this concern is fiber optic technology. A major advantage of fiber optics is increased capacity, but an added feature is its resistance to tapping by unauthorized personnel. A copper-based or coaxial wiring plan causes more concern for transmission security than does fiber optic.

Wiring

In the area of wiring, there is one concern which has surfaced and will continue to cause problems for developers and tenants alike. This concern is the scarcity of expertise and experience for wiring the building complex, and thereafter maintaining the wiring. There are numerous alternatives; however, there probably are a few simple guidelines which should be followed when approaching this area.

The Earlier the Better

One rule—the earlier the better—applies to just about all high tech real estate developments. Questions of wiring and supplying services to tenants need to be addressed as early as possible. This approach provides two major advantages: (1) flexibility to meet the changing technological needs of prospective tenants and (2) significant opportunities for reduced costs. Wiring before the building is closed up and finished saves enormous amounts of installation time.

Conduit Space Should Be Planned

Developers should plan for both initial needs and for future growth and change in the system. That either initial or future needs should be planned for is surprisingly not evident to many developers. For example, although fiber optics offers tremendous opportunities over twisted pair technology, in many cases these capabilities simply do not match tenants' needs. In this case, the developer should remain flexible so that future changes in tenants' needs can be met with expanded services to meet these requirements.

Do as Much as Possible

A major result of AT&T divestiture has been the continual finger pointing among the various telecommunications service vendors—most evident in the area of wiring. State regulatory agencies seem to have adopted 50 different rules for dealing with the question of internal wiring. It would prove to the developer's advantage to take control of this situation and provide one-stop service to tenants for all their wiring needs. Such service would benefit tenants and should allow the developer to avoid confrontations between vendors in the building.

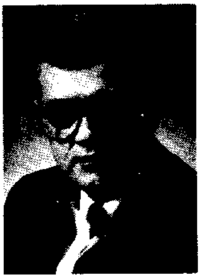
CONCLUSION

In the final analysis, the major economic and technological trends of high tech buildings are those that will be initiated, developed, and maintained by the marketplace. This, in and of itself, is a major change in the structure and development of the industry. Only a decade or so ago, many would have scoffed at the idea that a regulated industry controlled by an enormous corporation would be moved by marketplace demands. But surely this has happened and this pace of change is increasing rapidly.

Developers, tenants, vendors, and others can certainly gain from the overall outlook for high tech real estate. But success will not happen overnight. There will be failures as there are when any opportunity is as wide open as in this industry. That, however, should not deter those interested in pursuing high tech real estate as a business venture. At this time, all indications point toward tremendous opportunities for providing high-quality, reliable services at low prices. In addition, as more and more people seek to provide high tech services, their collective knowledge and experience should raise the quality of service to tenants. Although implementation means serious monetary risks for all parties involved, the economic and technological trends seem to indicate that there will be many, many more winners than losers in high tech services throughout the next decade.

Our next chapter will present the findings of our study on the future of telecommunications. Although we have alluded to some of these expected changes in this chapter, we will now explore in detail the telecommunications issues that underly the evolution of high tech real estate.

Authors



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Robert Baxter graduated from Drexel University with a B.S. in finance. He received an M.B.A. from Drexel in 1976 and also taught in their Evening College Curriculum. During his five years at Drexel, Baxter worked on a co-op basis for General Motors in a variety of accounting and financial positions. Before joining Arthur Andersen & Co. in May 1980, he worked for the IBM Office Products Division. His concentration with Arthur Andersen & Co. is in office automation consultation for law firms, government agencies, manufacturing companies, and so on.

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Chapter 6

New Directions in Telecommunications: Impact on Tenant Services

Robert I. Baxter
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Arthur Andersen & Co.

Outline

Telecommunications represents one of mankind's most remarkable achievements. The efficient transmission of voice, data, and pictures has become fundamental to our economy and culture. As energy and, consequently, transportation costs become relatively more expensive, telecommunications will provide numerous opportunities for cost reduction. Consequently opportunities will exist for using telecommunications as a marketing tool. High tech real estate will also provide similar opportunities because the competitive marketplace will drive the technological development of increasingly integrated, flexible systems. For example, real estate developers will have tremendous opportunities for linking state-of-the-art video teleconferencing systems to enhance a building's quality.

THE DELPHI STUDY

The advances we are seeing today are but a tip of the iceberg. Technology underlying the massive change in the telecommunications industry is progressing rapidly, so much so that it has become increasingly difficult to remain totally knowledgeable. These developments include digital computers, microelectronics, and fiber optics. In order to identify these major trends in the telecommunications industry, Arthur Andersen & Co. conducted a study of the U.S. telecommunications marketplace. This Delphi study solicited the views of more than 200 individuals, each an expert in some facet of the telecommunications industry. The focus of the study, conducted in 1983 prior to divestiture, concentrated on conditions expected in 1990. Although not specifically geared toward the high tech real estate marketplace, the results of the study highlight some trends that will have significant impact on this area. These trends indicate that there will be risks to those involved with high tech real estate, but that there will also be rewards to those who approach the area with an open mind and take the time to identify sound approaches and act on these alternatives.

Study Participants

The study was designed to identify and quantify the major trends in two-way telecommunications in the 1980s by developing consensus among leaders of the telecommunications industry responsible for mapping their organizations' strategies. These leaders were divided into six panels:

Transmission-marketer: presiding officers, presidents, planning executives, and marketing executives of telephone companies and common carriers.

Transmission-engineer: network and product engineering executives from telephone companies and common carriers.

Manufacturer-marketer: marketing, sales, and planning executives from manufacturers of telecommunications equipment—customer premises, central office, and transmission.

Manufacturer-engineer: engineering executives from telecommunications equipment manufacturers.

Financial: financial officers from telephone companies and common carriers and telecommunications industry analysts.

Government: Members of Congress, FCC staff members, state legislators, and federal and state regulators specializing in the telecommunications industry.

These industry leaders forecast the following:

Market roles and manufacturer shares of selected customer premises equipment (CPE) products and transmission equipment.

Customer acceptance of new features and functions for telephones and office communication networks.

Key factors influencing customer purchases of CPE and transmission equipment.

Technological advances in CPE and intercity transmission equipment.

Market positions of major competitors in CPE and intercity transmission markets.

Changes in regulatory policy.

Survey Findings

The survey findings present a consistent theme and consensus on the following issues:

There will be significant growth in all facets of the industry, including PBX sales, telephone sales, and intercity communications.

There will be increased emphasis on the marketing area. As the industry becomes deregulated and tenants become aware of possible choices to satisfy their needs, this emphasis will impact real estate development.

Significant competition is expected from manufacturers outside the United States.

A wide number of service and equipment alternatives will be available. Once again, tenants and developers will need to be aware of how these alternatives best fit their future plans for use of telecommunications.

The traditional regulations governing the telecommunications industry are changing and will continue to change. It will be critical for those involved in high tech real estate to understand which areas are affected by deregulation and which are not.

The level of business risk will increase dramatically as companies throughout the industry are forced to deal with competition and make the choices of breadth and mix of offering services in an unregulated environment.

Considerations for Developers

Overall, these findings could have significant impact on those involved with high tech real estate services. As more equipment alternatives become available to prospective tenants, developers will have the opportunity to provide a "single source contact" for determining which of these alternatives best fits the needs of their tenants. It will be critical for real estate developers to be able to provide the kinds of services that tenants could obtain through their own initiative. Somehow, developers need to position themselves as value-added suppliers of telecommunications services. They need to provide either lower prices or enhanced features and services, if not both.

Considerations for Tenants

Tenants can react to the overall situation of the telecommunications industry in much the same way. As marketing of telecommunications products is emphasized, tenants will begin to realize that there are risks associated with the path they choose for their telecommunications services. For example, tenants will need to weigh the advantages and disadvantages of placing control of their telecommunications needs in the hands of a third party, the developer or building manager. Although the developer's personnel should know the capabilities of the systems installed in the building and be able to match these to the needs of the tenants, does the tenant want to place this much responsibility in the hands of the developer? As regulations governing the industry change and the industry becomes open to free-market competition, it can be seen that there is a good deal of risk involved here for the tenant. Competitive forces will require that the developer offer up-to-date telecommunications equipment and networks, and such offerings will require some level of investment by the developer. The prospective tenants of the developer or tenant services manager will need to be assured that the overall direction of the high tech real estate venture is a sound one and that a long-term commitment has been made to high tech services. Finally, as developers and tenants become aware of the potential of high tech real estate offerings, there will be an ever-increasing need for vendors to offer cost competitive services.

PRICING

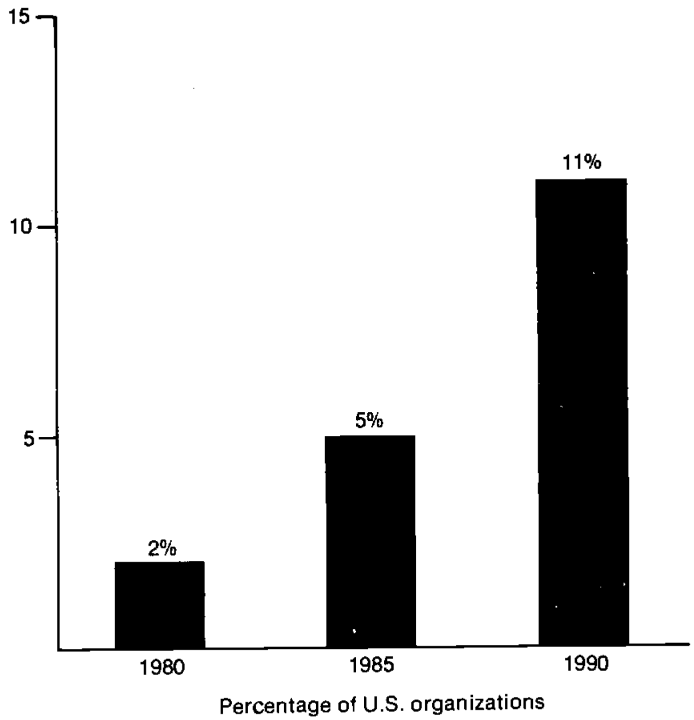
The Delphi panelists expect prices to increase for all types of telecommunications services. Since prices are moving toward a more cost-based structure, service providers must move to cut costs to remain price competitive. The panelists expect AT&T to establish relatively high prices due to higher access charges and its ability to keep customers due to customer loyalty and its image of high quality. This means other service providers should be prepared to set prices below those of AT&T, while providing acceptable quality that will still attract customers. For example, increasing prices in access costs and overall communications expenditures along with technology improvements may make bypass networks more attractive to many developers. Today only a handful of developers can justify bypass networks, however increased cost pressure combined with successful technological developments should provide similar opportunities for more developers.

For real estate developers and tenants, this could mean consortiums of developers who work together to decrease their cost per minute through the efficiencies of economies of scale. Each additional bypass network represents a loss of revenue to the service providers and will put added pressure on them to increase rates to offset this loss. In addition, service providers may need to reevaluate the pricing of their leased-line services, since these lines may be used to substitute for service on the public network that would normally be charged on a time and distance basis. It will be critical for those involved in high tech real estate who resell long-distance services to constantly monitor their network to ensure that it is operating at peak efficiency.

As shown in Figure 6–1, the panel predicts a significant increase in the number of large corporations that will undertake bypass of the local exchange. By 1990 approximately 11 percent (average of the panelists) of the U.S. organizations will use private networks. To those involved in high tech real estate services, the implications of this pricing/bypass scenario are significant. By taking the step of offering high tech services, developers assume that they can match or beat the costs tenants would incur if the tenants purchased their own communications equipment and network. As prices move toward a cost-based structure, both prospective tenants and developers must be able to make well-informed decisions as to which of the many alternatives best fit their needs. Bypass network opportunities may be presented to the developers, especially as tenants begin to utilize the system and as economy of scale opportunities become apparent.

Bypassing will also increase the cost to developers, tenants, and residential customers who use public networks because rates will have to be increased to offset the loss of bypassed services and revenues. In many states the impact of such bypass growth has already had some effect on the strategies of the local operating companies and service providers. In many cases they have

FIGURE 6–1
Private Network Growth



Courtesy Arthur Andersen & Co.

filed before their respective public utility commissions (PUCs) to restrict, or in some cases prohibit, developers from reselling local service. If this trend continues, a serious negative impact to the high tech real estate industry could result. Some PUCs have gone as far as requiring all resellers to acquire special permits and licenses to resell services. This trend may continue in some states, and in others the high tech real estate market may simply be opened into complete competition.

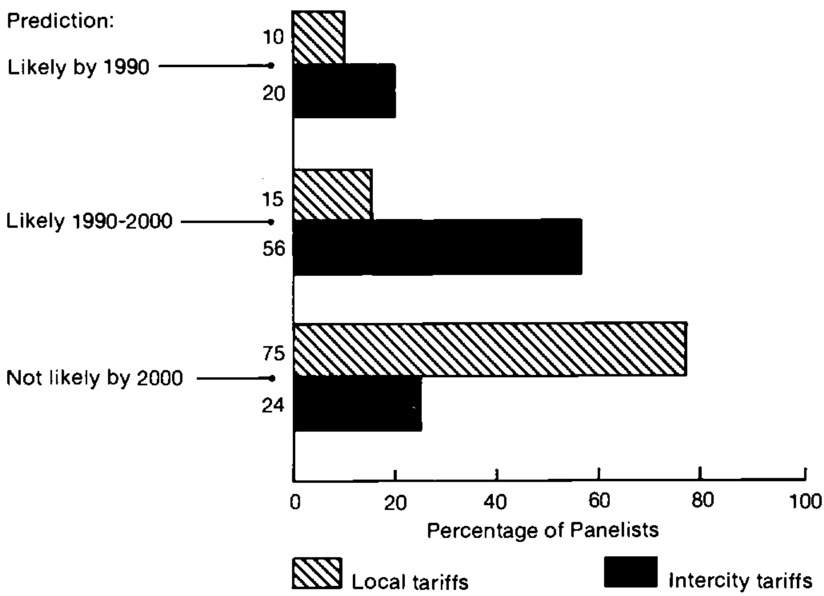
Government Policy Trend

Recent government policy decisions have focused on increasing competition in related segments of the telecommunications market, particularly intercity transmission services and the manufacture, sale, and installation of customer premises equipment. Regulatory policy will continue to be a major force influencing the direction of the telecommunications industry and thus the high tech real estate marketplace.

Local service deregulation unlikely. As seen in Figure 6–2, the government, the financial, and the two marketer panels strongly agree that deregulation of local telephone service tariffs will not occur by the year 2000. It is not surprising that the government panel projects that deregulation is least likely, and 95 percent of that panel said local deregulation is unlikely before the year 2000. The other panels—from 56 percent of the manufacturer-marketer panel to 82 percent of the financial panel—all predict local service deregulation unlikely before 2000.

To those involved in high tech real estate, these predictions could drastically continue to change the industry. Although deregulation is the very item that opened up tremendous opportunities for developers and tenants, this

FIGURE 6–2
Deregulation of Transmission Tariffs



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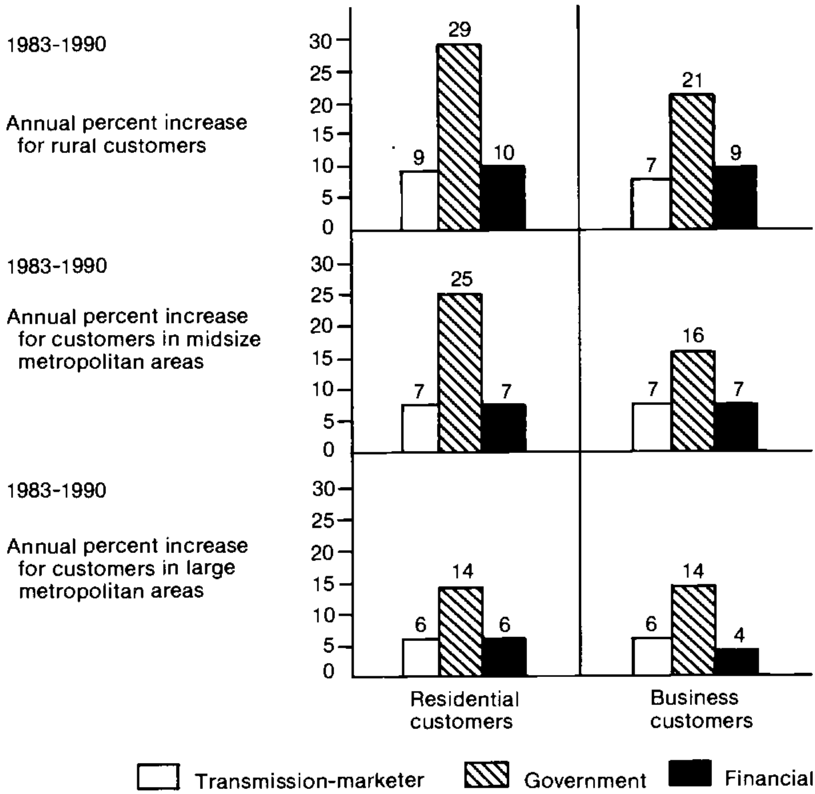
deregulation probably will not be complete by the year 2000. Those who decide to become involved in this industry will, for the foreseeable future, have to operate in at least a somewhat regulated environment, and this will vary from state to state. Monitoring of these trends is probably one of the most important tasks for those involved in high tech real estate. For the larger developers, it may require a dedicated professional whose main concentration is to perform such monitoring. As developers begin to operate in various states, this individual will be required to remain informed on the various regulations in each state.

FIGURE 6–3
Local Telephone Bill Increases



Courtesy Arthur Andersen & Co.

Price Increases for Local Service

Figure 6–3 shows what the panelists predict will be the effect of this continued trend for the regulated local service telephone bill.

Segmented by customer groups, it can be seen that the opinions differ as to the effect of these increases. For the high tech real estate industry, the most important is the segment of large metropolitan area users. The group predicting the highest percentage increase is the government group, and both the transmission marketer and financial groups predicted about the same levels of increase across the board.

Increases in local service costs may or may not have direct impact on those costs involved in high tech real estate. Directly, these increases could result in some tenants wanting to control their own destiny and not contracting their telecommunications services through a third party. By "going it alone," some tenants may think they have more control over their costs. Indirectly, increases in local service costs could have a positive effect on the third party services industry if those offering the services were to position themselves as value-added providers. Tenants could view the offerings of third party service providers as an opportunity to avoid the routine of keeping up-to-date with technical and regulatory changes and still maintain state-of-the-art communications. However, the providers of the services would have to market their products effectively and in increasingly imaginative ways.

Depending upon the approach taken to high tech opportunities, the industry will represent success for some and failure for others. This topic of who will succeed and who will flounder highlights an important finding of the Delphi Study. Figure 6–4 illustrates the panelists' predictions of office communication network manufacturer selection in the 1980s.

EQUIPMENT AND SERVICES

As is illustrated in Figure 6–4, U.S. customers will prefer foreign manufacturers on one of the key variables influencing the buying decision—price. U.S. manufacturers will be preferred for functions and features and installation costs. Although the marketer panels believe Western Electric will hold many advantages in making equipment for communication networks during the 1980s, they think the company will not be favored on the top purchase factors: functions and features and price. Lower ratings on these factors may explain why some panels believe Western Electric will be in a fierce competitive battle for the office communication network market.

The marketer panelists rank Western Electric first or second on five of the eight office network purchase factors. They see durability and reliability, quality, maintenance service, and the security of the communications system as Western's greatest strengths.

Although the panels do not rate other U.S. manufacturers as leaders in

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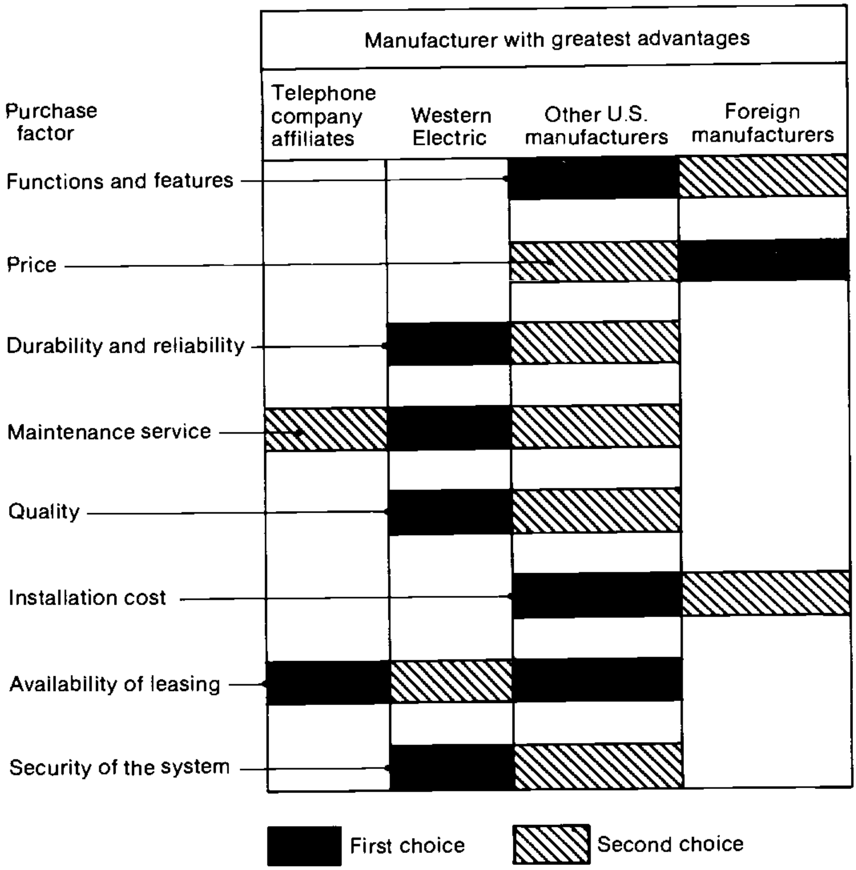
FIGURE 6–4
Office Communication Networking Manufacturer Selection



Courtesy Arthur Andersen & Co.

as many purchase factor categories as Western Electric, they rate them relatively high in all eight purchase factors. Their greatest strengths are functions and features, installation costs, and availability of a leasing option.

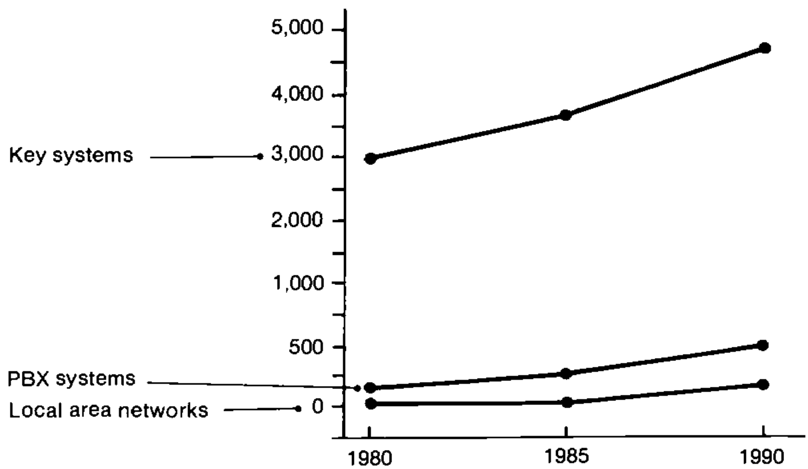
Those involved in high tech real estate decisions will want to position themselves with office network manufacturers who will succeed in delivering the most desirable features of each network. This could mean that the buildings wired for high tech services have a number of vendors capable of communicating and interfacing with each other. A single source for all communications needs will probably not be available. However, numerous alternatives will be. High tech developers, managers, and tenants must be aware of which vendor offers those services most suited to their short- and long-term needs.

PBXs versus LANs

Networking within a high tech building can be accomplished utilizing a number of mediums and a variety of equipment, including Private Branch Exchanges (PBXs) and Local Area Networks (LANs). As shown in Figure 6–5, PBX growth will be steady through this decade. PBX annual sales will more than double from 212,000 units in 1980 to 500,000–550,000 units in 1990, according to the three panels. The transmission-marketer panel foresees growth of approximately 10 percent per year, and the manufacturer-marketer and financial panels foresee a growth of approximately 9 percent per year.

LANs were virtually nonexistent in 1980. LAN sales are expected to reach 33,000 units in 1985 and 108,000 units in 1990. However, 1990 projections vary widely between panels—the manufacturer-marketer panel predicts sales of 200,000 units; the transmission-marketer panel, 110,000 units; and the financial panel, only 15,000 units.

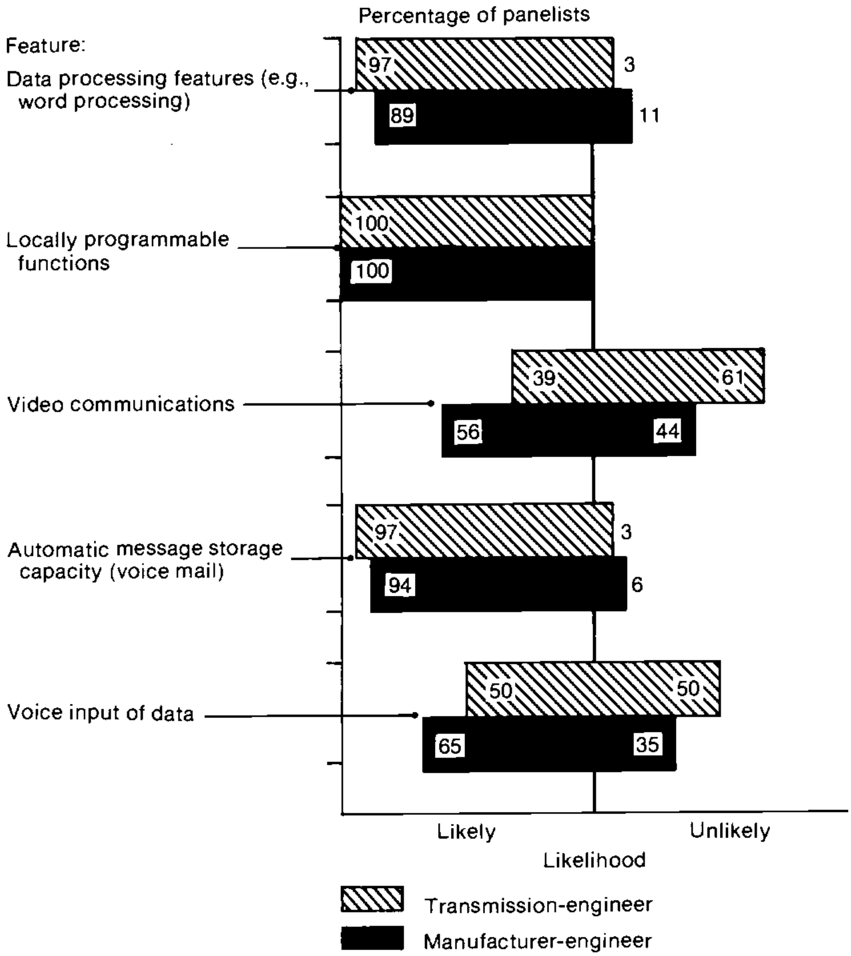
FIGURE 6–5
Key Systems PBX and LAN Unit Sales



Courtesy Arthur Andersen & Co.

In the future the distinction between PBXs and LANs will diminish; both will carry voice, data, and possibly video transmissions. Not surprisingly, the transmission panel (marketers of PBXs) expects lower LAN sales, and the manufacturer panel, representing companies that supply parts for PBXs (and possibly produce LANs), sees the greatest growth.

FIGURE 6–6
New Features in PBXs in 1990



Courtesy Arthur Andersen & Co.

The technology associated with these PBXs will advance rapidly. Accordingly, the study panel assessed those features that would be available in PBXs in 1980.

Functions and features included in PBXs (see Figure 6–6) will powerfully influence high tech real estate during the 1980s. According to 90 percent of the two engineer panels, PBX units in 1990 will probably be equipped with data processing features (e.g., word processing), locally programmable functions, and automatic message storage capability (voice mail). Panels disagree on whether video communications and voice input of data will be popular features in 1990. The manufacturer-engineer panel expects PBXs in 1990 to handle video communications, but the transmission-engineer panel believes that unlikely. If the manufacturer-engineer panel is correct, however, PBXs in 1990 will handle voice, data, and video and will, therefore, be able to perform switching for video teleconferencing.

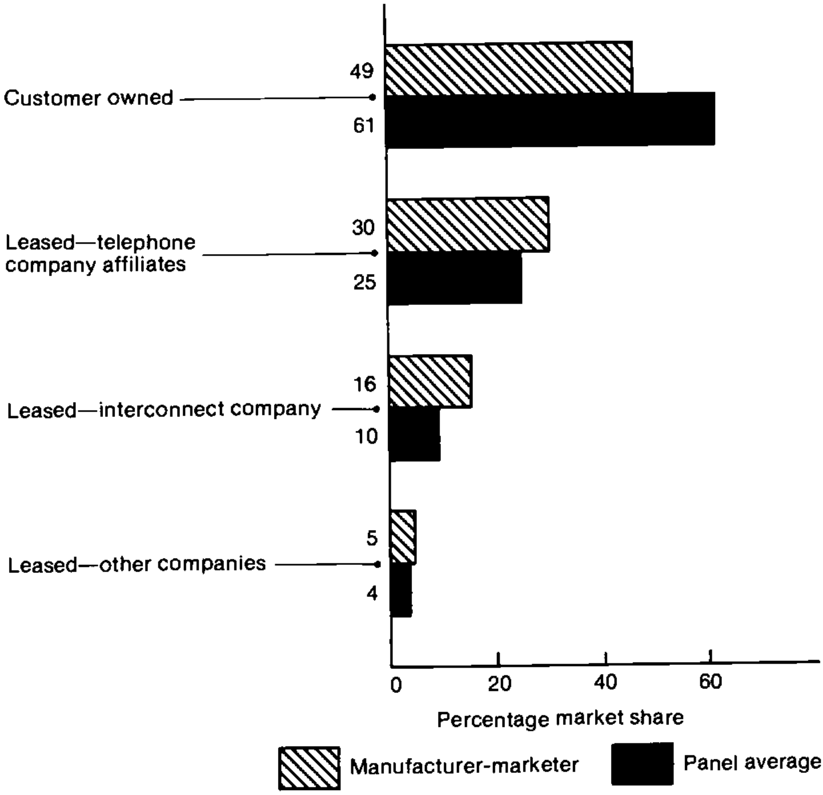
Another feature likely to be found on future PBXs is the translation of voice into data. This feature should significantly improve the productivity of data-entry personnel. Instead of using a keyboard, or some other data-entry device, people will enter data by speaking into a voice receiver that is part of a PBX network. About 65 percent of the manufacturer-engineer panel and 50 percent of the transmission-engineer panel believe that voice input of data will be incorporated into PBXs by 1990.

These projections confirm that manufacturers of telecommunications equipment intend to incorporate all forms of communication into one network system, either the PBX or LAN. As PBXs incorporate data processing functions, they will not only accomplish voice switching but also will perform many data-handling functions currently performed by LANs. This may result in PBXs absorbing a larger share of the office network market at the expense of LANs unless manufacturers expand the capability of LANs to handle both voice and video.

Financing Alternatives

The groups predict a marked change in the financing characteristics associated with the PBX systems. (See Figure 6–7.) Of the panel members, 59 percent owned rather than leased their PBX systems, which might indicate a reduced market for the services and benefits offered by developers and real estate managers involved in shared services. Most high tech real estate equipment offerings assume that tenants will lease their PBX systems and the marketing of the offerings concentrates on addressing the benefits of leasing versus purchasing. These benefits include minimal capital outlay and the ability to upgrade to enhanced products and services at any time. The trend toward increased ownership of PBX systems by tenants would seem to indicate that tenants may choose not to lease their systems. Successful marketing of the concept of high tech services will have to include a clear

FIGURE 6–7
Equipment Ownership Key Systems in 1990



Courtesy Arthur Andersen & Co.

assessment of the relative advantages and disadvantages of one financing option versus a second. To a developer or manager trying to penetrate the marketplace, this requires flexibility and the ability to identify the financial position that the prospective tenant may have.

Customer Service

Finally, the panel commented on a subject that has always been associated with the telephone and telecommunications industry, namely, customer ser-

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vice. Good customer service will become increasingly important as more competitors enter the market and the differences between equipment from various manufacturers become less distinct. The most important customer service factors are equipment availability and reliability. Equipment assembled to customer specifications must be built in increasingly shorter lead times in order to remain competitive. Continued emphasis on equipment reliability will be essential to retain customers.

Maintaining good customer service will become increasingly more difficult if a manufacturer must support two distinctly different technologies, such as digital and analog equipment. Manufacturers must balance the often conflicting objectives: providing spares, additions, and service for older technology equipment versus the desire to focus factories entirely on new technology equipment in order to improve productivity and reduce delivery lead times.

For high tech real estate participants, good customer service may be the one area in which service providers can be specifically compared. For instance, unless real estate developers provide quality services, even buildings having the newest in technology will be poorly accepted in the marketplace. Regardless of the PBX and LAN services offered, tenants expect support by knowledgeable service personnel. Without this support tenants' businesses could suffer, and the developer and the tenant will miss an opportunity for reduced costs and higher quality service.

■ CONCLUSION ■

Identifying and capitalizing on the significant opportunities created for both the providers and users of high tech services will require accurate forecasts of future market conditions and the development of appropriate business forecasts.

At this time the marketplace for shared services seems to be in the very early stages of development. Although some significant trends can be identified, discussed, and tracked, the field is still very wide open, and many questions remain. Serious consideration of topics like changing technology and regulations need to be assessed prior to making specific predictions of where the industry will be in the 1990s. However, it is certain that more and more participants will enter the field, and those who will succeed will understand the major trends in the industry and match them to the needs of those they are serving.

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Chapter 7

The Marketing of High Tech Buildings from the Owner's Viewpoint

William R. Henry
Merrill Lynch Commercial Real Estate

Outline

Commercial buildings are placed on this earth to provide an environment in which individuals may produce and interact with one another. One cannot produce and interact without the occupied structure providing light, heat (or cooling if you live in Texas), security, and devices through which to communicate.

Thomas Alva Edison invented the light bulb in 1879, and Alexander Graham Bell invented the telephone in 1874. The first air-conditioning system was placed in an office building about 1932. Police officers have been around forever. If nothing more is involved in the workplace, what is all the recent furor over the "smart" or "intelligent" building?

The furor is due to demand by American business to become more productive, to interact more with one another, to provide a safer environment in which to produce, and to do all this in the most cost-efficient manner possible. Personal computers and high-speed communication have become facts of life for American business. The aforementioned are the reasons the workplaces being built by real estate owners and developers need to be more intelligent or smart.

For the real estate developer, the rationale for providing the intelligent building is even more basic. A developer or investment group that does not provide the services offered by its competitor will not lease its space, will not achieve its pro forma cash flow projections—especially in this tremendously competitive real estate environment—and will face potential foreclosure. Furthermore, the developer must build structures that can be used into the next century.

In this chapter the marketing influence of the high tech building will be analyzed—where we have been, where we are now, where we are going as well as the overriding factor, *the bottom line.*

WHAT IS AN INTELLIGENT BUILDING?

The intelligent building does not exist. A talking elevator, a motion-detecting light switch, or a card-key access mechanism does not make a building smart. New technology brought forth through the enhancement of microprocessors places a building in the smart category. These microprocessors enable a building's computer to evaluate the building more quickly and thoroughly than can building maintenance personnel and give tenants access to a myriad of communication devices at a touch of a telephone key.

Basic Building Services

Basic building services include the heating, ventilation, and air-conditioning system, security and access, life and safety, and electrical system. These make up the lifeblood of internal building usage (along with communications, which will be discussed later) and are in greatest demand by the building user.

Since the inception of the climate-controlled office in the 1930s, the comfort level of personnel has been taken for granted. Employees expect to produce in an environment unaffected by the frigid temperatures of winter or the sweltering ones of summer. Employers, on the other hand, must look at the trade-off between creature comfort and cost.

Reduction of operating costs. Operating costs—which include climate control, real estate taxes, insurance, janitorial, maintenance, and utilities—represent between 25 and 40 percent of occupancy charges. A reduction of such an energy-consumptive tariff as heating and air conditioning for a major user of space is significant.

Therefore developers and users of space have sought ways to reduce the occupancy cost of the workplace. Since the costs of real estate taxes, insurance, janitorial services, maintenance, and so on are difficult to effectively reduce, energy consumption is the lone area where money can be saved. Energy costs are also generally the largest single component of operating costs.

Due to the cost effectiveness of microprocessors, computer hardware, prewritten software, and the greater attention being given to energy consumption since the oil boycott, energy management has become of paramount concern to the real estate developer and user.

Energy management. Energy is consumed within the workplace in three areas: lighting, climate control, and at the desktop. The new generation of buildings (since governmental and economic guidelines have taken effect) provide mechanisms through which to control energy usage.

Double-paned and reflective glass, variable air volume and chilled water mechanical systems, "smart" thermostats, parabolic light fixtures, perimeter light sensors, motion-detecting electrical systems, and thermal storage are but a few of what is now in vogue. But at what cost to the developer and to the user?

"Developers and users should challenge themselves to seek and match the building's overall mechanical and electrical needs with available and forthcoming technology without letting business approaches, financial considerations, and marketing hype obscure the real engineering and design issues involved," Ronald J. Caffrey, Marketing Vice President of Johnson Controls, points out.

HVAC and lighting. With the hardware and software advances currently offered, a computer-based energy management system is a must. According to Jim Kohlhoff, an internal consultant on building engineering for the Trammell Crow Company,

> Computer-enhanced mechanical systems are virtually the same cost (in todays' dollars) as mechanical systems of the past which did not offer the computer enhancement.
>
> With the new technology, availability of prewritten software, and competitive forces affecting both the microprocessor and the mechanical and electrical system industries, using a nonenhanced system would be ill advised.

What the computer-enhanced system allows the developer and user to do is monitor and control usage, thus expense. Electrical and mechanical systems are now designed to activate and deactivate at specified times while giving a particular tenant the flexibility of use during otherwise nonoperational building-service hours. This flexibility not only allows the system to operate more efficiency (i.e., not having to heat, cool, or light an entire building while satisfying the needs of a single tenant or group), but also gives the owner the opportunity to bill only the user responsible for the cost.

The bottom line, as it relates to the marketability of a certain building, is that these systems can save money (up to 30 percent, according to industry sources) for relatively little increase in initial capital outlay. More elaborate systems—such as sensing devices that monitor motion in an office suite as the triggering mechanism for lighting and climate control, thermal storage tanks, perimeter lighting sensors, light fixture bulb monitoring, and so on, can reduce energy consumption even more. However, the cost/benefit ratio may not enhance the marketability or the bottom line and should be studied in great detail, according to Del Fowler, Vice President of Blum Engineering.

Communications

Managing energy costs is important to the user of space in the 1980s, but perhaps more so is the ability to communicate. Both the services offered at desktop level and the capacity and capability of the structure to handle the nuances introduced by the electronic revolution are of major importance to the space user.

Desk tops today are not the resting places for a standard telephone, calculator, and/or typewriter. Today's desk offers personal computers, monitors, modems, word processors, data transmittal and receiving devices, elaborate telephone systems, and such trade fixtures as Quotron machines.

Not only should developers and owners consider what communication services to offer the user, but also how the structure will be cabled to power these and future office devices.

Telecommunications. Since the deregulation of AT&T and its operating entities, the telecommunications industry has been in a state of confusion. There has been confusion for the user of telecommunications, the developer or owner, the telephone company itself, and the new players in the industry.

Life was pretty simple in the past. If you wanted telephone service in your new suite, you called one of the Bell operating companies; the company sent a service representative out to install the system; you picked up the receiver; and you received a bill once a month. If you had a problem, you would call a service representative, who would be over in short order to alleviate the disorder. Telecommunications life was great. One might have griped about the charges after a rate hike, but soon got over it. After all, we did have the best telephone service in the world.

Now Owner/Developer and Tenant/User, you're in the telephone business. If you don't like it, meet a representative of the fastest growing industry in America today—the interconnect company. These folks will sell a telephone system and hook it up to a Bell cable, and you're in business, just like before the breakup. Right? Not so fast. Who services the unit? What happens when you outgrow the system? What about long-distance service? What about data transmittal and receipt? And so on. . . . Well, Developer/Owner and Tenant/User, meet the Bell Company lookalike—the service provider. Under such names as ShareCom, LinCom, and TechLoop, companies have been formed to look, act, and react as the telephone company used to and to solve your telecommunications needs. The new buzzword for this burgeoning industry is *shared tenant services* (STS), and the industry is helping alleviate many problems faced by the owner/developer and tenant/user.

Shared tenant services. The new ventures offer sophisticated integrated voice and data communications services—or anything less—to the tenants of office buildings, industrial parks, and other real estate developments, according to Albin C. Meier in a recent *Business Communications Review* article.

Because of their small size, many of these tenants might not otherwise be able to avail themselves of the new technological services offered. Even the smallest tenant in such a facility has the opportunity to share in such services as call-detail recording, least-cost routing of toll traffic, local area data and voice networking, electronic mail—both voice and text—facsimile, video conferencing, word processing, and other productivity enhancers usually available only to those able to invest in the more elaborate PBX or local area network (LAN) facilities.

The new shared services industry has sprung from the fertile imaginations of entrepreneurs—usually from the telecommunications field—who recognized an opportunity to make a profit by using modern technology to develop new markets and of astute real estate developers, who quickly picked up on an effective way of attracting users to their properties.

By sharing such resources among a large group of customers, the cost for introducing modern telecommunications and office automation capabilities can be reduced dramatically.

A telephone switch, hardware, and software—available from any number of vendors—costs about $1 million and will serve approximately 4,000 telephone lines, about the demand generated by a million square feet of multi-tenant office space. For a speculative office building of less than 500,000 square feet, providing this service makes little economic sense.

Wiring and Power

When designing a building, before detailing the marketing thrusts and impact of the intelligent building, the building owner/developer should consider the wiring closets, risers, conduits, and cabling necessary to serve the needs of the high tech space user.

Architects, developers, consultants, and users have become increasingly perplexed—especially with the new open-office space design—as to how to get the umbilical cords for all the new electronic and communication devices from the power source to the desktop as well as how much power is necessary today and tomorrow to run the high technology office.

Heretofore, standard office buildings were designed with a load factor of four watts per rentable square foot. That was broken out as two or three watts for lighting and one to two for internal consumption of office equipment. Lighting power demands have decreased due to new fixture technology (such as parabolic diffusers), a demand for fewer footcandles at desk top level than in the past, and the reduced lighting desired near CRT screens. However, desktop power consumption has quadrupled for many space users. For example, a recently completed energy study for a building Xerox is planning to construct calls for nine watts per square foot of desktop power. Building owners and developers must be cognizant of the new trends in power capacity (as well as heat generation) attributable to all the new electronic workstation devices by either adding capacity when designing mechanical and electrical systems or by planning means to upgrade those systems if and when needed. In addition, tenants need clean and reliable power to operate their large and small computers; a brief loss of power, even part of a second, can result in the loss of data.

Providing power and communications cable to the workstation, as stated earlier, is a major problem for the space user in an open environment. The poke-through method was once the only way to get power or communication links from the central source to the desktop. This method is extremely costly, labor intensive, disruptive to fellow space users, and has drawn criticism from municipal code enforcers in the name of fire safety.

Wiring has been designed to carry power under carpet to the workstation. However, this flat wiring system has only been approved to be used in conjunction with carpet squares (significantly more expensive than standard), does not have the capacity to carry communication lines (unless fiber optics are used), and does not hold up well in high-traffic areas.

With the problems created by the above, some building owners and developers have installed raised flooring throughout an entire suite to allow the easy accessibility of power sources to the workstation. Southwestern Bell, for example, placed a six-inch raised floor throughout its new 37-story office building in Dallas. This trend is growing throughout the United States, but it is extremely expensive. Construction estimates for placing this type flooring is about $6 per square foot. However, this flooring may be available for accelerated depreciation and investment tax credit.

Most efficient and gaining great industry appeal is the "electrified floor." Troughs are placed at 5-foot integrals in conjunction with building construction, and preset fittings are placed before the floor has been surfaced. The user has the ability upon move-in or any time during occupancy to change office configuration or add communication and power links with minimal cost. The cost of this feature equates to a net of about $2 per square foot in areas that generally build concrete rather than steel-framed structures.

This delineation is used because the electric floor can only be placed in a steel-framed building. In areas of the country historically using steel rather than concrete (i.e., Chicago, Philadelphia, Detroit) the cost of adding this feature to the base building is between 50 cents and $1. The developer needs to look at the aftertax cost of these enhancements—the impact in real dollars may turn out to be less.

THE FUTURE OF THE INTELLIGENT BUILDING

Computers have been used for years to control energy management, fire, and security systems. In todays' smarter buildings, they're doing that and much more. Just how intelligent the newest generation of buildings needs to be is currently a subject of debate among the various players in the new game of shared tenant services. All parties agree, however, developers should do their homework before plunging into the brave new world of integrated building systems. Today, developers and users alike face issues they've never had to confront before.

The recent changes that have swept the telecommunications industry have laid the groundwork of shared tenant services. The divestiture of AT&T allows telephone systems to be shared in new and different ways. Advances in telephone switching system technology make it possible for the same telephone line to carry both voice and data transmission at the same time. And the acceleration of the electronic information age is fueling a renewed interest in office automation and the productivity it can bring.

The Real Estate Developers' Point of View

"The system (shared telecommunication services) allows us to offer an amenity no one else has," says Mike Webster, tenant manager for developer Wortham, Van Liew & Horn of Houston—of the city's first intelligent building, United Bank Plaza. Recently built in a city with the highest office vacancy in the nation, the 535,000-square-foot, 45-story office building in downtown

Houston opened its doors over 50 percent preleased, and 90 percent of those tenants subscribe to the service.

According to Webster, it is hard to say that the system itself made a deal, but he likes to think it has contributed to the leases he has signed. He thought it could help him in the soft market which exists in Houston today, and believes it seems to be working.

The building's central telecommunication system is managed and maintained by ShareCom, a joint venture of the developers and Tel-Management Corporation, a Dallas-based provider of shared telecommunication systems. ShareCom is a tenant in the building, and its management, technicians, and billing departments are on-site.

"We operate our own phone company within the building," says Christy Johnson, ShareCom marketing representative. ShareCom offer tenants "one-stop shopping" for all communication needs. Included in its menu are reduced-rate long-distance service and free consulting for office automation and telecommunication system design. For local phone service, ShareCom serves as liasion between its customers and Southwestern Bell cables.

Tenants may also lease their telephone equipment if they choose. Therefore, total start-up costs for an advanced telecommunication system may be as little as $150, the amount charged by ShareCom to install overhead wiring in an office suite.

The wiring links each phone port with a master computer-run phone-switching system capable of handling about 3,000 individual lines. When plugged into the system, a person can talk on the phone and receive data fed into a personal computer at the same time. The need for cables to connect an automated office network is eliminated, as different workstations can "talk" to each other over telephone lines.

There is no growth penalty for the user of a system such as this. The growing tenant merely adds more phones as needed, avoiding the financial pains that can come without growing a leased or purchased phone system and switch of its own.

Discounted long-distance service is perhaps the most prominent tenant benefit. ShareCom has a bank of outgoing WATS lines built into its main switching system, along with access to a variety of independent long-distance carriers. When a tenant dials a long-distance number, the computer-driven switch choses the least costly route at that particular moment. ShareCom also resells its long-distance service to others outside the building.

Monthly management reports mailed to customers break out charges by division, station, or whatever unit the customer specifies.

Wortham, Van Liew & Horn intends to offer this service in all new downtown projects. Presently under construction is Heritage Plaza, a 53-story, 1.2-million-square-foot facility, which will have a standard integrated system menu—including ShareCom. The only difference between United Bank Plaza and Heritage Plaza is that Honeywell has joined the partnership with the developer and Tel-Management to tie in the building operations with telecommunications.

Trammell Crow. Speaking about LTV tower, Trammell Crow Company partner Barry Henry says the shared telecommunication services provided are still treated as an amenity, "but the integrated building system is not."

The 50-story, 1.3-million-square-foot granite structure is a totally automated system through United Technologies. The Otis elevator contains both audio and visual communications, including floor numbers, time, date, weather, news, and stock exchange information. The heating, air conditioning, energy management, lighting, fire, security, telecommunications, electronic office equipment, and services are controlled by distributed microprocessors and a control computer that gives the building the ability to react to changing situations.

Available to tenants are word and data processing, electronic mail and filing, high-speed facsimile transmission, and a host of other automated office services. In addition, LTV Center is equipped with digital telephones, which are capable of transmitting voice and data simultaneously. Also, the garage and stairwells are secured with a two-way sound-activated audio system. Monitored 24 hours a day, this system is activated by any out-of-the-ordinary disturbance. A security guard, in the control center, can therefore communicate with various areas of the garage.

Trammell Crow officials cannot place a number of any leases successfully negotiated because of the building's "intelligence" level, but the facility was 75 percent preleased at higher-than-average rents for downtown Dallas.

In Chicago, One Financial Place is billing itself as the city's premier intelligent building. In conjunction with Johnson Controls and Digital Equipment Corporation, One Financial Place offers a full menu of integrated information processing and building services. Telephone services include low-cost long-distance lines, call forwarding, call hold, automatic redialing, speed dialing, call transfer, and a host of additional features. Data transmission is provided through the InteCom IBX S/80 switch.

Subscribers are able to increase information management capabilities with access to the facility's DEC VDX II/780 mainframe computer. With virtually any microcomputer, a library of data management programs is available. A business support center offering facsimile transmission, Telex, high-speed letter printers, graphic plotters, and access to a broad range of financial data base systems are also available.

Las Colinas: Totally automated park. Perhaps the most elaborate and broad-based system today is found in Las Colinas, the futuristic, 12,000-acre, master-planned mixed use development located outside of Dallas. The development will offer three distinct cable networks throughout the entire park. The first, which is now operational, offers a broad-banned-based CATV system. Besides offering each resident, hotel occupant, office tenant, and retail user the ability to hook up to the entertainment satellite, the system affords the most elaborate security system in the area.

Placed in each home, apartment unit, and business operation is a microprocessor, which the master system "pulls" every seven seconds to determine a change in status. If a change occurs, such as the fire alarm, the microprocessor notifies the master system, which automatically alerts the proper authorities, and a fire unit is dispatched, all in less than 10 seconds.

The system has also been programmed for medical, intrusion, and assault. For medical and assault, panic buttons have been placed throughout the dwelling or business. If a problem occurs, the resident simply pushes the button, and authorities are dispatched immediately. Within five seconds, a call is placed to the affected location. If it is a false alarm, a code is given by the respondent, and the emergency unit is called back. Response time from pushing the button to arrival by emergency personnel is less than two minutes, which is extremely faster than any other municipality surveyed. The cost of the service is tied in with the local assessment fee (21 cents per $100 valuation).

The second cabling, which became operative January 1, 1985, will handle all data-type services on a synchronous and asynchronous transmission basis at extremely high volumes. It will allow any computer terminal to talk with any other computer terminal, just as a PBX would operate. It replaces the dialup modem and allows the transfer of significantly more information than can be accomplished through normal telephone cables.

The third cable will provide private telecommunication through the Las Colinas Teleport. The system will be set up under a T–1 rate configuration, the least expensive offered by AT&T. The capacity (1.5 million bytes per second) would allow one mainframe to dump all stored information to another in minutes. It will also allow Las Colinas subscribers to utilize digital video conferencing at very inexpensive rates.

The network has allowed Las Colinas to capture several large corporate and regional headquarters to its confines, including CalTex Petroleum, Boy Scouts of America, Sohio, The Associates, General Motors, and many others.

Madison Plaza. The marketing threat of Madison Plaza, a 1-million-square-foot office tower, developed by Lee Miglin and J. Paul Beitler in Chicago, is heavily weighted towards energy savings.

The building, which has been given two prestigious architectural and construction awards, is being touted as "the birth of a new generation in architecture . . . design created around energy efficiency."

"Between the building's design and a state-of-the-art building automation system, which controls and monitors energy use and other functions, Madison Plaza can cite dramatic savings as an appeal to prospective tenants," says Project Manager John Derby. "Compared to Chicago skyscrapers in the

70s, the building's energy efficiency is remarkable. Many of these use 75,000 to 250,000 BTUs per square foot per year, while Madison Plaza consumes approximately 40,000 BTUs."

In comparisons of the building's annual energy cost with those of other new Chicago buildings that use between 60,000 and 70,000 BTUs, Madison Plaza boasts a savings of about $1 per square foot.

In this application, the building automation system integrates energy management control with security and fire/safety monitoring. Derby believes the system is more than worth the price and goes beyond the general assessments of a payback averaging two or three years. He charts the payback of the building automation system at just over one and a half years. "The number 1 operating cost in running an office building is energy," he said. "It can average 25 percent of operating costs in a building such as this." Between the building design and the building automation system, Derby reduced the operating budget by as much as $250,000 per year in energy costs, or 25 cents per square foot, and about $120,000 in labor costs. Obviously this is a benefit for tenants because their operating expense escalators are reduced.

"Many of our tenants spend considerable overtime here," said Derby, "and that is something they can do economically because their overhead is minimal. The operating engineer virtually computerizes tenant's heating, ventilating, and air-conditioning systems to be on for specified periods of time. Each floor has a separate fan room, so you don't have to cool 10 floors for the use of 1. In fact, the temperatures can be controlled in spaces as small as half a floor."

Another item in the building automation system is a smoke evacation and control device. This feature is used to increase atmospheric pressure in floors above and below the fire, forcing the smoke out high-power vents.

Derby sees a benefit in the building automation and telecommunication system, "competition for tenants in Chicago will continue to be fierce with developers reaching for the latest and best building technologies in an attempt to decrease leasing costs and lure potential tenants. At Madison Plaza, its building automation system is a high tech marketing tool which can, the developers believe, give them a competitive advantage over building's without such a system."

The Architects' and Consultants' Points of View

When a building is contemplated, one of the first steps involves the architect. It is the architect's responsibility to design the structure through which all services emanate. It is the architect, many times in conjunction with mechanical and electrical consultants, who specifies the systems to be used.

In conversations with several architects and consultants, the prime concerns tend to deal with cabling and capacity for the new breed of building. "Designing the speculative, multi-tenant office building today is much more complicated than it was only a couple of years ago," says Douglas Compton, a partner with Harwood K. Smith & Associates. "Developers, still cognizant of their front-end costs, are beginning to realize todays' workstation will have a personal computer or word processor sitting atop it, not a typewriter or calculator."

Costs versus utility in the battle used today by the developer with its outside consultants. The battle becomes more heated when the supplier of these new systems enters the picture. The key question an owner or developer must ask is What do I *really* need to provide my users? "There are real items and there are gimmicks," according to Fowler. "Technology exists today to provide systems unheard or unthought of a few years ago. My concern is that developers may be pulled into systems not necessary for the optimum use of the facility."

Talking elevators and switchless office suites come to mind. Of what value to an owner is a talking elevators? High-speed, dependable, and aesthetically pleasing service is what most users want from an elevator. For the day-to-day user, is the constant "Going up" and "Going down" novel or annoying?

Are motion-detecting sensors that turn lights on and off when one enters or leaves an office suite necessary for optimal use of the suite? How about the same sensing device controlling heating and cooling? At a cost of $650 per sensor, the amenity may not be economically advantageous.

Flexibility. Fowler says, "We are recommending systems which do control the electrical and mechanical system as an energy management tool. It does make good economic sense to provide this service to the owner. If after-hours use is necessary, the user simply calls the building manager, and the manager programs the computer to provide electrical and mechanical service to the suite. The computer also keeps track of the cost and bills the user directly for its consumption."

This system, which automatically shuts down mechanical and electrical systems at specified times, is also programmable to maintain minimal lighting and cooling/heating for janitorial crews in building quadrants.

"The key point in all this," says Compton, "is that all the technology available today may not be necessary and that continued technological advancement will allow for even greater automation in the future at, perhaps, reduced costs."

Flexibility is the buzzword being disseminated. Increasing use of desktop power and heat generation has caused owners and developers to plan for additional capacity in their electrical and mechanical systems. They should look at ways to truly cut costs in this burgeoning technical age.

As stated earlier, the new intelligence is being brought forth in three district areas: Building controls, telecommunications, and information processing.

From a truly technical standpoint, all of these new technological advances have been evolving in their respective environments for the past several years.

The technology required is one that allows these independent systems to both share in the areas where commonality exists and communicate with one another to enhance productivity. From a cost standpoint, there seem to be some genuine savings opportunities.

Wiring. Studies suggest a 25 to 30 percent savings in wiring costs when all three systems are planned and wired simultaneously by one company. The basis of these savings seems to be logical in the sense that instead of 10 to 14 different wiring packages run by different suppliers, you have one intelligent/optimized wiring plan run by one contractor.

How about running all the signals in the entire building on one pair of wires? There are a few reasons this approach may not work. First, the fire system will, by necessity, be run on separate conductors to ensure compliance with local codes. Second, a wiring fault could lapse a building into total chaos. Another potential problem is exposure of telephone users to higher-than-normal voltages when running all building signals on one conductor.

Fiber optics. Listening to the characteristics of fiber optics would almost lead one to believe wire is obsolete. In fact, as a media for transmitting digital signaling, fiber optics does have some advantages.

1. It has the ability to handle large amounts of data at very high data rates.
2. It is relatively inexpensive to run when compared with wire in conduit.
3. It is immune to electrical storm and lightning damage.
4. It tends to be more secure than normal to conductor wire.
5. It does not occupy much conduit space.

In many applications, however, these advantages are outweighed by the relatively high cost of interfacing with the fiber optic cable. For the most part, getting on and off the cable is only cost effective when transmitting large amounts of data. This makes the attachment of individual phones and control points too expensive unless electrical storm immunity or a need for unusually high security is a valid concern. Rapid changes in technology, however, are expected to bring the costs down for devices to interconnect between optical fiber and standard electrical lines.

The intermediate solution to the wiring problem is the intelligent cabling plan. This concept uses a group of wires in a single sheath to run voice and data signals with spare wires available to support local area networks and control signaling. Both Honeywell and IBM are using this approach to maximize wiring efficiency and prepare buildings for the future. However, the diameter of these sheaths can be quite large and can rapidly clog conduit and riser space.

How much does it cost? The most common questions in today's marketplace are: How should I wire my building, and how much does it cost? The intelligent cabling plan should provide a good answer to the first part of the question, and here are some facts on the latter as of early 1985:

1. State-of-the-art building automation with lighting control, energy management, fire, security, and card access should run $1.50 to $2.50 per square foot.
2. Third-generation digital PBX systems that feature phone sets, least-cost routing, detailed call reporting, and all the frills, along with an intelligent cabling plan, should run $4 to $6 per square foot.
3. A central computer system to serve as a file server and auxiliary processor for the other systems should run 75 cents to $1 per square foot.

As noted earlier, the developer should analyze the aftertax costs of the improvements for the potential of favorable tax treatment.

Red flags. As with other new systems concepts, new areas of concern arise. Most important are these:

1. Compatibility of systems.
2. Experience of the vendor.
3. Future system expansion.
4. Ongoing support.

Be leery of brokers who package all systems under the guise of integration. We've all learned the lesson on compatibility. Be sure your system supplier has hands-on experience in all areas of the intelligent building. This, along with a strong financial structure, should assure you of receiving a good technology partner for your future needs. Don't become so enamored of the concept you lose sight of the real objective. Examine closely the characteristics, capabilities, and track record of your technology partner.

DO YOU WANT TO BE IN THE TELEPHONE BUSINESS?

Although there has been a lot of publicity about this relatively new business concept, the industry is still in its infancy. Some office developers initially thought they could enhance their properties simply by installing an advanced PBX and by cabling the property for their tenants, much as they might offer air conditioning. Confronted with some of the uncertainties of the communications industry and the ongoing complexity and cost of providing realistic service, many developers have backed off or have sought outside assistance.

Many of those brought in to provide assistance may not themselves have a clear idea of what is required for a long-term success in the shared services business. Manufacturers are interested in selling switches and station apparatus. Some consultants, primarily experienced in providing communication networks and hardware packages to meet the needs of single customers, may not relate to the ongoing management needs of a multi-tenant service business.

One well-entrenched shared services company founder has said, "I see perhaps 20 proposals or plans a week which are very light on the investment and expense and very heavy on the revenue side. It really doesn't work that way. There are constant needs which must be addressed, and they aren't based just on the capabilities of a piece of hardware."

The kind of development or office complex often dictates the type of services required. Small- or moderate-size office buildings built for speculation may fill up with numerous small operations. Large buildings with a few large, prime tenants, such as major banks or insurance companies, will require an entirely different mix of services. Developments that include condominiums or other residential content will shift the needs even more, and each type will probably require a different mix of services and develop a different basis for profitability. Most developers have their specialties and go after a certain kind of business, and this tends to affect the kind of shared services they offer and the kind of organization through which they are provided.

The Service Provider

Shared tenant services ventures that appear to be on the most solid footing at this time and that seem most likely to succeed over the long haul fit into one of these categories:

1. The entrepreneurial company heavily committed to high-quality customer service, as well as technical expertise.
2. Expert in-house or captive specialists in telecommunications and related technology, devoted to serving the needs of one company.
3. Professional communications companies or divisions with expertise in networking, software, data transmission, and other skills usually beyond those of typical interconnect companies or even the better manufacturers.

There is probably good justification for the existence of all three kinds of companies. At one end of the spectrum, the service-oriented entrepreneur company may be particularly well suited to serving the needs of a broader range of projects, including relatively small ones. At the other extreme, the in-house communications department or division can be justified to serve the needs of relatively large real estate development companies having specialized needs or requiring a highly structured approach.

Because the shared tenant services business is still very much in its formative stages, there are no hard rules as to what the future standards will be. However, discussions with representatives from each of the types of operations listed above provided interesting insights into how they perceive their business.

The entrepreneur. The entrepreneurial approach is in the classic American tradition of free enterprise. Many companies, such as Electronic Office Centers of America in Chicago and TEL-Management of Dallas, have sprung up to fill the perceived needs of developers, and many are doing a fine job. Usually those who succeed are strongly motivated and have a strong sense of mission in providing new—and highly profitable—services.

Ed Goodman, founder of TEL-Management, is a pioneer in the shared services business. Before starting the business, he had installed some 40 major switches in his career for such users as MCI, National Semiconductor, Equitable Life of New York, Signetics, Tektronix, and the military. A former design engineer, he was with Danray for four years, both before and after its acquisition by Northern Telecom. He was also a program manager for the Sprint program and was in military communications.

His first shared tenant services project, one of the first to come on-line in the nation, was in the first office tower of the posh multi-use Galleria project in Dallas. At the time he planned the new venture, FCC regulation of resale had not yet been lifted, and most real estate developers had not yet become so keenly aware of telecommunications enhancements for real estate development. Goodman convinced Galleria developer Gerald D. Hines to allow him to cable the office tower from the telephone company riser cables, for the purpose of offering enhanced communications services to occupants. By that time, construction was too far along to include the retail mall portion of the office-hotel-retail complex.

Goodman approached InteCom, which had just developed a large "third generation" switch with the integrated data and voice capabilities that could provide the enhanced services. The InteCom switch had demonstrated its capability to permit partitioning, which enabled a large number of brokers to be served independently at the Chicago Board of Trade, one of the very first shared tenant services installations. Goodman recalls the irony of his difficulty in convincing InteCom, now one of the leading switch suppliers in this field, of the potential market for shared tenant services as he envisioned.

TEL-Management now serves some 75 clients in one Galleria Tower. Tenants range from one-person offices having only a single telephone to such larger operations as an insurance company headquarters, a local office of the stock brokerage firm of Smith Barney, a large telephone sales room for another insurance company, and even AT&T Information Systems.

Customers can sign up for their own circuits with the telephone company and with other common carriers if they wish. TEL-Management guarantees a substantial discount on toll charges if it provides the long-distance service and it employs a sophisticated least-cost routing in its mainframe computer. Detailed call accounting is provided to whatever degree is desired by each customer.

TEL-Management provides all the station equipment, including several types of electronic telephones of various degrees of sophistication offered by InteCom. Surprisingly, TEL-Management's operations group is the only current user of data processing on the system (other than the call detail records of customer traffic and related accounting). Currently, however, TEL-Management is in the system definition phase of providing much more sophisticated data services for the insurance company whose headquarters is served by the system.

Emphasis is on service and customer satisfaction. The company plays down any emphasis on pure telephone service. Goodman regards his company as being in the technology management business, rather than merely communications or telephone. He believes that those who seek to enter the business by merely marking up the investment in a colleciton of hardware will not survive over the long run. Tailoring services to clients' needs and making sure that they are satisfied will make a business grow profitably. Goodman says:

> Our most profitable service is "the service representative." Our clients call us for everything under the sun—including plumbing failure. The company's network management group maintains the integrity of the local network, including transmission quality, even on a customer's private trunks carried through the switch. We are on the spot and we can respond immediately. We work hard at maintaining a good working relationship with Southwestern Bell, and they are probably one of our staunchest allies. We'll call the common carrier for the client and get the matter straightened out—and much more efficiently than if they had to do it themselves.

TEL-Management people talk with customers on almost a daily basis. It keeps the customers happy and leads to new business. "One five-minute conversation yielded $10,000 to $12,000 a month in new revenues," Goodman said proudly. "As tenants learn more about what they can get from us, they keep expanding their service."

TEL-Management's next project was the new Unitedbank Plaza, a 350,000-square-foot office building by Wortham, Van Liew & Horn in Houston. Here the climate had substantially improved over that of the start-up days. The management welcomed TEL-Management enthusiastically and promotes its services vigorously. So far, 90 percent of the tenants have signed up for TEL-Management services, suggesting that the enhanced services provided have been an effective inducement for tenants to choose this facility. In contrast to the Galleria Tower, there is very high usage of the relatively profitable data processing and transfer services. In LTV Tower, United Technologies has disbanded efforts to sell data processing services in favor of selling personal computers directly to the tenants.

In the Unitedbank Plaza project, one of several in Houston, TEL-Management is employing a Rolm switch, which Goodman and his staff have helped configure for this kind of application through design specifications. TEL-Management asserts that it is not committed to using any one product line but will employ those that best fit the needs of each project.

Like its InteCom equivalent, the Rolm switch will have the capability of being partitioned into about a thousand "compartments" and will offer whatever kind of integrated LAN configuration the customer desires. The Rolm Cypress personal communication terminals are offered, as well as other electronic telephone terminals. As with the InteCom system, all station wiring is over conventional two-pair cables, now essentially an industry standard. Although the Unitedbank Plaza system is already in service, the final configuration specified by TEL-Management will not be operational until June.

As in the Dallas Galleria project, the system will have its own full-time resident network management and service group. Customized software and system definition is available to tailor services to individual needs. Each building will serve as its own profit center, audits services will be tailored to the needs of local clients in keeping with Goodman's emphasis on user-friendly service. TEL-Management is developing similar operations in Houston, Dallas, Austin, and cities in other states.

In-house services. A different approach is that taken by Lincoln Property Company, currently ranked as the second largest privately held real estate developer in the world behind Trammell Crow. Lincoln is the first major real estate development firm to form its own subsidiary corporation to provide high tech shared services for its tenants.

Lincoln's attention was drawn to the changing communications situation by the growing confusion surrounding future provision of basic telephone and other communications services, ownership of building wiring, and similar uncertainties caused by the dissolution of the Bell System and the changing regulatory situation. After conducting studies with the help of consultants, Lincoln made the decision to develop its own telecommunications capabilities.

Lincoln's philosophy is to control every aspect of the management of its properties rather than depend on outside contractors or services, primarily in order to maintain higher quality standards. Like other developers, Lincoln quickly determined the problem was not simple and that substantial technical expertise would be required to provide modern technical services to the same high standards it follows in managing other aspects of the properties.

Robert Dammeyer and Gary Peacock, partners in their own shared tenant services company, approached Lincoln in the summer of 1983 to propose providing such services. Instead, Lincoln convinced them that they would do better establishing a wholly-owned telecommunications subsidiary to provide enhanced tenant services for all new Lincoln properties. LinCom Corporation was formed and a corporate business plan prepared by Dammeyer and Peacock. By November the new group had committed to the purchase of $50 million in InteCom switches for 17 new buildings in eight cities across the nation.

The company's projects tend to be on the large size—the typical high-rise building is said to average perhaps 700,000 square feet. One of the new projects for which LinCom will provide communications and other amenities is an island in Tampa Bay. There Lincoln will build office buildings, hotels, and other facilities in what amounts to a planned community.

The initial thrust for LinCom will be to work with only the office buildings and hotels because of the magnitude of the work to be done. Later, resale services and other services will be added for other residential properties. In addition to providing a full range of LAN capabilities, video conferencing facilities, data processing, call accounting, and lower-cost long-distance calling, Lincoln will also offer access to such data bases as The Source, Lexis, and Dow Jones.

Lincoln has recently entered into an agreement with one of its major equity partners, Metropolitan Life, to handle all telecommunications in Metropolitan Life buildings in the nation. Unlike most other shared tenant services, LinCom will handle all toll traffic through a single carrier, Satelco. Satelco has already begun construction of facilities to tie into the first 17 buildings now under way.

Dammeyer emphasizes that the unique characteristic of LinCom is that it is an integral part of the property itself: "We provide our services for the benefit of our tenants only. We're not an interconnect company; we're not a communications company, as such—we're an amenity of our property."

According to Peacock, as a part of Lincoln Property Company and dedicated to enhancing the property and making it more attractive, LinCom "might not be as profit oriented as some of the third-party companies (such as TEL-Management) might be. We will show a profit in the form of a management fee to get our system installed and provide its management, but our main function is to provide the buildings with the highest quality service capabilities."

The communications company. The third type of operation in the shared tenant services field is the large communications company. Several of these are being formed or are evolving from earlier forms to provide shared tenant services. One of them is SBS Real Estate Communications (RealCom), a subsidiary of Satellite Business Systems of McLean, Virginia. SBS is in turn a subsidiary of Aetna and IBM. RealCom will specialize in supplying the hardware and system management to provide the full package of services desired by the real estate developer. RealCom has also joined forces with Ameritech, one of the regional Bell holding companies to provide STS services.

United Technologies is another major factor in offering enhanced office buildings. UTC is a holding company for Carrier Air Conditioning, Otis Elevators, Lexar Corporation (which makes an advanced voice and data switch), and United Technologies Communications. The UTC companies offer a fully integrated approach to building equipment and automation. UTC projects include LTV Tower, Crystal Gateway, and Skyline city office complexes near Washington, D.C. Recently, UTC has entered into a joint venture with AT&T to provide shared tenant services. The joint venture, ShareTech, is a formidable competitor and because of AT&T's involvement will have a major impact on the industry.

Another ambitious operation undertaken was announced in mid-November by OlympiaNet, a joint venture of United Business Communications and Olympia & York, one of the largest real estate developers in North America. Its headquarters are located in Toronto, Canada. United Business Communications is a subsidiary of United Telecom, third largest telephone holding company in the United States.

OlympiaNet will be a far-ranging telecommunications network serving the tenants of Olympia & York buildings. The services will include discounted long-distance services obtained through bulk agreements with all the major carriers, video conferencing, and the full spectrum of telephone and integrated voice and data services.

OlympiaNet will establish a full national and international telecommunications network using the satellite facilities of ISACOMM, a United Telecom subsidiary, as well as terrestrial facilities. UNINET, another United Telecom subsidiary specializing in data communications, will provide data communications services to the network. Individual building communications will be provided through InteCom switches.

One of the reasons for selection of the InteCom switch, in addition to its large capacity and partitionability, was its capability of serving a number of buildings from a central location. In this kind of operation, an interface multiplexer (IM) at a remote site as far away as 10 miles provides local data and voice switching under the supervisory control of the central switch over a 4,800-baud data line.

Olympia & York, which owns numerous buildings in New York City and is currently constructing an office complex of more than 8 million square feet, has said that they expect to establish central switching locations in mid-Manhattan and will be pulling in their own fiber optic cables to link all of their buildings. They also own buildings in eight other U.S. cities, totaling 23 million square feet. They have indicated that they intend to retrofit all their existing buildings with the enhanced shared telecommunications features and full access to the OlympiaNet national and international network.

Although the dissolution of AT&T and deregulation appeared to create considerable chaos, the net effect appears to be the opening of floodgates of innovation that will set the new standards for communication, personal services of many kinds, and quite possibly new economies of scale that have not been seen before. The opportunities for enhancing the telecommunications capabilities of almost every size business have never been better.

■ CONCLUSION ■

The information herein provides only a thimble full of what is necessary to make intelligent decisions on what type systems to provide in the construction or renovation of an office or industrial facility. There is very little evidence that these new systems have lured users into equipped facilities rather than nonequipped ones, but it is a safe to assume these high tech systems will become as commonplace and be in as much demand as air conditioning.

It is also safe to assume today's unsophisticated space user will become educated in very short order as to this new technology. And an otherwise class A structure will be relegated to class B or worse if it doesn't have integrated systems. Those firms providing tenants' space and new technological advances will continue their marketing efforts. The heretofore unsophisticated user will become educated in a hurry and will not be satisfied with any structure that does not offer these new advances.

Owners and developers will be concerned with building services, telecommunications, and communications. The advanced systems *do* save operating cost dollars, which is important to the user as well as to the developer of space. And, because of divestiture and deregulation, the provider of space must be concerned with telecommunications. Other communications, such as data transmittal and video teleconferencing, are not in extremely high demand by the standard space user today but are gaining importance. There is strong evidence the desktop personal computer will be replaced by communication links from the desktop to mainframes.

Designers must keep up with industry trends and must be sure that even if sophisticated systems are not initially installed, the building can later be retrofitted to incorporate new technology to avoid obsolescence. Do not overly rely on your tenants to forecast their future requirements. One must also be aware of the demands to be placed on electrical and mechanical systems, since power consumption at the desktop level will increase, as will the heat generated by the new devices foreseen in the office suite. Finally, wiring

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closets, risers, and conduit space should be more than adequate to last for the next 30 years.

Having accepted the intelligent office as the wave of the future and contemplating the installation of these systems, one must be aware of what actually needs to be provided—not what a salesperson tries to sell. Not all the bells and whistles are necessary to provide an efficient workplace—in spite of the more-is-better theory. Rather, it is best to provide the services necessary for the optimum efficiency of the facility for the owner and user alike.

In some form a building owner will be in the telephone business and must decide how the service will be provided. All three of the scenarios mentioned in this chapter have positive and negative implications, but whatever method is chosen to provide telecommunications services must fit into the overall business plan of the building owner and the anticipated user mix. Providing telecommunications service is management intensive and tedious. Communication is the lifeblood of American industry and should be taken very seriously.

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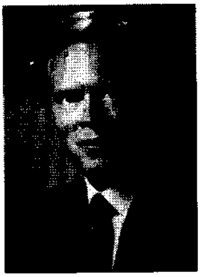

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In his present capacity, Henry oversees site acquisition, leasing and sales of office and industrial facilities in a seven-state region. Prior to joining Merrill Lynch, he was involved with the leasing and development of more than 5 million square feet of office and industrial facilities with the Trammell Crow Company and Lakeview Properties.

Companies which have utilized Henry's services include American Airlines Inc., Texas Instruments Incorporated, Teledyne, Harris Communications, Sunbeam, Foremost-McKesson, Ampex, Aerospatiale Helicopter, LTV Corporation, Halliburton, Union Carbide, Continental Can, St. Regis Paper, Lennox, R. J. Reynolds, Continental Insurance, 3M Company, and Merrill Lynch, Pierce, Fenner & Smith, Inc.

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Chapter 8

Multi-Tenant Telecommunications Services: Winning Strategies and Opportunities

Theodore H. Schell
SBS Real Estate Communications Company—RealCom

Outline

A PERSPECTIVE ON THE TENANT SERVICES INDUSTRY

In 1980, when I was asked to spend a few hours one day with a group of ÆEtna executives to explore a notion they captured with the then-novel phrase the "smart office building," the concept of tenant services was an unrefined notion in the minds of its inventors. Those few of us who were then struggling with the concept felt very lonely, a problem we no longer have.

Initially, our perspective was that of technologists engaged in the development, management, and funding of telecommunications technologies and technology-based communications ventures. The goal was to equip buildings with technologies that would assure tenants of their long-term ability to receive and transmit signals of various types and bandwidths. With that meeting, an odyssey began that led the SBS partners, ÆEtna, COMSAT, and IBM, to establish RealCom, which was the first entry into the tenant services business by a major communications company.

After much analysis, consideration, and deliberation, the mission of RealCom was carefully construed. In the end, it intentionally did not emphasize technology per se, since we had consciously moved from a "technology push" to a "demand pull" strategy. Simply stated, our emphasis was placed on service and not on the provision of technologies; and we gave RealCom the mission of working with the real estate community to provide fully integrated, end-to-end telecommunications *services* to tenants of multi-tenant office buildings. Our emphasis had moved from technology to service because we realized that users would prefer the technology to be totally transparent to them. Our conclusion was that tenants were interested in what the technology would do for them, in the simplicity and ease of its operations, and in its reliability—and that communications end users would benefit significantly from an in-building service provider that assured the availability of communications capabilities whenever needed from a single, fully integrated service provider at a competitive price. This was particularly important due to the pace of deregulation, the then impending divestiture by AT&T of the Bell Operating Companies, and the rapid rate of change in telecommunications technologies.

A TENANT SERVICES STRATEGY

In defining RealCom's mission and its approach, we enjoyed the advantage of being able to join within one corporate family the four business perspectives that I believe all firms associated with tenant services—whether they are developers or service providers—must have. These perspectives are that of the real estate developer, the communications company, the investor, and the office automation and communications technology industry.

The Developer's Perspective

From the perspective of the real estate developer, we drew the following conclusions, which became design parameters for RealCom's offering and which we believe appropriately apply to all shared tenant services offerings.

1. We decided that it was extremely important not only to provide a telecommunications service capability that would help assure the long-term ability of tenants to gain access to the range of communications and office automation services likely to be required over time, but to do so in a manner that placed the least strain on the infrastructure of the building.

2. We concluded that to be attractive to tenants a telecommunications offering needed to be designed in a manner sensitive to their real needs and perspectives. The package must yield direct economic benefit to the tenant in the areas of overhead control, productivity enhancement, and assured communications reliability, thereby differentiating the building from others in the marketplace and encouraging lease up, both initially and over time. From a developer's point of view, the offering must be responsive to tenants' needs; place an emphasis on service; facilitate, rather than block, a tenant's access to advanced communications capabilities; be competitively priced; and be solid, reliable, and sure. In short, it must reenforce, not detract, from the tenants' overall perception of building quality.

3. We believed further that offering tenant services represented an opportunity to enhance a building's value, but concluded that the increased net income from a telecommunications offering was less than what most developers might imagine.

4. After dealing with more than 25 consulting organizations, numerous financial analysts, a slew of regulatory experts, every major PBX manufacturer, and a number of interconnect companies, we concluded that a service provider must be well capitalized and committed to the communications industry. The tenant services field is not a business to go into unless one is prepared to become a fully integrated and broad-ranging telecommunications company. One must also be careful to select a provider that is free from conflicts of interest that may constrain rather than enhance the availability of services and products to tenants.

5. We believed that, from a real estate point of view, it is very important to maintain distance between the service provider and the building owner. We concluded that the optimal transaction should be between tenants and the service provider, while the developer's role should be that of enforcing the quality of service as a last resort in assuring the overall quality of the building's amenities package. The developer, in sum, should not be the communications provider, because he is neither equipped to address the complexity of the undertaking nor desirous of linking the provision of space to the provision of communications services in the mind of the tenant.

The Communication Company's Perspective

The second perspective that is critical in implementing a tenant services offering, and one following from the above, is that of a communications company that understands not only the complexity of delivering high quality communications services but also the implications of: rapidly changing telecommunications technologies upon the delivery of telecommunications services; the rapid pace of deregulation; and, the consequences of the divestiture of the Bell Operating Companies (BOCs) by AT&T. The blending of business, regulatory, operational, and technological concerns must be thoroughly identified and understood, particularly as they relate to the perspectives of the property owner. In addition, the perspective of a communications company is essential to the definition of effective marketing and sales strategies. Again, the complexity of the undertaking cannot be minimized.

The Investor's Perspective

Our third perspective is that of the prudent investor in capital-intensive telecommunications enterprises. We clearly understood the need to implement a demand-driven strategy to prevent financial losses of such a magnitude as to render problematic the realization of an acceptable, long-term return on investment. From the investor's point of view, we considered issues of technological obsolescence, the balance of installed versus utilized equipment, the downward price curves of underlying technologies, and the appropriate mechanisms for capital equipment financing, to name but a few.

The Automation Industry Perspective

The fourth perspective we considered essential to an understanding of the tenant services business is that of the information processing, office automation, and communications hardware industries. In general, we recognized that there is a real trend toward decentralized processing and a likely erosion of the economies of scale in equipment installations as the growth paths of installations become increasingly linear. Further, we recognized that once one concludes that a computer does not have to be located in the end-user's own space, there is no particular magic to a computer's being located in one place versus another. In this industry there is also an increasing level of integration of communications and office automation functions and a need to understand both sets of applications in order to bring forth an offering of maximum utility over time. Issues of cost recovery, product design, and methodologies for service delivery are but a few of the problems that this last perspective helps to resolve.

In being able to blend these four perspectives, we addressed such complex issues as technological obsolescence, downward price movements of technology, and concerns for the proper placement of enhanced service delivery technologies at the appropriate point in the communications hierarchy—the desk, the PBX, the central office switch, and the long-distance network switch. All of these issues must be addressed and understood by anyone who is either entering the industry or bringing a service provider within a building. These perspectives clearly underscore the complexity that in the end will affect the short- and long-term success of any offering.

The deliberations of those that created RealCom were not the only ones taking place. The deliberations of other small groups—some starting from the perspective of the building systems industry, others from the equipment manufacturing industry, others from the transmission industry, and some simply from the perspective of the seasoned communications professional who recognized the entrepreneurial opportunity—has resulted in an avalanche of market entities and in an incredible array of service providers, all of which have superficially similar offerings, but reflect, in the end, some substantial differences in the nature of offerings and their implications for tenants. To choose wisely a developer must seek to understand the differences in providers' strategies and offerings. A recent occurrence hints at the complexity of choice. Recently, a request for proposal (RFP) was sent by a developer to approximately 22 firms selected from a list of about 40 identified providers. The names of many of these companies are well known. In addition to RealCom, they include UBC, ATTIS, MCC Powers, EOCA, CP National, and United Technologies. Although these groups provide similar services, none of their offerings are really the same. There are subtle differences between the array of services and the characteristics of providers that developers need to understand and evaluate.

PROBLEMS AND RECOMMENDATIONS

The tenant services industry is today very crowded. This is a comforting feeling in some respects to those of us who were lonely a few years ago; but from another point of view, it is disquieting. One should not be deluded by the number of actors into thinking that a crowded industry, one in which all of the "big companies" have jumped in, is a mature industry.

Lack of Consensus

In spite of the billions of dollars committed to developing the industry, there are many profound indicators of the industry's infancy:

There is no consensus as to what constitutes an appropriate service offering.

There is no consensus as to the appropriate characteristics of a good service provider.

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There is no consensus as to the characteristics of a "good deal" between a service provider and a developer.

There is extraordinary variance in the projected financial results in the pro forma income statements developed for projects by virtually all providers.

There is an extremely prolonged sales cycle between the developer and the service provider.

There is no firm understanding of the levels of profitability within the tenant services industry, or of the relationship that will hold over time between gross revenues and net profits.

There is an extraordinary use of consultants by developers, despite an inadequate understanding of the business on the part of many within the consulting community. There has simply not been enough experience within the industry to permit a detailed understanding of its operating dynamics to pass from providers to observers and analysts. The operating industry is too young for its participants to have found their way into consulting practices. The revolving door that exists between operating companies and the consulting community has not as yet revolved in the tenant services industry.

Finally, there is turmoil—witness the new actors jumping in virtually every day and the number of small- and medium-size service providers (including real estate firms who undertook the endeavor on their own) who are already going out of business, seeking larger providers willing to buy them out.

Recommendations

Although the industry is immature, it is beginning to manifest some trends. In studying these trends, lessons and recommendations for developers and providers alike can be drawn:

Beware of the technology-push strategy. Technologies have no value unto themselves. They are only as valuable as the services they provide. Investment in technology is only as justified as there is a market for the services it delivers at the price that must be charged in order to realize an acceptable return on investment.

Developers, as well as service providers, too frequently adopt a technology-push strategy, install capabilities that the target market represented by a building tenancy neither requires nor wants, and incur very significant costs as a result. There is no clear indication that the demand for many of the services embodied within these technologies—and deliverable through them—will ever manifest themselves sufficiently within a building to justify the investment. In many instances, the investment by a service provider in virtually everything beyond basic voice and low-speed data transmission falls into this category at the present time, particularly if the installations are in speculative office buildings whose tenancy is a big unknown. Wide-scale investment in speculative services will lead to substantial start-up losses that can be easily predicted. These losses will put smaller providers under and cause even some of the very big actors to rethink their approach and attitude to the business. In the long term, the only one that really stands to gain from the technology-push strategy is the manufacturer or vendor of the equipment whose bills are paid by the overambitious service provider or developer. In the end, it will inevitably be the property owner who will lose if the service provider goes under and the responsibility for operating the system falls back on the developer.

Adopt instead a prudent demand-pull strategy. Be confident of the fact that tenants will not be attracted by offerings they do not need but will respond well to an evidenced ability to provide the required capabilities when they are needed. "High glitz" may catch someone's attention, but useless technology will not help close a sale. It may even prevent one if prospective tenants believe that the availability of capabilities they do not need will mean increased costs to them.

Costs of underutilized equipment. A related point is the holding cost associated with underutilized capital equipment. The longer it is unproductive, the higher the probability of nonrecoverable losses. Thus not only must one be careful with regard to the speculative investment in enhanced service capabilities, but one must also be very careful that the installed capacity and capabilities in a building match very closely the capacities and capabilities actually utilized by tenants at any given time. When the two are out of phase, the proverbial bottomless pit opens.

Because the cost of communications technologies is going down, tenants and service providers alike have a great deal to gain by waiting to stage investment in these technologies until there is an economic use for the services the technologies embody.

No pot of gold. There is a pervasive myth in this business that has to be exploded—the myth that there is an enormous pot of gold at the bottom line of the tenant services pro forma rainbow.

Obviously, neither RealCom nor its investors nor its many competitors would be in this business without believing it to be profitable. However, the returns are not as sure or as grand as some suggest. Despite the natural linkages between the tenant services industry and the mainline business of RealCom's owners and teaming partners, the business must be managed very carefully to minimize costs, enhance margins, and assure profitability in the face of enormous uncertainties over the life of an installation within a building. RealCom has had to come to grips with a few conclusions:

> The tenant services business is a supermarket business, not a jewelry store. The margins are small, and they will shrink over time in the basic voice and data offerings, particularly in the area of long-distance resale. However, the volumes will be there, along with profits, if the management of technology is astute and the scale of operations is very large. We believe further that long-term profits will be realized in the enhanced services area, but timing is crucial, and the manner in which each offering is construed and brought forward is critical to success.
>
> Furthermore, do not think of the ability to capture investment tax credits and depreciation allowance on telecommunications equipment as a windfall. To be competitive, the value of such tax benefits must be flowed through to the end user and reflected in the rates charged tenants. Otherwise, tenants will view the offering as noncompetitive. Tenants always have the choice to purchase a stand-alone system for themselves and in turn capture the tax benefits. Consequently, the value of such benefits must be reflected in the rates charged to tenants.

It is very important to recognize from the outset that long-term equipment losses cannot be subsidized by long-distance transmission profit. Beware of the cross-subsidies in the business case. Do not think that you can project seven-year losses on the equipment and make it up, for example, with seven years of high, sustained profits from the long-distance resale operations. In all probability this will prove to be nonsense. But whether or not it is possible, in looking at pro formas take a good look at the underlying assumptions on which costs and revenues are based, and look at the relationships between lines of business.

Ask questions about the cost of equipment assumed and the cost of long-distance and local transmission. Make sure that little things like the cost of white- and yellow-page listings are not left out. Then determine the minimum price for which the offering must be sold to yield a profit. Finish off with a look at the prices of competing products in the marketplace. See what they cost, and determine if your offering is in fact competitive. Do not assume a revenue stream based on a cost-plus-margin calculation, for if the competitive market does not validate the offering at a given price, a sale to a tenant will not be made. Make sure the buildup in revenues tracks the probable leaseup and occupancy of the building, and see if the costs build in a way that matches.

Be skeptical, therefore, of pro forma income statements that appear around the country for residential installations, for example, which project high acceptance and profitability from an offering that must be three times the cost of residential service to break even. Equally absurd is the projected $5 million-positive cash flow over five years that I saw projected in a pro forma from a 1 million-square-foot building when most of the revenues were to be derived from enhanced voice and data services for which no such market can be definitively projected at this time within a speculative office building.

Buy wholesale. Equipment costs are critical, and once purchased their cost is fixed! If you buy at retail and sell at retail, you lose money. You cannot bet your business case on the likelihood that tenants will perceive such value added that they will be willing to pay substantially more for your in-building service than the friendly equipment vendor or consultant will suggest they have to pay for an alternative stand-alone system. Therefore, buy your equipment cheap, and be careful to look at the life-cycle cost of the equipment. A great deal of equipment is being installed daily in office buildings that, given its purchase price, its life-cycle cost, and the degree to which its capacity and capability outstrip near- or intermediate-term demand, will generate very steep, long-term losses. In many of those instances, if not all, there will never be an overall profit. This would be all right if this phenomenon were understood by informed system buyers and if other values were derived, e.g., if the developer calculated a return in terms of enhanced leaseup and swallowed the losses on that account from capital or tenant allowance budgets. It is not acceptable, however, if the service provider incurs such long-term losses, because this will jeopardize the provider's long-term viability or, at least, long-term interest in the business. If the provider bails out, it is the property owner who is at risk. So I would caution developers to look carefully at their capital equipment costs in the context of the competitive marketplace and at the underlying cost and capital structure of alternative service providers.

Tenants may require different solutions. Do not kid yourself into thinking that a single switch, regardless of its elegance, will be all things to all tenants.

Hybrid solutions will be essential, if for no other reason than the real need to be competitive with stand-alone offerings. Interestingly enough, users in the under 10,000-square-foot range may have cheaper alternatives than using the building system, unless hybrid installations are engineered. So design very careful approaches to addressing their installations. Be creative.

Recognize also that there will be instances in which people simply want their own installations. Be prepared to deal with this by recognizing that the tenant services business must be a full-service business, and the provider must be a facilities manager to some, a full-service provider to others, a network provider to others, and so on. As a full-service provider, the provider brings to the developer a capability to address the needs of the tenants, whoever they are, and without regard to whether or not they already own their own systems. The economic life of a full-service provider does not depend so critically on variations in the characteristics of the tenants who move into the building. In sum, tenant services providers should be able to involve themselves in almost every communications dollar spent within a building and to bring value to tenants by so doing. This is a very fundamental aspect of RealCom's approach to the business.

Continuing responsibilities. Let me explode the myth that a developer can install and operate a switch with ease, that there is nothing more to it. The future requirements of tenants will prove otherwise. Begin with a recognition of the ongoing need for continual network balancing, given changing traffic patterns and tariffs, and end with the tenant who may request an integrated voice mail-automated message center capability be installed in a switch that, in turn, needs software upgrades. Consider the need for integration of an office automation system with a switch that needs a higher-level software package or is fundamentally an analog switch. You will recognize that, without the cooperation of the service provider, tenants will be blocked from addressing their needs; and the costs of meeting tenant requirements, both engineering and hardware, can be very high. The provision of tenant services is not a one-shot endeavor. It requires a low-cost access to far-ranging expertise that is continually aware of the overall status of a system's hardware, software, and cabling. The unprepared provider will create very significant problems for tenants over the long term.

THE CHARACTERISTICS OF A STRONG SERVICE PROVIDER

Given the above, it is clear that the developer needs a partner—an expert, full-service telecommunications company with which to deal. The key question for the developer is that of the characteristics of a good provider.

Survivability

A provider must be able to evidence an ability to survive in business for the life of the building and must have a sufficiently broad commitment to the telecommunications industry in order to guarantee continued interest in the tenant services business, even if the business were to turn out to be a marginal one. Providers need capital, backing, and natural linkages to fundamental aspects of the telecommunications industry—particularly to the transmission, equipment, or service aspects—in order to assure sustained commitment. Otherwise, there is a considerable risk with regard to their staying power. The long-distance resale margins will likely decline very significantly over the next few years, and should transmission become a bulk commodity, it will be very important for providers to have underlying reasons to sustain their interest in the business.

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Independence

Next, a provider must recognize that the linkages that will sustain a commitment to the tenant services industry may also give rise to real conflicts of interest between providers and developers, or between providers and tenants, or among all three. For example, equipment manufacturers will have a bias toward their own products (as may transmission providers), and left unchecked, the tenant may suffer. In turn, look to a provider who has developed, or is willing to develop, a methodology for dealing with these conflicts. As noted, such conflicts usually grow out of linkages that give the provider an interest in the business to begin with. For example, RealCom deals with its linkage to SBS's transmission by commiting itself to purchase such transmission only when all else is equally acceptable to a tenant—both cost and transmission characteristics. Others who manufacture equipment or who are tied to vendors with long-term procurement contracts must be prepared to go beyond such relationships in responding to tenant needs on a timely and cost-effective basis.

Economic Sophistication

Next, providers must absolutely understand the economics of the equipment, transmission, and enhanced services business, as well as their own position within those industries. They must be able to demonstrate such an understanding in the way in which the project pro forma income statement is developed. Any pro forma developed without a considered discussion with a developer regarding building occupancy schedules and likely tenant profiles is a pro forma that has little basis and reflects badly on the understanding that the provider has of the business.

Technical and Regulatory Expertise

Next, providers must have access to a very wide range of technical expertise in all underlying aspects of the tenant service industry; they must remain aware of the regulatory environment within each state in which they conduct operations; and they must purchase equipment very cheaply and have access to a very wide equipment/product line.

Realism

Look for a service provider who is skeptical that capital-intensive enhanced services will be bought by tenants. The provider's real concern is that the capital investments in technologies required to deliver enhanced services must be staged to reflect high-probability user demand based on the emerging profile of tenants who will actually occupy the building. Those providers who are somewhat risk averse have a healthy outlook and a far higher probability of success and of a sustained interest in the business.

Image

Be concerned with the image the provider projects to tenants who will be occupying a building because after the relationship is cemented with the property owner, the provider must then sell services to the end users. To do so, the provider must appear credible. Paramount in the end user's mind will be concerns for the provider's reputation, service record, and reliability as a communications company. Tenants who place their communications requirements in the hands of a service provider will want assurance that the communications company is experienced and credible.

Long-Term Commitment

Finally, one should not lose sight of the fact that the provider/developer relationship is a very long term one; remember also that the provider's investment is only about 3 percent of the overall building's cost. Make sure, therefore, that the provider is a good partner; make sure that you know and understand one another and that, as a property owner, you are convinced you can work with the firm. Make sure that the provider understands the relationship as a partnership, regardless of its legal construal; and make sure that there are open channels of communication to the firm's senior management whenever necessary. In many ways, a developer needs to be dealing with a large and well-capitalized organization, or the risks are enormous. In another sense, however, the property owner must feel secure that the provider's organization is set up in such a way as to assure the developer rapid responsiveness to the needs of the building and its tenants.

CHOOSING A CONSULTANT

In choosing a provider, a developer may elect to work with a consultant. I would advise care and assert the need to choose wisely. If you do choose wisely and understand where the consultant's expertise begins and ends, you will do well. In the end, however, you are entering a partnership, and you must become involved and knowledgeable with the service provider and exercise independent judgment in choosing between finalists.

A good consultant understands that the technological considerations are only a small part of the overall concerns and understands that a qualified service provider is one who is qualified to select, engineer, and operate the requisite capital equipment, and market relevant services to tenants. Therefore the issue is not, fundamentally, a technological one when it comes to selecting a provider. It is rather one of evaluating capabilities, service orientation, staying power, relationships, and commitment. The expertise of the consultant must go well beyond technical matters. The real concern will be in the evaluation of business issues, which involves an in-depth understanding of the economics of the business as the different providers approach it. The consultant must be able to help you develop such an understanding. Thus the typical telecommunications consultant who specializes in technological evaluations of competing hardware or transmission offerings must buttress technical expertise with the economic and business understanding of a very complex business—with the latter being far more important. The real issue is not technology but the level of confidence you have in the provider's understanding of business issues and the manner with which they are dealt.

THE DEAL

Finally, to understand the characteristics of a good deal, it is valuable to remember a fundamental principle: A good deal is one in which everyone's needs are met. The developer must have a service provider who is credible and reliable and who emphasizes service in response to tenant needs. Developers must therefore recognize that to the degree to which their call on the revenue stream of the tenant services provider undermines the profitability of the provider or the price competitiveness of the offering to tenants, the offering will fail. It is in the interest of the developer that the undertaking of the tenant services provider is a profitable one, providing a sufficient return on investment to maintain the long-term interest of the provider in providing high-quality, responsive service.

Distributing the Revenues

The determination of the appropriate distribution of revenues must take into consideration not only the long-term commitment by the service provider, but also a further understanding that to the degree to which the undertaking is important to the long-term leaseup and currency of the building, the developer is realizing financial gain from the service provider's investment, independent of a participation in revenue streams. The developer gains from the provider's commitment, from the long-term quality of the offering, and from the provider's willingness to make future investments of capital in the building's system. The developer loses, however, from an economic failure on the part of the service provider and risks failure if the provider's margins are squeezed. Furthermore, it must be remembered that the provider has a very small constrained marketplace to address—the provider's market is constrained by the size of the building.

This is all common sense; but, in the context of a business in which the economics are poorly understood even by the most experienced providers, common sense is hard to apply. I and many others believe that profits will be sufficient to make a tenant service offering a profitable undertaking for qualified providers in qualifying buildings. However, it is unclear how the economics will play out in the long term, and the economic future of all service providers is clouded substantially by providing to the building owner a participation in the gross revenue stream of the tenant services business. Any deal in which the developer participates in a percentage of the gross revenues is problematic and very risky to all parties. At the very minimum, flow-through revenues must be exempted, but the problem is even more fundamental. First, not even the most experienced providers know enough about the relationship between revenues and profits to know what is being given away and what is being kept, and such relationships between gross receipts and net income can be affected in regulatory change and external competitive forces—particularly in the long-distance transmission areas—that are beyond the provider's ability to control. Consequently, revenues could rise and profits fall at the same time, as would result, for example, from increases in the cost of providing local transmission. Furthermore, there is the fundamental fact that the tenant services business is a very capital intensive one and as such will likely show a high return on equity and a low return on sales. In sum, percentage of gross participation by a developer could cause a service provider to lose considerable amounts of money, thereby calling into question the viability of the operator and, in turn, the ability of tenants to realize their needs. The real estate community concluded some time ago that an anchor department store within a shopping center would be subject to different rental schedules than the small-mall tenant, in part due to the financial structures of the anchor and in part due to the realization that the quality of the anchor tenant would effect the overall draw of the mall. A similar recognition with regard to the tenant services industry is in order.

Agreement Term

Another key point is the length of the term of the agreement. It must be sufficiently long so as not to erode the provider's incentive to invest in enhanced service technologies over the course of the provider's tenure within the building. As the term draws toward the end, one's incentive to provide new services or to migrate technologies will erode because of the artificially truncated payback periods. A 10-year term would seem the minimum acceptable length.

Most important, the developer and the provider should make sure that the arrangement is founded on trust and that there is a strong commitment on the part of both parties to making the endeavor work. Provisions should be made for termination of the agreement for cause, but the interests of all parties has already been undermined at the point at which such termination is required.

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■ CONCLUSION ■

The tenant services industry is immature, and it is fraught with unknowns and with an inability to predict all of the problems that may arise over the life of the service provider's tenure within a building. Thus, regardless of the structure of the transaction between a property owner and a service provider, the relationship is truly a partnership. If the parties bother to understand each other, and if there is a mutual feeling of good faith, then there is a high probability that the interests of the building owner, of the tenants, and of the service provider will remain coincident through time to the mutual benefit of all.

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Chapter 9

Case Study of a High Tech Corporate Headquarters-Planning Research Corporation

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Outline

Such buzzwords as *smart buildings* and *intelligent buildings* are commonly used to describe and market high tech buildings. These terms, however, are misused, since it is not the buildings that are smart or intelligent but the people who design and operate them. It is the technical knowledge and creativity of the people who engineer the high tech building that generates positive results. Yet, ingenuity as well as effort can be wasted if not properly coordinated and directed. One positive approach that has proven successful in the development of Planning Research Corporation's (PRC) headquarters has been the merger of two disciplines, that of the facilities manager and the telecommunications manager.

Today's well-engineered, high tech building incorporates sophisticated security, climate, energy management, lighting controls, and voice and data communications systems served by one or more computerized systems. To accomplish this level of sophistication cost effectively, the need for teamwork between the facilities manager and telecommunications manager is essential and must begin during the initial planning stages of a building project, whether the building is owned or leased. This teamwork premise was adhered to in the planning, design, construction, operation, and management of PRC's headquarters building in McLean, Virginia, a suburb of Washington, D.C. The result is a model for the high tech building of today. After three years of occupancy, it still stands in a class by itself—a highly flexible, energy-efficient, cost-efficient, and easily maintainable building with amenities unmatched by comparable office buildings. Another 126,172-square-foot building is under construction and will be linked to the original 461,200-square-foot headquarters by conduits so that voice and data telecommunications and security can be expanded with minimal hardware and personnel additions. The new facility is expected to be occupied by September 1985.

This chapter will deal with the planning and implementation processes used by PRC to produce a high tech facility that works. The authors hope that the information presented herein will assist readers in planning their projects.

PROJECT HISTORY

PRC, one of the world's largest diversified professional services organizations, serves government, business, and industry through more than 200 offices in 30 countries and 80 U.S. cities. It employs nearly 7,500 people, 75 percent of whom are highly skilled and trained professionals. Prior to occupancy of the new building, approximately 1,400 employees were located in nine separate leased facilities in northern Virginia.

In 1979, PRC executive management decided to consolidate its northern Virginia operations in a single facility in McLean, Virginia. The plan provided for growth to 2,000 employees by 1986. Since the work environment was office oriented we attempted through careful detailed planning and design to create efficient, productive, and pleasant space. Design flexibility was included to provide for future expansion.

Since initial surveys indicated a need for PRC to occupy 336,000 square feet of the 461,200 gross square-foot building, it was decided to sublease the remaining 85,000 net square feet to short-term (three- to five-year) tenants, whose lease termination dates would be staggered in such a way as to provide space for forecasted company growth. Such short-term subleasing would provide revenue until the space was needed to accommodate anticipated expansion. With these requirements delineated, PRC set out to create a work environment conducive to an office of the future—one that would be truly productive and attract and retain office professionals.

FACILITY DESCRIPTION

Incorporated in the facilities and grounds are virtually all of the technical systems, features, and amenities to support an environment tailored to serve the needs of PRC and its tenants. Particular attention was given to creating appropriate work spaces for the professionals, the engineers, computer scientists, and programmers who make up a large part of the PRC staff. To ensure privacy for both discussions and individual performance, the decision was made early in the planning stage to construct private offices. More than 1,000 private offices were configured within the X-shaped building (four wings, six stories high), thus providing the majority of offices with windows overlooking lawns and landscaped walks. Other features of the building included the following:

A 100-seat auditorium with rearview projection system.

Thirty-five conference rooms, each with seating for 10 to 26 people.

A 10,000-square-foot main computer room, a 3,500-square-foot showcase computer room for prospective clients, and three small computer facilities that operate 24 hours a day.

Kitchenettes on each floor, equipped with refrigerators, sinks, and coffee makers.

One and a half miles of jogging and nature trails with an 18-station exercise course.

Employee sauna and locker rooms with showers.

A wooded picnic area.

A rooftop deck.

An outdoor plaza adjoining the 400-seat cafeteria.

An executive dining room, seating 50, and a private dining room with seating for 30.

More than 300 underground parking spaces.

A 24-hour automatic teller machine and a convenience store located within the building.

Clerical personnel were also accorded a high degree of privacy. Secretarial positions, most equipped with word processors or personal computers, were located in enclaves off the main corridors. Glass partitions separated the secretarial positions to provide even greater privacy and to minimize noise levels.

Maintainability

Although the creation of an environment conducive to employee productivity was the chief criterion in the degree of the building, maintainability was also a major consideration because experience and statistics show that over the life of a building, operating and maintenance costs could easily add up to 700 percent of the building's original cost. Therefore, maintainability features were incorporated from the start and, to ensure the attainment of this objective, contractors were provided with a tight set of specifications at the very beginning of the project.

Maintainability features were incorporated in structural work, concrete, masonry, landscaped areas, electrical systems, roofing, ceilings, carpentry, painted surfaces and walls, entrances and exits, windows, restrooms, custodial areas, trash rooms, storage areas, elevators, coffee and vending areas, and more. Since PRC had historically been spending hundreds of thousands of dollars each year altering facilities to accommodate employee wishes, it was decided to standardize office sizes and decor and use carefully selected materials to prevent scuff marks and chipping. Vinyl wall coverings were chosen instead of paint, and one color scheme was used throughout the building for uniformity. Today the only item that distinguishes the office of a top executive from any other office is a walnut door. Otherwise, the same gray, nonstatic carpet and plum and rose accent colors are used in all offices and corridors. Plants and artwork are appropriately placed on a substantial scale to keep the building from looking monotonous. The end result is a clean, harmonious appearance that looks efficient, but not cold and sterile.

Energy Efficiency

Another criterion used in PRC's building design was energy efficiency. The HVAC system is a hydronic, closed-loop heat pump system with a 40,000 gallon underground water storage facility that keeps water temperature between 60 and 90° F and maximizes the efficiency of the heat pump. The HVAC system recaptures more than 1 million BTU per hour from PRC's computer centers, enough to provide nearly two thirds of the heat required during the winter months. Other energy efficient features include:

A computerized energy management system with load shedding and 92 control points.

Econo-watt fluorescent lighting and minimal use of incandescent lighting.

Extensive roof and wall insulation.

Separate water meters to avoid sewer charges for cooling towers and lawn-sprinkling systems.

Precast eyebrows over the south and west facades.

Double-glazed, tinted windows with some solar film application.

An energy-efficient supplemental air conditioning system for PRC's five computer centers.

TELECOMMUNICATIONS SYSTEM DESIGN

During the initial planning, and particularly following the needs-assessment stage, the decision was made to provide a flexible and cost-effective telecommunications system to meet the needs of PRC entities as well as tenant requirements. Initial surveys indicated that a system capable of serving at least 2,000 telephone-station instruments plus 1,000 data terminals would be required at full occupancy of the new building. As in the planning for other facilities and amenities, four criteria became the watchwords:

Flexibility

Maintainability

Practical application

Cost efficiency

Studies indicated that, although PRC was faced with installing a "veritable plethora" of computers, there was no need for a single network to provide for interconnection between machines. Most professional (knowledge-type) production workers had no need to connect their terminals to other than the host computers serving their projects. Therefore, in contrast to the insistent promotions of most vendors of today's so-called state-of-the-art systems, the decision was to serve the projected, real requirements and not guesswork. Accordingly, it was decided to provide a digital PBX capable of handling voice as well as switched data on a limited basis plus install one basic station (twisted pair) wiring plan to provide direct connections between the telephone instrument and/or data terminal with the PBX, as well as direct connections between data terminals and host computers and/or other high-speed networks.

BUILDING WIRING—THE INTEGRATED NETWORK

Following the initial physical survey, the need to connect more than 400 data terminals on move-in day to 22 host computers was identified. These computers ranged from relatively small Hewlett Packard 1000s to the large NAS 6000 mainframes. Included in the total number were two Hewlett Packard 3000s, a DEC VAX 780, a Data General MV 6000, DEC Systems Computers as well as the PRC custom-designed Multiprogrammable Controller (MPC), which had been developed to allow dissimilar computers to communicate with each other. As the majority of the host units were connected to input/output (I/O) devices by direct asynchronous RS232–C links at their existing locations, the decision was made to put in place twisted pair station wire that would serve high- and low-speed transmission requirements. Transmission tests of 24-gauge twisted pair station wire using signal generators and error recorders were conducted on 1,000-foot runs to verify that error rates over this Teflon-coated station wire would not be substantially greater than that experienced with the existing cabling. Results proved so satisfactory that the decision was made to implement a twisted pair network which we have named the PRC Integrated Network. Those readers who are network watchers will recognize that this approach has now been emulated by both AT&T and IBM.

During the final phase of building construction, 1,500 dual (RJ11 and RJ45) outlets were installed in work spaces and offices and connected by the six-pair cable to intermediate distribution frames (IDFs) in each riser closet in each of the four wings of the six-story building. Two pair of the six were connected to the RJ11 jack of the dual outlet to provide access to the PBX. Four pair (eight conductors) were connected to the RJ 45s to provide more than sufficient conductors for RS232/449 data connections. At the IDF, all six pairs were cut down (terminated) on standard punch blocks. Riser cable sufficient to connect all station cable pairs was cut down on separate blocks. As each jack was assigned an identification number and each riser pair identified by number, the task of connecting one or more pairs by crossconnection to serve either a data or voice and data requirement was simplified. Special jumper cables were also developed with a male RS232C connector on one end and a male RJ45 (eight-pin) connector for the jack end, providing for quick connectivity between the I/O device and the wall jack.

Thus, the PRC Integrated Network was born and now offers the utmost in flexibility. Connections between terminals and host computers are established in a matter of minutes. Today, more than 700 terminals are actually operating, and the great majority transmit at 9,600 bits per second (bps) without significant error rates. Most important, these connections cost an average of $85, which is substantially less than the $300 to $1,200 expense that might have been incurred if other available networks had been employed, and an even greater amount if the wiring methods used in most office buildings even today were employed.

Other Network Applications

In addition to those I/O devices that are directly connected to asynchronous and synchronous ports in the backplane of host computers, other network applications are served by extension of the same wiring plan. IBM personal computers, for example, transmitting at 9,600 bps, are connected via the twisted pair cable to a dedicated 10 MBS Ethernet coaxial cable network extended through the riser closets. Interlan terminal servers and transceivers are utilized in this configuration and permit the PCs connected to the Ethernet to be used for electronic mail as well as to provide access to a VAX 780 system and to the mainframes (AS–6000). In one other application, coaxial is also used to connect 3270-like Harris terminals to the controller at the mainframe. Because provision was made for tenants to use the twisted pair integrated network, one major occupant has connected 60 terminals to a host (Stratus) system using the RS232 direct-link arrangement.

Although this approach may appear to the casual appraiser as being diverse, difficult to manage, and expensive, it is indeed the opposite. Wiring from the station wall jack to the riser closet is a universal, basic requirement of all PBX systems. It therefore stands to reason that the station cable should serve other purposes as well; and in the PRC Integrated Network, it does.

The Multi-Tenant Shared-Use PBX

As described earlier in this chapter, PRC's space-occupancy plan involving short-term tenant leases created the consideration for a shared PBX. In view of PRC's plan to eventually occupy the entire building, an obvious question arose: Why not put one system in place that would offer tenants the option to share the PBX? A shared PBX would avoid the need to provide space and the environmental controls for a multitude of systems and wiring plans. Also, it would allow tenants to capitalize on the economy of scale offered in the use of one large system and one long-distance network controlled by an automatic route selection program. Tenants would also benefit by not having to administer and maintain systems, and PRC would not be faced with the task of extending service from the existing system if and when it occupied tenant-vacated space.

All the advantages of sharing the PBX proved so numerous and incontrovertible that the project received immediate approval. On July 1, 1981, the first large-scale, shared PBX system in the United States became operative.

After three years of operation, the results proved extremely beneficial to both PRC and its tenants. Listed below are just some of the advantages resulting from sharing:

- Reduced cost to PRC for the system.
- A 20 to 30 percent reduction in cost to the tenant for equipment, service, and long-distance calling.
- Tenant obligation for equipment limited to term of lease.
- Tenant enjoyment of feature-rich system at lower cost than if system had been secured independently.
- PRC control of cabling and equipment dispersion in its building.
- PRC ability to reuse space as it becomes available without the need to install additions to the PBX.

Currently, there are 1,650 station lines in the shared system, 1,200 are utilized by PRC, and 450 by 19 tenants. Tenant use ranges from 1- to 2-line use to as many as 90 lines. In June 1985 PRC will be extending this shared system to an adjacent 126,172-square-foot building. When fully occupied, the new building will add 600 more lines to the existing system. Station lines in the new building will be served by a remote peripheral equipment (RPE) cabinet, which will house the line cards. Connection to the mainframe in the headquarters building (1,200 feet distant) will be accomplished by installing six T1 carriers on wire lines. Four 4-inch conduits are already installed between the two sites to provide capacity for the underground cable as well as coaxial or fiber optic conductors. The station cable (twisted pair) network installed in the headquarters building will also be duplicated in the new location.

The Message Center

PRC further enhanced the shared system by introducing the first large-scale, computer-supported message center. The inadequacy and inefficiency of the systems then in place essentially forced this decision. Surveys of the equipment in place in the nine different locations housing PRC personnel prior to the occupancy of the new building pointed out that, like those used by most other firms of that day, almost 90 percent of the telephone instruments in use were multibutton sets conventionally designed to permit secretaries and clericals to screen incoming calls, use intercoms to contact the called party to determine whether they were available to answer the call, and then to release the call or take a message. It is an understatement to say that this process is inefficient and wastes time that could be better applied to more productive tasks.

The PRC message center accomplishes two purposes; it minimizes the expense for hardware (almost 90 percent of all instruments in place are single-line units), and it centralizes the answering function so that attendants are better equipped to respond to all calls. Heres how it works: The system gives callers the impression that everyone has a private secretary, yet enables secretaries to concentrate their skills on projects other than answering the phone. For example, if my phone rings and I am away from my desk, the call is automatically transferred after four rings to the message center.

The message center is staffed by eight attendants, each with a video display terminal connected to a central minicomputer. When the phone rings, the operator checks the video display to see whose phone it is, and what if any special instructions should be used in answering the call. The attendant can also determine whether or not someone else is available to help the caller. With this information, the operator can then answer the phone just as a private secretary would. If the caller leaves a message, it is entered into the terminal, and the operator instructs the system to light a message-waiting light on the called party's phone. To retrieve messages, the called party simply dials the message center. Because the caller's number is automatically displayed, the attendant can bring up the message file in an instant and provide name, time of call, message, and so on without delay. A directory and functional locator file are also available to assist the attendant in completing calls. Unlike the voice-messaging machines, a human voice answers all calls and provides assistance to the degree possible. In essence, personal attention is provided.

The message center answers 3200–3500 calls on a typical day and takes about 1050 messages. At the end of the day, the 150 messages that have not been called for are printed out and delivered to the employees' offices by 8:30 A.M. the next day.

The task of printing directories is also minimized. When required, the directory data on file is simply printed and reproduced by the publications department.

Telecom Billing Administration

One of the unique features of the system is the functional integration of the message center software with that of Creative Management Systems (CMS) software that controls the billing function. Because the message center data base is updated on a daily basis to reflect the changes to the file name associated with the extension number, room and mail stop locations, type of equipment, etc.), it provides an absolute record that is subsequently used as the data base for the billing process.

Extracts from the message center data files are transmitted at the end of the month to the mainframe where, under control of resident CMS software, the call detail tape (CDR), previously removed from the PBX, is processed. As a result, all users of the system are provided with an itemized bill that lists both the call charges and the cost for equipment. Summarization of expenses in hierarchical levels individual, cost center, department, and company—are provided.

OTHER AMENITIES OFFERED

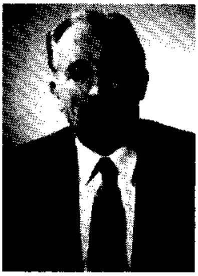
To add to the amenities offered, PRC provides tenants with access to all of the facilities within the building via wire connections or on an over-the-counter basis. Access to the computer center processors can be on a time-share, dialup, or leased-wire connection. Assistance in software development is offered at consultant rates. High-speed printing and processing are also available from the computer center, and workstations are made available for walk-in clients. Building maintenance people install electrical and mechanical devices, run wire and cable, move and relocate furniture and equipment, and respond in general to all types of service requests.

The publications department offers text editing, reproduction, artwork, and graphics using the latest in technological equipment. Word processing stations are available on a per-hour-of-use basis.

From a functional standpoint, the building is truly self-sufficient. From the automated banking equipment installed in the elevator lobby of the parking level to the automated security of the controlled door-opening mechanism, virtually every cost-effective amenity that leads to functionality, productivity, and enhancement of the working environment has been put in place. It is, in truth, not a smart building or a high tech building, but one carefully designed to serve needs so that business objectives may be realized.

Although designed initially for a single corporate user, the services offered to PRC departments were also offered to tenants in the expansion space. For developers of multi-tenanted buildings, the PRC experience offers a model as to the potential of a high tech building.

Authors



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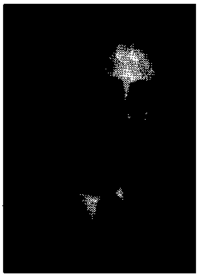
John D. Daly is corporate telecommunications manager and senior consultant to PRC worldwide. A 30-year veteran of the telecommunications industry, his career in New York Telephone encompassed such assignments as installer, repairer, foreman, communications consultant, and PBX and data services sales manager. Daly spent his last four years with Bell as a major account manager responsible for the Citibank, Morgan, and Chemical New York accounts. From 1968 to 1974, he served as an assistant vice president for Irving Trust, New York. Daly managed their telecommunications, message testing and wire transfer departments. During this period, he was responsible for the initial design of the U.S. portion of the international Society Worldwide International Funds Transfer network. From 1974 to 1979 he served as director of customer service and marketing for the American Satellite Corporation, where he was principally involved in the development of voice frequency and broadband satellite networks for the airline and banking industries. Daly's formal training includes U.S. Navy and Bell Systems communications and electronic courses and undergraduate work at Long Island University and Adelphi College in business administration. He has been very active in speaking engagements for the Urban Land Institute, Probe Research, Telestrategies, and Communications Networks conferences and seminars. He has authored numerous articles on the subject of multitenant shared telecommunications systems and is currently president of the MTTA (Multi-Tenant Telecommunications Association) and president of the Telecommunications Managers Association of the Washington, D.C., Capitol Area.



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Chapter 10

Designing the High Tech Building: Updating Traditional Technologies and Implementing New Technologies

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Outline

The modern office building will continue to change and become more efficient with the increasing speed of technological developments. It is therefore critical to incorporate into the design of new buildings both new technology and amenities to accommodate people. This chapter deals with both aspects. We will first explore how to make sure the people are happy and productive in their work environment and, second, the elements for designing an advanced technological building.

THE HUMAN FACTOR

The smart building has evolved at a mind-boggling rate, but the employee inside it is little different from the office worker of 10, 20, or even 50 years ago. Human beings simply do not change as rapidly as technology; in fact, human nature changes hardly at all. It is true that people's *expectations* change—and at a rate only slightly lagging the technology that shifts those expectations (e.g., no accountant today expects to crank numbers by hand or on a manual adding machine). However, the *feelings* that people have about the ways in which their expectations are met remain fairly constant (e.g., today's accountant's attitude toward a computer terminal is little different from his or her predecessor's attitude toward an adding machine). Which is to say, whether it is a microchip or an old fashioned spring mechanism that is driving a machine, the person using the machine wants it to work, wants to be comfortable working at it, and wants to feel more important than the machine being used.

The Potential for Dehumanization

The machine, ideally, is an extension of the human being, not vice versa. Therefore the smart building cannot be designed only to support the machine; it must support the user as well. This means that the smart building need not—and in most instances should not—look like a science fiction fantasy. The "high tech" style so popular 10 or 15 years ago has given way to a more traditional architecture, precisely because the machine has become too real a part of everyday life to serve as a romantic image of some distant future. Advanced office systems *are* the future, and many people now spend entire workdays confronted with keyboards and cathode ray tubes; to be surrounded with exposed ducts, shiny metal tubes, and machine-styled workstations becomes not only redundant but frightening. Larger electrical closets, access flooring, common uninterruptable power supply facilities, and increased cooling capacity can be taken for granted. To make people more consciously aware of all this technology by expressing it in a machinelike architecture tends to dehumanize the workplace, to make people feel less important than the machine they have to work with.

In the smart building, it is the human quality of the work environment—not the technology—that makes employees more or less productive. If everything about that environment says that the machine is more important than the person, an assembly-line mentality sets in. Workers who formerly would have been regarded as managers or professionals join unions that guarantee they won't have to spend more than a minimum number of hours at a CRT; secretaries who used to type 60 words a minute refuse to execute more than a minimum number of keystrokes per hour; supervisors who once prided themselves on their ability to solve interpersonal problems evaluate clerks on the basis of computer printout.

Designing for Humans

Given that there are real physical problems associated with the automated office (eye fatigue and muscle strain related to the use of the CRT being the most common), how does one tackle these high tech problems without resorting to high tech solutions? Lighting is a case in point. About 35 footcandles is the recommended level of illumination for routine office tasks and CRT use, with no glare and no reflected ceiling light pattern. The conventional solution is a furniture-mounted, up-lighting system that casts a kind of etheral glow throughout the space. That glow is perfect for working at machines but leaves people walking about feeling slightly disembodied. Moreover, only about 18 footcandles are required for circulation, but intensive reading requires 55 footcandles. Therefore, a design in which distinctively lit circulation paths are visually differentiated from work areas, and where work areas are punctuated with brighter pools of task light, immediately becomes more humane. The user is offered a variety of moods and responses for the variety of activities required. Moreover, by expressing some of the light source—allowing people to see where the light comes from—the designer can make the space seem 10 percent brighter than it really is and, at the same time, offset the etheral effect of most ambient lighting systems. The amount of energy used is actually less than in a uniform lighting scheme, and the psychological benefit is enormous.

Color, soft materials, wood detailing, and lots of sound absorption also make spaces feel warm—or "user friendly," as computer jargon would have it. Architects can also build into space opportunities to see other people, to meet serendipitously in common spaces (atriums or gallerias), or to encounter one's superiors face-to-face. By breaking up large, anonymous floor plates with architectural elements that house closets, filing banks, or conference rooms, an interior designer can create more intimate "rooms" (even with open office landscaping) that reinforce an employee's sense of individual and group identity.

Seen from the outside, the smart building need not look like a laboratory or a factory. In an urban context, it is important that newer buildings relate comfortably to the older buildings around them. The use of masonry, punched windows (which also relieve solar heat gain and make smart buildings more energy efficient), and decorative detailing can recall the more traditional architecture of these older buildings without impairing any of the technological infrastructure. The careful scaling of doorways and other architectural elements at the base of a building can reinforce the traditional street fabric, allowing both the daily office worker and the random pedestrian to feel comfortable with the advanced technology inside.

In short, the smart building *is* the future, but the future—to be acceptable—may have to look a lot like the past.

HIGH TECH BUILDING DESIGN

The real estate developer has always, to varying degrees, been concerned with decisions involving the application of new and developing technology for properties. The issue is whether or not new technologies will enhance the marketability and profitability of one's development and at what cost. Today, the problem is particularly pressing as new technology is rapidly being introduced, and the influence of the microchip has become clearly apparent in office buildings. The major component in this relatively new scenario is of course the computer with such attendant requirements as data communications, operator comfort, and power. Additionally, there are the innovations brought about by the energy crisis and the concern for conservation. The third area of great change is the field of data and voice communication.

Our position is that a consensus exists concerning the nature of these new technologies and the function that they will perform in the foreseeable future. It is also safe to say that, although there will be an enormous evolution in the way "futuristic" technologies will manifest themselves in the years to come, they will affect only a small number of buildings.

Developers, then, have an obligation to stay informed about these technologies and the forms they acquire in order to make decisions about costs and applicability to their properties. The issues involved are complex, for the developer in a competitive marketplace must constantly provide tenants and prospective tenants with the most attractive package or suffer the obvious consequences of the market. The risks lie in correctly assessing the application of any given technology in terms of its cost and inevitable obsolescence. At a minimum, developers must ensure that they are creating a property sufficiently flexible and in tune with the future so as to make retrofitting feasible in response to future innovations and an evolving market.

The cost of adopting these technologies is a central issue. The developer must respond to a market that will dictate technical innovations and establish costs. Ultimately these decisions become marketing concerns, and risks are incurred in order to retain the cutting edge. Of course the difficulty lies in predicting the market, wherein no absolutes exist. However, it is imperative that developers and their teams be well acquainted with technological developments in order to take educated risks.

VDUs and the Electronic Office

The major cause of change has of course been due to rapid expansion in the use of the computer and the advent of the electronic office. Conservative predictions are that within the next 10 years, one third of all office workers will be equipped with a visual display unit (VDU) and that this number will significantly rise by the end of the century. The rate of increase should be staggering and holds some important implications for the developer.

Although there still may be some conjecture about the form of automated offices in the future, there is no doubt that they will probably utilize at least as many data terminals as there are telephones in today's offices. Consequently, it is advisable that the developer provide for a well-planned and effective data-wiring system or local network in the design of new buildings. Otherwise, tenants will be destined to work in a chaotic environment, buildings will compromise their flexibility, and marketability may suffer.

Today, moving or adding terminals may not be a major problem in many instances, even though the result is an ever-increasing maze of cables and incremental costs. However, when automation reaches predicted levels, flexibility may become a physical impossibility. Consequently, a modern user-oriented data communications package should include as many outlets to plug in data terminals as there are telephone outlets in offices today. In addition, there should be a structured wiring approach that includes wiring closets and a system of crossconnect panels, for ease of maintenance, change, and installation.

Local Area Networks

In an attempt to alleviate the problems caused by the proliferation of tangled wires, local area networks (LANs) are gaining popularity and are predicted to grow from 6,000 systems today to 22,000 systems by 1990. LANs make up the connection portion of an in-house communications system that permits the transfer of information among a number of terminals along coaxial, fiber optic, or twisted wire pairs. They have the capacity to link different computer devices to a central processing unit (CPU) for file transfer and peripheral sharing, and they eliminate the need for separate communications systems within a building. Such a network may include a variety of information display stations, including word processors, file and printer units, facsimile equipment, computer graphics devices, video cameras and monitors,

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even whole computer systems and telephone switchboards. The major advantage of LANs is that they preserve the independence of each workstation while enabling users to share information and peripheral devices.

Wiring Systems

The success of such a system and arguably that of a modern office building therefore lies in the successful implementation of an efficient and flexible wire management strategy. There are a number of possible conceptual wire networking configurations that can serve as the basis of such a system, each with its own inherent implications and the risk of creating a restrictive office hierarchy. The star network, in which all devices are connected to a central multiplexer, emphasizes a centralized decision-making structure. A circular ring and linear bus network tends to stress a decentralized system. It must be clear that the choice of any one of these networks has serious architectural and marketing implications.

It is no longer acceptable to deal separately with Power, Lighting, Electronics, and Communications (PLEC); these elements must now be considered an integrated system as essential as HVAC. Inadequate provisions for PLEC will result in impaired flexibility and monetary expense every time there is a modification to an office layout. Designers and developers often hesitate to adopt adequate PLEC systems because initial costs often seem high and, for the time being, relocation costs can be passed on to the tenant. However, in light of these technological innovations, the highly competitive nature of today's market, and the fact that tenants are becoming increasingly sophisticated in analyzing their needs, these PLEC issues must be confronted.

Fortunately, a number of options are available to the developer and the design team who wish to implement a successful wiring management strategy. These are covered elsewhere in the book, but it may be worthwhile to summarize the more important ones briefly in terms of their potential and inherent implications:

Poke-through. The least expensive system in terms of first cost. It is a delivery system consisting of a fire-rated fitting and floor outlet assembly. Outlets are installed by core drilling and are limited to one fitting per 65 square feet in order to maintain fire rating. A traditional hardware distribution system is employed, including conduit and junction boxes. Outlets stand 4 inches above the floor, and relocations require an electrician and interfere with tenants on the floor below.

Access floors. First cost is high, but relocation is inexpensive. The system consists of raised metal panels supported on pedestals. The panels are usually 2 by 2 feet and are covered with carpet tiles. The floor plenum is easily

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accessible and may enclose all wiring and HVAC ducts. Outlets are flush with the floor. Advantages include total flexibility in placement of outlets, unlimited possibility for expansion, and possibly tax depreciation advantages. Disadvantages are high initial cost and a small amount of deflection when walking.

Modular plug-in duct. Uses power poles to deliver PLEC services from ceiling plenum to workstation. Service is distributed through the pole to prewired furniture. Advantage is high flexibility; disadvantages are mainly aesthetic. Can also be used in conjunction with floor poke-through outlets.

Cellular floors. Designed for steel frame construction. A metal channel or trench header links the structural steel decking that forms part of the composite floor slab. Outlets are preset to a module. The system cannot accommodate overhead lighting but accommodates electronics and communication. Advantages are relative flexiblity, prewired building, and relatively low initial cost. Disadvantages are the fact that the system must be used in conjunction with another system for ceiling lighting and the inflexibility of the module.

Flat cable. Especially suited for renovations and retrofitting. The system is composed of one, two, or three circuits of flat copper conductors enclosed in an insulating material. The conductors are taped to the floor and covered with floor tiles. There is full PLEC capacity but no ceiling light capacity. Disadvantages are that flatwire cannot be used under fixed walls; mobility is limited because of complications created by crossover of power, electronics, and telephone; each transition from hardwire to flat cable requires an accessible transition box; and initial installation cost are high. Advantages are that it is easily retrofitted, relatively flexible, and accessible.

The jury is still out on this subject. A number of studies have been written comparing the different systems with different conclusions. There is no question about the inherent flexibility of such systems as cellular floors, underfloor ducts, access floors, and modular ducts—but at what cost? Furthermore, will tenants avail themselves of this flexibility frequently enough to justify the adoption of such systems over the traditional and initially cheaper and flexible poke-through system? The problem is complex, and the solution requires astute judgment by the developer in order to retain the competitiveness and profitability of properties.

In light of these circumstances, vertical conduiting and electrical closets are generally inadequate in most buildings in operation today. At the very least, communications and electrical closets for vertical runs and their associated terminal equipment must be enlarged. Furthermore, the use of satellite dishes and microwave antenna will require that spare conduits be run through the roof to a specially reinforced base. Spare conduits should also probably be brought into the building from the street and terminated in the main communication terminal room in order to serve future expansion in communication requirements and shared tenant systems.

Power Requirements

Another corollary of the advent of the electronic office is the rapidly rising power requirements of individual tenants. Many buildings in existence today are designed to provide at most 8 to 10 watts per square foot, and even this relatively large amount of power is creating problems in some buildings. A developer holding properties with inadequate electrical power jeopardizes the possibility of catering to tenants whose operations may be power intensive—such as legal, publishing, industrial, and accounting concerns. Building in the potential to provide a much greater power supply than is normally available today probably is highly advisable. This in turn will have architectural implications in terms of the size and location of transformer vaults and conduit sleeves.

Reliable power. Modern mainframe computers required uninterruptable power supply (UPS) in order to have stable, spikefree, and continuous input power. A UPS system can consist of a battery pack providing continuous power and emergency power for the first 15 minutes and a diesel generator for any additional time. Where individual tenants provide their own system, valuable floor space is wasted, and problems with ventilation, structural support, and fuel supply are created. It may be worthwhile ultimately to provide a common UPS facility in the basement or roof, thus avoiding many of the problems created by such systems. Furthermore, two independent power risers can be provided in case power is cut off at any specific point in a building.

Computer power needs. Large, centrally located computer rooms present their own specific problems. Such systems require rooms having power capability as high as 100 watts per square foot. Electrical power panels should connect directly to feeders serving no other purpose, and individual circuits must be protected with circuit breakers. The potential for damage caused by fire in these rooms is enormous. Walls must have 1½-hour fire ratings, and the rooms should be equipped with halogen gas fire-extinguishing systems. Furthermore, the raised floors necessary in these rooms must be capable of bearing the loads of heavy machinery, and walls and carpets must be antistatic. Physical security is also an important concern in such rooms. Protection can be provided with a key and buzzer system, magnetic card, and more sophisticated voice activated systems.

It would of course be difficult to predict the exact location of such a room in a speculative building; however, costs could be reduced by having an infrastructure capable of absorbing such structures when they become necessary.

Office Automation

Office automation and information technology hold the key to productivity, profit, and financial survival in the future. As a result, ergonomics—the science of human interaction with machinery—has currently been receiving attention. Statistics cite levels of dissatisfaction as high as 90 percent among VDU users, with complaints ranging from eyestrain and fatigue to nausea and depression. The major culprit is the glare given off by the units in environments not specifically designed to house them. In Europe, where clerical unions are strong, much research has gone into alleviating the problem; these measures are being enacted, including regulations governing furniture design and mandatory work breaks. Even in America, as many as 12 states are currently considering legislation to govern requirements for all workplaces that use such modern technological devices as VDUs.

The problem is basically that existing facilities are still designed to support an essentially paper-based work process. As workers become more dependent on computers, work activity will change dramatically, and the "facility environmental support" requirements will have to keep up with this change. Some factors that should be considered for a safe and productive ergonomic environment include floor space (it is estimated that only 50 percent of an office in the future will be usable space), lighting, electrical service, noise level, furniture requirements, and wall and floor finishes. Furthermore, flexibility is becoming an important feature of interiors as it becomes increasingly important to be able to adapt space and furniture to rapid changes in equipment.

Environmental comfort has also been greatly affected by the staggering increase in the use of VDU in the office environment. Knowing that the heat generated by one such unit is roughly equivalent to the heat generated by its operator points to the inadequate cooling and ventilating capacity of many buildings in existence today and the requirements for buildings of tomorrow. At the very least, buildings will demand increased cooling tower capacity, extra mechanical room space, larger plant rooms, and expanded vertical shafts to respond to VDU demands. Furthermore, maintaining corrective humidity levels is also important in these environments, since excessive dryness can promote the generation of static and interfere with delicate circuitry, and excessive dampness can be detrimental to the storage of tapes and hardcopy material. Solutions to these problems exist, including ingenious products created by furniture designers to deal with the problem locally by exhausting excess heat directly, from the source through ducts running under raised floors.

All these factors are therefore instrumental to the planning of the office of the future, and all encompass issues that are being hotly debated. There are no absolute, clear-cut solutions, but an insight is offered into the complexity of the problem at hand and the importance of the decisions taken at the initial design stages by the developer and the design team. Failure to address these problems could prove costly to the owner of such properties at some future stage in the life of a building.

Energy Conservation

Findings of the AIA energy committee published in 1981 indicate that approximately 40 percent of America's energy consumption is used in the building sector to heat, cool, and light buildings. The report also states that savings on the order of 50 percent are feasible using existing technologies. The incentive to save energy is clear, but one might ask whether or not the monetary savings would be greater than the cost of equipment. Cost predictions in this area are particularly difficult given the volatility of world oil markets, even though they are presently stable.

Day lighting design. There are of course many ways to save energy, but one of the more interesting approaches is through daylighting design. Daylighting design basically attempts to develop an architectural response—both in plan and envelope—to the orientation of the sun and to utilize natural ventilation in order to maximize the cooling, heating, and lighting potential of a building. This approach is based on principles that have been understood for years, and it can lead to substantial savings in energy. There are many successful examples of such designs, and an interesting corollary to this technique can be the creation of rich, and often unique, architectural forms.

Daylighting design typically maximizes the north and south exposure of a building and increases floor to ceiling heights in order to allow daylight to penetrate as deeply as possible. Atriums are often used, which augment the perimeter as a source of diffused light, and can be a source of natural ventilation that can be integrated with a successful HVAC system. Finally, a system of shades, baffles, and overhangs are designed to reduce the effects of direct light and increase the potential of natural light for illumination. This can all result in sensible solutions to energy conservation that do not confine architectural expression but, on the contrary, give rise to features that can add to a building's excitement and identity.

Computerized energy management. Another fascinating innovation lies in the introduction of computerized energy management systems, which are often part of a larger computerized building management system controlling a number of services, such as life safety, security, and vertical circulation. These systems form part of what has been called the intelligent or smart building.

The smart building, then, is basically controlled by a central processing unit (CPU), which is then linked by fiber optic cables to individual digitized sensors. Such a system can be used to maintain comfort levels, turn lights on and off through the use of movement sensors, restrict access to particular areas, warn of intrusions, operate elevators, and warn of fires or breakdowns in mechanical and electrical systems.

The newest energy management systems use a network of microprocessors, connected to a central processing unit, which monitors conditions and coordinates and manages equipment. This pattern avoids problems created by systems shutdowns or power outages. Battery packs are part of each individual microprocessor and enable operations to continue during power failure. The distinguishing factor between systems is software because it controls the various functions and can assure flexibility. Currently such systems are said to result in energy savings of 20 percent. However, surveys indicate a measure of dissatisfaction among users who claim that the energy saving potential is exaggerated and that systems are hampered by inadequate service, installation, and maintenance and poor integration with other building equipment. Furthermore, viewed in light of existing technologies using such devices as time clocks these systems are still not cost effective for the majority of potential users.

Regardless of such inevitable teething problems, specific portions of such integrated building management systems are currently in operation quite successfully. It is inevitable that such systems will become an integral part of buildings in the not too distant future and that a building's marketability will be greatly affected by its ability to provide such services. Developers and their architects must acquaint themselves with such systems in order to design an infrastructure that will enable them to avail themselves of such a system at some future date when the market may require its adoption.

Shared Tenant Services.

One of the more exciting technological developments with attractive market and profit potential is shared tenant systems (STS). STS will allow building owners to install one switching and wiring network for an entire development and then resell a number of services to the tenant. Such services could include telephone equipment, long-distance and local-line service, data communications and processing, voice managing, shared word processing and data storage, centralized answering, detailed call accounting, and video conferencing. The tenant thus has the propect of access to all these facilities, which would otherwise be unaffordable. The building owner can look forward to a marketable office space, energy saving and space saving through modular design, and more efficient management control—whereby tenants' needs could be dealt with by manipulating software and profitability could be assured through the resale of services.

There is already a rapidly expanding market for such services spurred on by the increasingly competitive market for commercial office space and the promise of high profits. The developer has a number of management options in adopting such a system. Independent concerns can be brought in to manage shared tenant systems as concessions within a development;

management firms can be formed with the developer as a partner; or integrated management firms can be hired, handling STS along with other services, such as HVAC, security, and maintenance. Furthermore, national networks, such as Olympia Net, are being established, encouraging firms to locate their regional offices within buildings belonging to a particular developer's properties, with the hire of data communication facilities.

The system does currently suffer some disadvantages. Initial investment is high, and there are too few high tech buildings on the market to enable sound judgments to be made based on experience. Given the newness of such technology, obsolescence is an inevitability. Furthermore, retrofitting can be an expensive proposition as the system is predicated on a modular prewired building. Preexisting telecommunication strategies of potential tenants, and the fact that PBX manufacturers are targetting small users as potential profit centers will also hinder the marketability of STS. Then there are the problems posed by maintenance—whose cost could be passed on to the tenant—and the rather nebulous question of business interruption liability should the system shut down.

However, developers must realize that they may be forced to adopt STS in the future to ensure the marketability of properties. Retrofitting will entail the expansion of telecommunications and computer rooms, as well as a prewired wiring network and well-positioned conduits both within the building and to the street. If allowances are not made for such a possibility, retrofitting may not be economically feasible.

■ CONCLUSION ■

This chapter has attempted to address a few of the more salient issues that may be encountered by the developer seeking to design for the future. Some of the technology may seem outlandish, even though much of it is already emerging on a small scale. As an analogy, one is tempted to consider the invention of such technologies as the elevator and air conditioning and then reflect on how much they changed the form, architecture, and marketability of buildings. Furthermore, today's tenant is increasingly sophisticated, and developers in a competitive commercial market may find that some of these innovations may soon be necessary marketing tools. There will always be a risk involved in adopting emergent technologies; however, the developer and the design team have an obligation to remain abreast of developments and make judgments that will ensure the continued profitability of the properties.

Finally, we must remember that high tech buildings are not designed for computer and telecommunications equipment, but are designed for *people* to use this equipment. A paramount principle is to design for people first, and then for technology. Technological needs must accommodate human needs, and *not* the other way around.

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Chapter 11

Retrofitting Existing Buildings for Office Automation

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Outline

Studies by the Department of Labor have determined that average clerical workers produce about 50 percent of their potential output; managers, about 65 percent of their potential. In the past 10 years, the federal government and the private sector have invested more than $25,000 per factory worker to improve performance, and their productivity has nearly doubled. Over the same period, only $2,000 was invested per office worker, and the result was a correspondingly low (4 percent) rise in productivity. With the current shift from a manufacturing to a service-oriented economy, there is acute pressure to invest in the American office worker. Evidence of this is exemplified in how two giants of office systems, IBM and AT&T, are spending more than $4.5 billion a year on product research and development, all targeted at the office marketplace. As a result of this and other research, better office automation systems with greater capacities and lower costs are entering the market daily. IBM adds telephones to its terminals and acquires Rolm; AT&T sells computers and software; and Wang expands into data processing and telecommunications. At the same time divestiture of the telephone industry and the lack of compatibility between competing office automation systems creates confusion in the marketplace.

Today 1 of out every 10 office workers is at an automated workstation; predictions for 1990 are as high as one out of every two. In their recently completed "Office 88" study, Mike Bell and Mike Clevenger of The Harbinger Group, a Xerox company, calculated that only 8 percent of the new automated office equipment to be installed in the next decade would go into newly constructed buildings and that 92 percent of the space that will accommodate "the office of the future" will be in the existing building stock. This chapter will focus on the retrofitting of existing office buildings to accept office automation and sophisticated building management systems. We will attempt to point out some of the critical issues that must be addressed and the potential impact of the solutions on construction costs.

In many respects the greatest immediate impact of the smart building on our practice as architects is not in the physical design of the building. The technicalities of physically accommodating office automation are not unusually complicated. However, as chief representative of the client, we must take fiduciary and managerial responsibility for a design process that smart buildings have elevated to a new level of complexity. Architects must be able to seek out the right consultants to provide the technical advice necessary to protect the client's investment. They must be able to evaluate a consultant's proposal for expanded engineering, telecommunications, and office automation services for its appropriateness to the client's needs. They must also successfully orchestrate the activity of the expanded team to assure timely completion of their activity and to maintain the client's budget and schedule. Realizing that automation functions and equipment are constantly being updated within client organizations, we find that this broader responsibility of the architect includes such items as facilities management services to support ongoing building operations. Within our own organization, we have recently introduced as integral parts of our services such automated operations as computer-aided design and drafting (CADD), space planning, and computer data bases for cost/benefit analysis of many smart building features.

DEFINITION OF A SMART BUILDING

To paraphrase a recent article in the *New York Times*, a smart building is one that has a computer for a brain and a nervous system of cables and electronic sensors that allow the computer to monitor and interact with building conditions and that tenants can access for telecommunications and for automated office services. Smart buildings have been around in one form or another for several years, but only the largest corporations have been able to afford the sophisticated technology involved. What is making headlines now is the fact that developers are beginning to offer their tenants these capabilities, much as they once offered air conditioning or other amenities. The major impetus to this development has been the divestiture of AT&T and the subsequent deregulation of the telecommunications industry, which has made possible the bypass of the Bell operating companies in the long-distance transmission of voice, data, and video signals.

Two major systems make up the smart building—building management systems (BMS) and shared tenant services (STS). Building management systems form the operations core of a building; they consist of fire and life safety, entry control and security, energy management, environmental controls, lighting controls, and elevator controls. The latest technology in BMS includes sensors distributed throughout the system that provide self-monitoring capabilities. BMS can result in reduced operating costs, better preventive maintenance, and increased equipment life, according to Don Bentley of Bentley Engineering, mechanical and electrical engineers. A smaller but more highly trained staff can monitor and maintain a larger building or several buildings from a remote location. The selection of the proper BMS systems, whether for new construction or renovation, involves programming and cost/benefit analysis by the architectural and engineering consultant team at the earliest stages of a project's development in order to fully integrate the systems and thereby derive maximum benefit of their use. Rather than futuristic technology, BMS is a proven way of reducing the long-term costs of building ownership and a necessary part of a building's structure in today's competitive leasing market.

Shared tenant services consist of communication, data processing, and other office systems. Communications include such things as local and long-distance voice, video, and data transmission, as well as teleconferencing and electronic mail. This can be supplied by means of a twisted pair of wires, coaxial cable, flat wiring, fiber optics, microwave, satellite, or a combination thereof. Data processing includes desktop computers or terminals with a central-processing unit, either operating singly or networked across the room or across the world. Office systems include word processing, copying, and image transmission (such as telefax). All of these systems are packaged as the automated office and are the focus of most of the research and development and aggressive marketing of high tech office product manufacturers.

REASONS TO CONSIDER RENOVATION

There are a number of reasons for considering renovation of an existing building as a real estate investment. With the recent revitalization of many city centers, there is a wealth of existing office buildings and other structures suitable for renovation or adaptive reuse. In selecting a potential site the same considerations apply as for new construction—location, cost, time, function, and image. Prime access to transportation, public facilities, housing, and other amenities should be considered. Another reason is the image of a company in its community created through restoring an older building. Preserving a building helps to preserve the history of a city. The ambience and drama of scale and materials of older buildings are not available through new construction.

There are financial reasons to consider renovation as well. Generally, rehabilitation, exclusive of automation, is 20 to 35 percent cheaper than new construction. One of the reasons for this is that renovation avoids many of the expenses of materials associated with new construction. Rehabilitation is by its nature labor intensive; most of the materials are already on the site. The construction time is shorter, and in many cities, the approvals process for a renovation project is much quicker than for new construction, which accelerates the project and reduces carrying costs. In some cases tenants can even remain during construction, avoiding loss of revenues. Ultimately the costs in renovation depend on a multitude of conditions. In general, however, the additional cost of preparing a building to accept smart features during renovation are higher than for new construction, which runs $2 to $5 per square foot. This is the cost for preparing the building to accept only smart features, and does not include the cost of equipment or wiring or other related items. Because of the rapidly improving technology and the variety of services possible, do not rely on rules of thumb. A case-by-case cost analysis is required.

There are also specific investment tax credits to encourage renovation of existing buildings. The highest of the three categories is a 25 percent credit for certified rehabilitation of a historic structure that is on the National Register of Historic Places. The process to qualify involves extensive coordination with the State Historical Preservation Officer throughout design and construction, and the construction must conform to the Secretary of the

Interior's Rehabilitation Standards. The intent of the guidelines is to restore the exterior of the building as closely as possible to its original state and carries with the 25 percent tax credit numerous restrictions. More attractive for most commercial purposes is the 20 percent investment tax credit available for renovation of all buildings more than 40 years old and the 15 percent credit for buildings 30 to 39 years old. Neither of these options carries the restrictions of the 25 percent credit.

DEFINING DEVELOPMENT GOALS

Before any final decision can be made regarding selection of a building for renovation, one should define the goals and objectives of the investment. For a developer considering renovation of an existing building into a smart building, this would involve the following: (1) defining the leasing market the project will ultimately seek to attract, (2) determining what shared tenant services are appropriate to that market and what building management systems are suitable to the building's operations, and (3) deciding when to provide and how best to structure the details of providing shared telecommunications and office automation features in the building—that is, owner provided or through a third-party provider. This process should involve the developer, the architect, leasing agents, operations staff, and special consultants for the engineering disciplines, telecommunications, and office information systems. In general, at current costs a developer must be able to service 250,000 to 400,000 square feet of tenant space before shared tenant services can be economically justified, although this range will most likely come down. The tenant mix is also important. Smaller tenants may not need sophisticated office services, and larger ones may not be interested because they already own or lease such equipment. The most likely potential users are those businesses with relatively heavy telecommunications and office automation needs, such as large accounting firms, law firms and other consulting groups, banks, and stock brokers.

OFFICE AUTOMATION AND THE CORPORATE USER

Setting goals is somewhat different for the corporate user considering housing company operations in a renovated structure. It begins with an internal audit to determine automation usage in the company, both at current levels and at levels anticipated for the next three to five years. Questions to ask include: What benefits will be gained by using these technologies? Who should use them—executives, professionals, clerical staff? Which equipment is most appropriate? How much system integration is required? The dialogue should involve data processing staff, financial officers, appropriate departmental and facilities managers, architects, and specialized telecommunications and office automation consultants. Involving a broad base of staff in the goal-setting process prevents data processing personnel from forcing solutions on other departments and develops a broad base of commitment within the organization to the program developed.

Historically, information systems were installed to solve internal problems in order to free key individuals to focus on making business decisions. The ability of top management to understand the potential of office technology to achieve organizational results is critical to its success in effecting productivity gains. These range from supporting existing processes, to creating new operational functions, to technology as a strategic tool in developing new business opportunities. The challenge to executive management is how to experiment with this new approach to information systems—how much control is needed, how to encourage innovation in the use of different technologies, and while doing this, how to keep costs at a reasonable level.

According to the recently completed BOSTI study undertaken by Michael Brill and Westinghouse Corporation, 28 percent of officeworkers relocate once or twice a year, and 9 percent relocate three to six times a year. Statistics such as these illustrate the need for top corporate management to set policy on the issue of flexibility versus adaptability in their facility's design.

Basically *flexibility* in building design translates into structures capable of accommodating changing operations and office technology requirements by quickly reconfiguring basic service systems. This versatility carries with it increased initial costs and is characterized by total reliance on such systems as flat wiring with carpet tiles, full-height removable partitions, and sophisticated HVAC-zoning capabilities, among other technologies. *Adaptability,* on the other hand, seeks to establish basic system configurations that allow expansion and contraction of functional areas, but always within established and fixed constraints. An example is the use of a series of L-shape, fixed walls in a large space to access cabling systems from the ceiling plenum. Expansion of a department would be accomplished by growth out from the fixed wall into shrinking areas of adjacent operations and would only require additional cabling, and that probably through the furniture systems. Adaptability may cost less initially for the facility, but it makes a greater demand on the employee to make do with what is available. For instance, newly promoted managers may find no suitable size office available to match that of their peers in the corporate culture, and other, perhaps financial, rewards may have to substitute for the more traditional recognition.

THE GO/NO GO DECISION

Whether for the developer or the corporate user, once the programming phase is completed, the architect and consultant team can undertake a detailed analysis of the existing building systems and services and can recommend the amount and type of additional structural, mechanical, electrical, and telecommunications infrastructure required. Meetings with the city's planning and building department staff should be conducted at this stage to assure that building renovation plans are within zoning and other code guidelines. This feasibility study is best accomplished before any financial commitments to the property are made. The critical product of this phase of project development is a preliminary cost estimate to accomplish the program. With this information, a pro forma can be generated, life-cycle costs calculated, and a go/no go decision made. The financial importance of this decision reinforces the need for early involvement of the right consultants to provide sound and complete professional advice. At this stage selecting a qualified general contractor provides a valuable monitor for cost and construction suitability. The contractor should be engaged with no guarantees to take the project into construction. If terminated, a fair fee should be negotiated for services to that point. Incidently, if microwave or satellite transmission is part of the program, a site analysis for technical suitability and the regulatory constraints of local public utility commissions should be part of the feasibility study to support the go/no go decision.

For corporate users of office automation, the earlier in the design process the automated office and telecommunications equipment can be specified, the simpler it is for the architect to design for its dimensional, electrical, acoustical, and heat-dissipation requirements without costly change orders and construction delays. Developers, on the other hand, may be better advised to delay specifically selecting their office automation offerings until a major tenant is signed up whose needs can then be more specifically accommodated. This approach avoids purchase of unnecessary or incompatible equipment. For the architect it dictates a design strategy of preparing the renovated building to accept smart features without necessarily implementing them initially.

Contingencies for cost overruns and design changes are especially important in renovation projects. Generally speaking, during early stages of design a 15 percent contingency is advisable, and even at the end of the construction documents phase, the contingency should not drop below 8 percent.

DESCRIPTION OF THE EXISTING BUILDING STOCK

Before proceeding further, it might be helpful to categorize and describe the basic types of building stock available for renovation into smart buildings.

The first group consists of buildings constructed from the late 19th century to just before World War II. These may have originally been office buildings, lofts, warehouses, or factories. Most likely, if an office building, the structure has been renovated at some time previously in its history, but there are problems of power distribution and a need for other updated base support services. Whatever cabling system there is throughout the building is overcrowded with cables, which are unidentified and perhaps cannot be reduced in bulk. Structural bay sizes are small by today's standards, but greater floor-to-floor heights provide the possibility of plenum or raised-floor approaches to new cabling, and the many columns allow for easy cable drops. Elevators, if present, are probably outdated, and energy conservation and life safety systems are nonexistent.

The second category of buildings were constructed after World War II. These buildings were wired originally by the telephone company and were in fact overwired. This wiring might be reused for many of today's automated applications provided that adequate wiring plans exist and provided that the insulation is still in good condition. Typically, the ceiling plenum is utilized for mechanical systems. Main electrical cable distribution is through walls, from the ceiling plenum, or through service boxes coming from in-floor electrical ducts.

The final category is buildings built in the past 10 to 15 years. Many people would be surprised that such recently constructed buildings are candidates for rehabilitation into smart buildings. However, we have undertaken several such projects, including one speculative building, which was completed only last year but was unable to accept the extensive office automation of the stock brokerage firm that leased the structure for its corporate headquarters. Buildings from this period are characterized by HVAC in the ceiling plenum and overhead recessed fluorescent lighting. They may have underfloor ducting for wire management and have outlet boxes built into the concrete floor. Power is probably adequate for some automation uses; however, the problem lies in the distribution of power to meet current office space layout and special equipment needs. Many of these buildings may have elements of a building management system already in place.

CABLING

Perhaps the greatest demand the new office technology makes on a renovated building is how to accommodate the complex cabling requirements—how to handle all the spaghetti. Existing buildings were designed for cabling to enter at the ground level and then to be distributed upward. Microwave and satellite dishes on the roof upset the traditional bottom-up approach, wherein the riser system narrows dramatically as it goes up through the building. In addition, telephone closets were previously built to the specification of AT&T, but now in multitenant buildings they must accommodate a variety of potential telephone equipment or service providers. Larger telephone closets may also be required because video and data transmission require access to cable of larger diameter and other kinds of equipment. At least a doubling in the size of these areas seems inevitable.

The status of existing wiring can have a significant impact on the cost of renovation. As stated earlier, the telephone company often overwired older buildings, and much of this cabling may possibly be used to meet the needs of office automation. Moreover, Peter Valentine, of Comsul Ltd, telecommunications consultants, emphasizes that raceway represents the greatest portion of the cost of wiring. Given a situation with an existing in-floor duct system filled with unidentified or unusable cables, he says it may be more economical to salvage the duct system by removing all the wires and starting over. He also points out the importance of keeping power cables separate from data lines to avoid signal interference.

Even simple personal computers require three power connections: one for the VDU, one for the computer itself, and one for the printer, and the power may need to be stable and "clean." Beyond distribution of power, the automated office requires voice, data, and sometimes video cabling. There are a variety of cabling distribution systems suitable for use in renovations, including ceiling plenum, raised floor, poke through, flat wire, and wiring in furniture systems, as well as combinations of each.

Ceiling Plenums

In older buildings with high floor-to-floor intervals, both ceiling plenums and raised-floor systems can be used. Ceiling plenums can economically accommodate a vast array of wiring, HVAC, sprinklers, and lighting. Delivering the wiring to the workstation can be somewhat of a problem. Using fixed walls is one solution. Although they are not flexible, they do provide privacy and would be appropriate in some instances, such as private offices in a law firm. Another alternative is full-height, movable partitions. These are not as acoustically private as fixed walls, but they do have the advantage of depreciating as pieces of office furniture or equipment. Power poles, although a somewhat unsightly solution, are probably the cheapest means of carrying the wiring down from the ceiling in open office design.

Poke-Through

Ceiling plenums are also utilized in the poke-through system of cabling. Feeder lines are run through cable trays or brackets in the ceiling plenum. Floor penetration brings the services close to where they are needed and are capable of delivering power, telephone, and data through a single service fitting. Relatively low in cost at $2 to $4 per square foot, this system cannot be used in renovated buildings with thick concrete floors or those of post tension construction because of resultant structural problems. The floor penetration requires other special considerations because most floors are a part of the fire-rated protection of the building. This rating must be maintained, and all through-floor service fittings should contain fire-stopping material. The poke-through method has disadvantages in its inflexibility, and the structure is increasingly weakened when moves are made. Therefore, floor outlets must be placed carefully.

Raised Floor

Raised access floors were originally developed for areas where mainframe computers were located, but they are increasingly used throughout buildings in both new construction and renovations. The system is made up of pedestals or stanchions installed on the structural floor upon which modular floor panels are placed, creating a plenum underneath. This floor plenum can accommodate conventional cabling and, although an unusual application, it can also act as a void for return air from heating and air conditioning. The system requires no structural adjustments to the renovated building, but interfacing with nonraised areas—such as elevators, stairs, hallways, and bathrooms—must be dealt with. With a high initial cost of $6–$10 per square foot, the raised-floor system provides maximum flexibility and minimal disruption to accomplish later changes. For a corporate client, we would recommend this system in areas where significant operational changes occur and of course in mainframe computer areas. For a speculative developer, allowance in the building design for a raised floor can provide a leasing advantage because new tenants are not as restricted by former tenants' layouts. In addition, the raised floor may be considered to be tangible personal property and accorded substantial tax benefits. See Chapter 23.

Flat Wire

Flat wire, used for cabling in both new construction and renovation, is taped directly on the structural floor and then covered with carpet squares. Building codes do not yet allow its use with broadloom carpet, but carpet squares although somewhat more expensive have many advantages in their own right. It can carry power, voice, and data signals. For retrofit designs, permanent walls and structural columns can be utilized for transition boxes to convert from conventional wiring in existing raceways to flat wires. A combination of this sort costs slightly more than poke through. Flat wire's benefits include the fact that any future moves and additions can be made with minimal physical impact and only very localized operational disruption. Because of its potential to wrinkle over a long run, it does require the floor underneath to be perfectly flat. Since it is a relatively new product, there is not yet any data on the long-term performance of flat wire.

Furniture Systems

Most furniture systems on the market today have cable raceways integrated within the panels and partitions. Although such systems are higher in cost than nonelectrified furniture, they are extremely flexible and a good choice in renovations as part of a strategy to retain existing wiring in fixed walls. The increased initial costs can be offset by the accelerated depreciation and tax credit on office furniture purchases.

Wire System Maintenance

Whatever system is implemented, cable should be tested before and after installation of the lines and before hookup of equipment to assure that the loop is good. In large, highly automated operations this can become a significant, but necessary, expense. Service people have in the past added new wires without pulling out the old, resulting in overcrowding and much useless wire in place. With increasing wiring loads, this cannot be done in the future. Owners should assume responsibility for maintaining building wiring diagrams and schedules.

POWER SUPPLY

Power supplies and distribution in existing buildings are usually inadequate for a heavier user of office technology. However, an energy audit by a qualified electrical engineer should be an integral part of the feasibility study undertaken before a final go/no go decision is made. For general budgeting purposes, assuming a routine renovation, one should allow $5 and $10 per square foot for electrical costs.

Automated offices require conventional electrical power and interference-free, "clean" power for both computers and telecommunications switches. In most situations, *clean power* simply means that by using special equipment and dedicated grounding lines, circuits are protected from power fluctuations that can cause serious damage to electronic equipment. Backup generators and an uninterrupted power supply (UPS), although expensive, may also be required to protect valuable data bases. The UPS consists of a reserve electrical supply stored in batteries, which provides enough power to back up diesel generators until they come up to full power or until computer operators can safely shut down the system without a loss of data. In addition, public utility power can also be cleaned using the UPS in conjunction with other equipment to absorb fluctuations in the power. Because of the danger of potential acid leaks from batteries, the UPS should be stored in an isolated area. If electrically wired furniture systems are used, the UPS, in conjunction with the backup power system, constitutes a separate power source from normal utility power. The National Electrical Code requires each power source circuit to be housed in a separate raceway. If the extra circuit is required and it is not present in the furniture system, either additional conduit must be provided or some other solution must be implemented at the user's expense. This wiring cost, as well as backup generators and UPS, is not included in the $5 to $10 electrical cost quoted earlier.

STRUCTURAL

The first step in assessing whether structural adjustments are needed is to understand the capacities of the existing system, which in the case of an older building can involve research and load testing. In California and some other states, there is the additional requirement of seismic retrofit. Many buildings today are designed with an 80 to 100 pound live load capacity to accommodate office automation equipment. Many of the older buildings that are candidates for renovation were originally intended in part for warehousing and live load capacities of 100 to 150 pounds are not unusual. If your building is a good, sound concrete and steel building, with concrete floors and diaphragms in good condition, an allowance of $5 to $15 per square foot for seismic work is appropriate.

However, for a structurally sound building, several aspects of smart building renovation design may tax the structural integrity—including weight loads on the roof imposed by microwave and satellite dishes, extra chillers, and other mechanical equipment. Within the building there can be extreme weight loads from automation and telecommunications equipment or from the UPS batteries. In addition, cutting holes in the floor to accommodate the increased size or number of risers and the chilled water lines from HVAC equipment can compromise the structure and may require mitigating measures.

HVAC

According to Fred Dubin of Dubin-Bloome Engineers, older buildings are excellent candidates for developing energy efficiency programs. This is because they were originally designed to function well in their climate to keep their occupants as comfortable as possible. They generally have thick exterior walls and smaller and fewer windows than recently completed buildings. These aspects of the building, when combined with a few additional passive features and active energy systems, can produce substantial energy savings.

Sophisticated computers and related equipment generate substantial ambient heat into the workspace—as much as a 15 to 20 percent average load increase over traditional offices. The impact of this increased heat load on mechanical systems varies depending on such criteria as climate, building location, building materials, energy costs, and types of occupants and activities in the building. Other than in the renovation of the most recently completed buildings, one can assume that additional air conditioning and sophisticated energy management will enhance user comfort and operating efficiency. Based upon a thorough listing of energy needs, a mechanical engineer can do an energy audit during the feasibility study and then give recommendations and prices for steps that may be appropriate. An allowance for upgrading of the HVAC in an existing building should range from $5 to $15 per square foot.

Chiller capacity and the ability of the system to handle discrete zones where heat loads may be greater become more important with office automation. In many instances, mainframe computers require a jacket of chilled water or pipes running through the equipment to provide adequate cooling. Special computer utility closets in highly automated operations also require extra cooling. Air conditioning of these special areas should operate 24 hours a day, year round.

LIGHTING

As with energy efficient mechanical systems, technology currently exists for several energy saving lighting controls suitable for retrofits, most of which have payback within the first few years of operation. Some of these include infrared motion detectors that turn lights on and off as a person enters or leaves and photo cells that measure daylight contributions and adjust the levels of artifical light accordingly.

Glare on the VDU screen, which creates eye fatigue, is the greatest lighting problem in automated offices. Positioning the VDU away from windows or using blinds or shades helps. The wall behind the VDU screen should be a midtoned or medium color if possible. Light levels in general need to be lower in areas of heavy VDU usage. Where there is a mix of both automated and nonautomated workstations, some combination of lighting is advisable. According to David Malman, a lighting consultant, 30–40 foot candles of ambient light is desirable provided by uplights or by parabolic flourescent fixtures, with the remaining lighting by task lights directly on the work surfaces. The latter are more effective and more appreciated if they can be user adjusted. Incidently, static is one of the worst enemies of electronic equipment. Someone walking across a room in a building without humidity control and antistatic carpet could generate an electrical discharge strong enough to seriously harm both worker and machine.

OFFICE FURNITURE SYSTEMS

Herman Miller first introduced modular office furniture with acoustic panels in 1968. Today there are more than 100 manufacturers of these systems. They have redefined modern space planning and are an integral part of the automated office.

Open Plan Limitations

The BOSTI Study sponsored by Westinghouse Corporation revealed some interesting statistics on workers' attitudes and productivity in open plan offices. In spite of the fact that computers and printers can take up one third of the available horizonal space at a workstation, individual office space is currently shrinking in size due to economic pressures. Managers now generally are alloted an average of 115 square feet; professional and technical employees, 82; and clerical, 43. Space planners have tried to compensate for this shrinking space by lowering partition heights so that employees psychologically share their work areas. BOSTI discovered that workers actually favor offices with a high degree of enclosure and that this reflects in productivity levels. The study also found that, up to a point, this reduced size office does not negatively affect job satisfaction. Extremes in crowding, noise, light level, and temperature, however, do have the expected detrimental effect on performance. The Xerox "Office 88" study predicts that the integration and miniaturization of office equipment will provide a long-term solution to the crowded work station.

Selecting an Office Furniture System

As mentioned earlier in this article, selecting an office furniture system designed to accommodate the new automated technologies can in some cases reduce the cost of installing cabling systems, facilitate future network changes, and improve the aesthetics and productivity of the modern office and its maze of cabling. Acoustical panels and full-height relocatable partitions can significantly reduce the cost of reconfiguration over dry-wall construction. They also allow a 10 percent investment writeoff as furniture and they depreciate faster than fixed walls, which are considered real estate. Beyond that, panels and modular office systems move when the tenant moves and allow for quicker occupancy in the new space.

Rather than moving from file cabinet and back for information, VDU operators are confined to the screen for both input and output. As a result, they are much more stationary, and the chair assumes a major role in worker comfort. Furniture companies are responding to this need with an array of new designs capable of a variety of adjustments for varying users. If preparing to purchase a large quantity of any office equipment, one would do well to work test various options in actual in-office experiments.

CASE STUDIES

In the past few years our office has been involved in several significant building renovations that included large amounts of office automation.

Major Stock Brokerage Firm

The client for the largest of our smart building renovations is a major stock brokerage firm that had selected a newly constructed 28-story building in the heart of a downtown financial district. The building is typical of current speculative office building design and had not been specifically designed for their highly automated operations. One hundred percent of the clients' employees use either IBM terminals or Quotron, an electronic stock quotation system. Three floors of special computer rooms were required for the mainframes and related equipment. The Quotron system requires a home-run configuration, as opposed to a local area network (LAN), to provide maximum protection from tampering with the integrity of the financial data. The client also rejected flat wire as being too experimental for its conservative, highly security conscious operating standards. Originally, the client anticipated leasing only the lower 16 floors of the building and the 28th floor, but initial programming and space planning studies showed that the entire building would be required.

RG62 coaxial cabling was used throughout the building, distributed by means of cable trays using a poke-through method in combination with electrified Herman Miller office furniture to reach the individual workstations. Quotron actually requires an RG59 cable; transformers were attached at the terminal end of the run to accommodate these specifications. This was done because the IBM equipment required RG62 cable, which is generally more common for automated needs. Extensive cable testing and wire management records were provided.

Each floor includes a 140-square-foot telephone room. The telephone room on every third floor includes Quotron processing equipment, which requires extra cooling to relieve heat loads. Because the four 4-inch risers originally in the building were inadequate for telephone and data lines, *eight* risers were added. However, their addition necessitated structural reinforcement to maintain the integrity of the floor slab.

The three-floor computer center was designed with a raised floor. Located in the central levels of the bulding, it is served by special chiller units located on the roof. This HVAC required additional structural support. Two 8-inch diameter water lines run from the chiller to the central computer area. In addition to extra air conditioning, some of the computer equipment requires chilled water piped directly through it. Halon fire extinguishing equipment was installed in the computer center to avoid water damage from normal sprinkling systems. Extensive electronic security protects the center as well as other sensitive areas. A UPS and backup power generator were also installed to provide emergency power to the computer, which required four dedicated 4-inch conduits to span from their locations to the computer center. According to the National Electrical Code, the UPS and emergency system would have required a separate raceway in the workstations that was not provided by the manufacturer; to avoid this extra expense and meet the code requirements, all power runs through what is technically the emergency circuit. The "regular" power circuits are few and are only found in areas without any VDUs or electronic equipment, such as lobbies and storage areas.

Advertising Agency

The second case history deals with an advertising agency that had leased space in an office building completed in the previous five years. The building provided an in-floor cable duct system with "knock out" access points every five feet. Lack of reliable wire management records meant much of the cable was unidentified and unusable. Sophisticated building energy monitors had to be coordinated with the new interior construction. Renovation began with demolition of the three floors of space; only part of the HVAC ductwork was retained.

The client's program stipulated numerous private offices with fixed walls. These areas have wall outlets, which include closed-circuit television on coaxial cable. The clerical areas use a Steelcase furniture system. Each station was designed to include a word processing unit with a printer. Cabling in these areas is accomplished through the in-floor duct system. All the existing cables in the ducts were removed and new wiring installed. Clusters of six stations are served by a single electrical, telephone, and data floor monument; cable is run through the furniture system, which is prewired. Data from the word processor is transmitted through the duct system to central processing units located in a separate closet. A Donovan Data System is used for accounting with a similar layout, but it links with a modem in the telephone closet to access their East Coast headquarters. The overall space is very dense, with approximately 180 square feet per person. The preset knock outs did not work well with the layout, and numerous outlets had to be specially core drilled to access the cable trenches in the needed locations.

Computer Training Center

The final case study was undertaken for a large corporation's computer training center several years ago. Floor-to-ceiling heights were not great enough for a raised floor, and in any event the client did not think the expense was justifiable. We attempted an unusual solution. A thin, wire duct system, two inches in depth, was laid out on the existing slab. Sleepers were used to provide additional support for a plywood subfloor, which was then covered with carpet. This solution was used before flat wire was on the market. The client has used the facility for some time now, and the limitations to accommodate the extensive cabling are becoming apparent.

■ CONCLUSION ■

The impetus behind making buildings "smart" is the desire of American business to become more efficient, more productive, and more profitable. Leading companies have targeted office automation technology as one of the key vehicles to increase clerical and management productivity. These companies recognize that their profit potential will be directly affected by worker productivity gains.

Likewise, building owners are beginning to ensure their tenants' success, and thereby their own rent structure, through direct support of these office technologies. Building management systems further enhance the owner's investment by reducing operating costs. As architects, we advise our clients to consider the following steps toward achieving their goals:

1. If a corporate user, define the objectives and goals for office automation. How will it assist current operations? How will it allow the business to remain competitive? How will it help to create new markets for products and services?

2. For the developer, define the leasing market. What kinds of tenants does one hope to attract? What shared tenant services will these tenants be looking for? How can these services best be provided—through the developer or through a third-party vendor/service provider? What services are needed now, and which should wait until the market demand is stronger?

3. Be willing to expand the traditional consultant team to include involvement of office automation and telecommunications consultants, and seek their early advice before firmly committing to any site whenever possible. If microwave or satellite transmission is part of the program, a site analysis for technical suitability and regulatory constraints should be part of the feasibility study.

4. Consider renovation as the attractive alternative it is. When considering renovation remember that it is cheaper to provide the ability for a building to become smart at the same time that traditional renovation work is done.

As architects, we are prepared to advise our clients what the best technical, financial, and aesthetic options are for accommodating office automation technology in their buildings. Yet, in the end, the best advice we can give to clients is to remember to design for their people as well because that is the ultimate focus of productivity gains.

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Piero Patri, FAIA, is president of Whisler-Patri, a 90-person firm of architects, planners, and interior designers. He has recently overseen the programming and design of over 2 million square feet of smart buildings. One of these projects is a 25-story office and retail development in downtown San Francisco. Another is a mixed-use housing/retail/office development on the city's waterfront, which includes significant amounts of renovation and adaptive reuse of landmark buildings. Whisler-Patri is the interior designer/space planner for the new world headquarters of a major stock brokerage firm, whose highly automated offices occupy 28 floors of a San Francisco high-rise.

As a member of the Urban Land Institute's Hi-Tech Committee, Patri's research and dialogue with owners of existing smart buildings has broadened his awareness of the management and marketing issues inherent in the ongoing operations of these building systems. Because of his knowledge in the field, he recently spoke to the Industrial Development and Research Council on smart buildings and was invited to participate in the recent presentations before the Office of Technology Assessment on the impact of future technology changes on the building construction industry. Patri chairs the National Research Council Committee on Technologically Advanced Buildings. The Committee is charged to evaluate the application of office automation and enhanced communications systems in federal facilities as well as its application in the private sector.

A native San Franciscan, he was educated at the Politecnico di Milano and graduated Phi Beta Kappa from the University of California at Berkeley. Besides the design of smart office buildings, his professional career includes development masterplanning and architectural and interior design of office residential, retail, hotel, and industrial/R&D facilities. Current and

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past clients include Lincoln Property Company, Gerald D. Hines Interests, Criswell Development, Bank of America, the Lurie Company, Amfac Hotels & Resorts, Crown Zellerbach, and Neiman-Marcus.

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Jay Hendler directs Whisler-Patri's Architectural Rehabilitation Studio. In this capacity, he has served as principal-in-charge for the restoration of the historic City of Paris dome and rotunda in the new Neiman-Marcus store on Union Square in San Francisco; the renovation of the 200,000-square-foot, 1907 vintage Monadnock Building at Market and Third Streets in that city; and the adaptive reuse of the Cogswell College building on Nob Hill into a five-star luxury hotel, also in San Francisco. As a result, he is highly experienced in resolving the issues of introducing smart building features into the renovation process. Hendler spoke before the Industrial Development and Research Council on retrofitting existing facilities to accommodate office automation.

Hendler is an active member of professional and community organizations. A graduate of Washington State University, where he was elected to the honorary architectural fraternity Alpha Rho Chi, for a number of years he has taught courses in rehabilitation at the University of California Extension.

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Richard Reisman has served as project manager for several large commercial developments and office projects in both new and retrofit applications. As such, he has directed the consultant teams with the responsibilities for contract, budget and schedule compliance. For the past several years, he has also undertaken special research in their areas of smart buildings and office automation and the related costs of their impact on building design. In particular, he developed a computer matrix assessing specific building component costs and benefits. Reisman has spoken at several smart building conferences and recently participated in presentations before the Office of Technology Assessment on the current and future impact of office automation on the construction industry.

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Chapter 12

The Role of the Telecommunications Consultant in High Tech Buildings and Teleports

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Outline

The telecommunications industry presents patterns of development that parallel almost all of its high tech relatives. In its growth, telecom designers and technicians created a language that is field and product unique. This language serves the industry well, but it has had the adverse effect of confusing the general public. Compounding the problem, salespeople representing telecom products and services have appropriated the vernacular for use, in many instances, as a tool to intimidate buyers. Recognizing this problem, we will keep the language of this chapter comprehensible in order to best communicate points and information.

This chapter will explore the role of the consultant in assisting developers and real estate owners (hereinafter "developers") to understand the nature of tenant telecommunications requirements and the attendant service and system options. The chapter will also review the consultant's role in the design process of new and retrofitted buildings.

IDENTIFYING TENANT NEEDS

Prior to a complete discussion of the consultant's role, a key point on the emergence of developer-provided tenant services is in order. An increasing number of developers now wish to offer a host of services to their tenants, including filing/data storage, shared word processing, telephone equipment, and discounted long-distance telephone service. As a result of this expansion, the consultant must provide developers with a future view of the profitable interface between the planned building and the tenant services opportunity.

To clearly understand how tenants perceive their need to upgrade or replace communication systems, and therefore to appreciate the importance of this service opportunity, the reader should be aware of how the process is normally conducted.

Three primary reasons drive a normal user to replace or upgrade communications equipment. First, and not necessarily in order of priority, is the recognition that the system can no longer meet organizational needs. Typically, the system has reached its capacity, and/or its special features are unable to accommodate specific operating objectives. Second, the concern or perception that current systems are excessively expensive causes many to upgrade; these users are convinced that cost effectiveness can be attained through use of more modern and competitive offerings. Finally, organizational relocation and reorganization are catalysts for change.

As both tenant needs and telecom equipment have become more sophisticated, tenants relocating or expanding existing space are more keenly interested in the developer's ability to respond to their needs. The result is the emergence of telecom capabilities as a primary factor in the making of initial leasing decisions by tenants. Similarly, the developer's ability to provide related office automation/data systems and services will have further impact on tenant decisions. Accordingly, the consultant's objective must be to provide both professional design assistance and alternatives for future profitability.

THE SCOPE OF WORK UNDER CONSULTATION

Logically, the scope of the consultant's role begins with a definition of what is needed. As with any purveyor of outside management assistance, telecom consultants are retained for a variety of reasons, ranging from equipment acquisition to management education. For purposes of this chapter, the consultant's mission will be treated as providing expertise in the design and placement of base building systems for new and existing projects.

In first viewing an assignment that requires consultant assistance, a consultant must recognize differences in perspective between the developer and the tenant.

Differences in Perspective of Tenants and Developers

From the developer's standpoint, the focus of attention is oriented toward the base building design. Questions are general in nature and should be identified at the beginning of the building planning process. On the other hand, tenant needs are more detailed in nature and are specific to the tenant's business operation, reflecting a need for flexibility in office moves and changes. Common to both the base building design and the tenant operations is the ability of systems to communicate, best described as the issue of connectivity.

The role of the consultant in planning for the structure is therefore twofold:

1. Planning building design. The consultant must identify for the developer the general range of high tech, telecom, and office automation systems and services that can be supported as tenants move in or require telecommunications services. The consultant supports the developer, architect, and mechanical electrical engineer in ensuring that the design of the physical structure has been adequately prepared to accept a variety of high tech vehicles over its life. This planning requirement may be extended to include the support of virtually all low-voltage signaling that occurs within the structure, including energy management, security, and the entire host of building management options. Planning will require a comprehensive program to satisfy the issues of space, special environmental controls, wire and signal distribution, interface with closets and equipment rooms, interface with outside connectivity for remote signals, and other major concerns best dealt with at the forefront of project planning.

2. Planning for tenants services. The second major effort within the consultant's work scope is the strategic planning for the range of services that the building will offer to its tenant base. Again, early in the project planning effort, the consultant must develop the listing of tenant services that best fit the nature of the project. The consultant must also assist in formulation of economic studies and marketing concepts, in concert with leasing personnel. From there the consultant should prepare statements of intent regarding nature and depth of service offerings and then proceed to organize the thrust of tenant service activities.

Although most base building planning and tenant services activity has occurred in new construction, the same values and planning requirements accrue to existing structures, which currently represent 95 percent of all tenant space.

CONSULTANT'S APPROACH TO THE WORK

The consultant's approach to this work scope should be consistent with that of other planning subcontractors. As a general statement of project approach, the consultant typically offers the following:

Phase 1: Programming Requirements and Development of a Conceptual Design

Phase 1 involves interviewing and data gathering from the developer, architect, mechanical electrical engineer and other design team members to establish broad base systems requirements. The conceptual design's purpose is to acquaint all parties with the state-of-the-art equipment available in the marketplace and to establish broad guidelines for suggested systems and to allow developers to select systems compatible with their requirements for the tenant base.

Phase 2: Summary of Base Building Requirements

Phase 2 produces the design documents and supporting drawings displaying all information required by the architect and the mechanical electrical engineers and others as such information relates to the specialized needs of the communications systems. Information provided includes space, electrical loads, HVAC requirements, coordinated low-voltage distribution systems with conduit sizing, and allowances for future wiring/fiber optic technologies.

Phase 3: Development of Equipment Specifications, Vendor Research, and Tendering of Request for Proposal Documents

Phase 3 involves the preparation of detailed specifications, including completed systems drawings and equipment lists for bidding by qualified vendors.

The consultant conducts a prebid orientation meeting for prospective vendors, then renders bid evaluations based on specification response and financial analysis and assists the developer in negotiating the contract with the successful bidder.

Phase 4: Installation Supervision and Acceptance

Phase 4 is normally akin to the construction management process and usually includes schedule review, check of contractor's shop drawings, site inspection, spot check of workmanship, and complete operational checkout of all systems prior to final payment by developer to contractors. This step becomes very important to the project's overall success approach, since there are many coordination factors between disciplines to ensure complete and working systems.

Deliverables

As part of this process, the developer should expect as a minimum the following deliverables:

Phases 1 and 2. A report that identifies all the systems and services that will be supported or offered by the building management. The report must set forth the capital budgets for the developer's portion of the system costs, as well as a description of any ongoing operating costs associated with system operation and management. Too often, the budgets for these systems have been left out of the project planning, resulting in 11th-hour funding drives. The Phase 1 report should include a discussion of the developer's positioning with regard to tenant services and should include the extent of the developer's involvement in the actual operation/ownership of these offerings.

In addition to the written report, the deliverables from Phases 1 and 2 should include marked drawings and general specifications for all necessary support of the projected systems—both those potentially offered by the developer and those likely to be installed by the tenants.

Finally, the preliminary phases should determine the methodology for the key issue of connectivity between systems. If the specific systems for such signal distribution are not actually identified, then the provisions for future accommodation of the systems should be settled.

Phase 3. Deliverables should be the actual specifications and bid documents that emanate from the design decisions and conclusions of Phases 1 and 2. The second part of Phase 3 requires development of a report of findings and recommendations that set forth the results of the Phase 3 evaluation process.

Phase 4. The deliverables in Phase 4 should all relate to leaving a clear audit trail of how and where systems were implemented. This audit trail should be updated as the building and tenants change, in order to simplify the implementation of emerging technologies and support the tenant's facility management programs.

At this point, the issue of connectivity must be brought into focus. Without discussing the attributes of digital technology and the migration of telephone systems from analog to digital, the assumption is made that the new office environment will be centered upon the transmission of information in digital form through electrical or optical fiber media. The economics of moving information in this method rather than physically has dictated the trend in office automation and telecom technology toward "distributed" data and "distributed" communications. It therefore becomes imperative that building planners incorporate an overall plan to allow tenants to easily:

1. Move information digitally within their own space.
2. Move information to/from other locations within the building.
3. Access digital signals from outside the building.

In the development of a network to support the above, the consultant should also consider the needs of the developer to integrate the digital signals for building management systems, security and energy management systems, flow valve alarms, and other building controls.

As obvious as the interconnection of these systems appears, this concept is often overlooked when the system vendor and not the consultant is used to establish the main distribution design.

Throughout the entire four phases of consultant activity, the consultant's effort must be guided and coordinated through the project architect. In thinking through the entire process, the value of the consultant is best described as planning and coordinating the design of "diverse but compatible technologies." There do not appear to be any major design revelations to date in this process, rather the need has been to know how to properly apply and integrate the technologies into a sensible package, an equation beneficial to all participants.

CONSULTANT QUALIFICATIONS

The above scope and approach indicates minimum requirements for a consultant, from both a discipline and an experience standpoint:

1. Telephone.
   a. Knowledge of customer premise equipment.
   b. Experience in long-distance and networking design.
   c. Planning of shared/partitioned PBX systems.

2. Distributed data processing communications.
   a. Experience in local area networks.
   b. Experience in various manufacturers' system protocols.
   c. Understanding of alternative networking designs and requirements.
3. Interdisciplinary skills—The ability to interface with the architect, mechanical/electrical engineer, and other major design groups.
4. Electrical—Experience in low-voltage distribution of wiring in base-building design, tenant spaces, and entrance and exit of networks to buildings.

In addition, the consultant should be required to provide proof that the consultant is covered by an errors and omissions policy, in the event the consultant acts negligently in the provision of advice.

CONSULTANT ORIENTATION

A look at the consultant's orientation, including possible conflicts of interest, predispositions, and methods of compensation, is very important. The communications consulting organizations that have emerged over the past few years fall into three main categories.

Groups deriving fees exclusively from parties other than the client. Consulting organizations have formal or informal incentive arrangements with vendors and manufacturers of services and equipment. One must recognize such an organization as an agent of the vendor/manufacturer, and use their services accordingly. The advantage of this relationship is that the fee requirements are minimal, but the disadvantage is that the consultant's objectivity may be compromised due to the vendor/manufacturer relationship.

Groups deriving fees from a percentage of the savings achieved on the client's behalf. For the most part, consultants in the second category do not participate in real estate planning. Nevertheless, firms entering into such contingency agreements have been known to pay for mock savings. Inducements, generally, are inconsistent with professional advice.

Groups deriving fees exclusively from the client. Typically, these organizations quote not-to-exceed fee amounts and base their fees on a project basis. It is not unusual to find these services available on an hourly contract basis in the event that specific assignments have not been clearly defined or fleshed out. These groups most closely approximate the arrangements that developers (and architects) identify with and provide the best insurance on objectivity. The disadvantage is higher fees. Nevertheless, the benefits issuing from this group tend to more than offset any increased cost.

CONSULTANT REPRESENTATIONS AND WARRANTIES

In the event of any question regarding the consultant's orientation or objectivity (and perhaps in any event), written representations and warranties should be obtained from the consultant including, as an example, the following.

1. The consultant warrants the existence of no economic affiliations with any vendor, supplier, or manufacturer of telecommunications equipment.
2. The consultant will not accept commissions, brokerage, locator, or contingency fees from any source and warrants that all income received from project work will be derived solely from the client.
3. The consultant's billing process will provide for vendor competition on a face-to-face basis to ensure the lowest possible quotes and most uniform response to specifications.
4. Any savings, discounts, or nonmonetary purchasing incentives tendered by any vendor to the consultant will be documented and passed on directly to the client.

TIMING

As discussed above, the consultant should be brought in at the beginning of the project planning. Although the consultant's specialized role is commensurately smaller than that of the mechanical/electrical engineer, for example, the need for systems planning at the beginning of the project is key. This is because the consultant's input into the project will partially dictate the required levels of HVAC, power, and physical spaces within the structure to house equipment. In this regard, the consultant's initial report should be required to exhibit a critical path schedule for all the identified systems and include the issues of both lead times and installation intervals.

EVALUATION OF THE CONSULTANT

In addition to investigating the consultant's abilities to perform the tasks outlined above, the developer should focus on several other values in order to maximize a consultant investment. Key among these is the commitment by the consultant organization to remain with the project from inception to completion. The telecommunications industry and its high tech siblings currently suffer from a lack of professional talent to serve the expanding market, leaving the consumer open to the risk of inefficient service. The symptoms of this condition are most clearly demonstrated by the inability of the vendor to provide personnel who:

1. Are familiar with the vendor's products and services.
2. Understand the nature of the developer's requirements.
3. Can or will be assigned to a project and remain over the project life.

It is not uncommon for sales and service representatives to change two or three times within a year. Since most building projects run from 24 to 36 months, the advisory relationship can reverse itself, so that the developer educates the vendor's representatives continually during the project's life. Therefore, it makes sense for the buyer of consultant service to evaluate the potential consultant according to the following three tests:

1. How long has the organization been in business, and what commitment will they make to keep personnel consistent? It is wise to determine the commitment of both principals and associate staff to the project, and even to require a firm bid for the time of all parties. As well, a penalty clause may be desired to cover the potential problem of inconsistent staffing.

2. What is the specific team's experience in similar engagements? It is not wise or practical to retain a consultant organization solely on the basis of reputation. In order to ensure competent and professional assistance, determinations must turn on the background of the assigned team to the specific task. Generally, senior team members should possess two to three years' experience on at least five endeavors similar to the developer's project.

3. How great is the consultant's motivation? As discussed above, the developer is best served when the consultant's loyalties are not compromised by any conflict of interest. Nevertheless, it is anticipated that for the next few years vendor-driven consultants will be in demand, therefore commanding fees (albeit lesser ones) for their services. In searching for consultant assistance, be reminded that if the bargain seems too good to be true, it may not be true to your needs.

■ CONCLUSION ■

Consultant selection necessitates a careful evaluation of skills and qualifications, but the benefits attained are worth the effort incurred. The proper consultant in the proper role can offer the developer a wealth of professional advice, ranging from basic design strategy to an analysis of the future profitability of developer-provided tenant services. Finally, in addition to the numerous technical services provided, the consultant should serve as a teacher, allowing the developer a comprehensive understanding of what was considered, what was selected, how it was implemented, and how it has and will be of benefit to the project.

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Peter B. Valentine is president of Comsul, Ltd., a telecommunications planning and consulting group founded in 1967. The organization has successfully completed over 1,200 communications design projects over the past 17 years. Valentine came to Comsul in 1970 from the investment and securities industry. His background in business management brings a balance of economic common sense to the firm's technical expertise.

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Chapter 13

Technical Aspects of Applying Telecommunications and Related Technologies to High Tech Real Estate

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Outline

This chapter has been written to familiarize real estate and other nontechnical professionals with telecommunications transmission facilities and technology.

The term "transmission facilities" covers a broad area ranging from internal cabling and wiring of a building to satellite communications. In this chapter, we will first discuss cabling and wiring. In the past, cabling and wiring a building for communications was a relatively easy task for the planner; the local telephone company provided not only the material, but also the technical expertise and expense for the engineering and installation of the cable facilities. In addition, the cable outlay for a building was designed to handle primarily voice telephone conversations with only a little data communication for the occasional user. Today, however, because of the Bell divestiture, the high cost of cable, manpower, and the rapid growth in integrated voice and data telecommunications technology, cabling a building becomes an important and far more complex issue, which must be dealt with by real estate planners and managers.

Related topics discussed in this chapter include sharing of communications services in a multi-tenant building, satellite services, multiplexing, local area networks, direct termination systems, and the concept of "bypassing" the local telephone company communications facilities.

CABLE AND WIRING PLANS

Planning for the cabling of a high tech building involves careful consideration of present and future uses, the application of known technologies, and the application of conservative safety factors.

Building Entry Conduits

An average building can be assumed to contain 500,000 square feet of floor space with a mix of tenants having portions of floors and an occasional multifloor operation. One telephone will probably be installed for each 200 square feet of floor space, thus approximately 2,500 telephone instruments would be required to serve the building. This density, one telephone per 200 square feet, is appropriate for consideration in Manhattan, downtown Chicago, Center City Philadelphia, as well as Dallas and Houston office building locations.

Assuming that there will be 2,500 telephones installed in a building and giving consideration to the variety of communications concessionaire service offerings available, we can choose a split between the local telephone company-supplied services and services supplied by others. For the purpose of this discussion, the local telephone company will provide 1,000 lines, and the other services will provide 1,500 lines. Also assume that the 1,500 telephones served by the private service might very well go to a central PBX that serves another 1,500 lines in adjoining or nearby buildings. This approach provides for flexibility in design and allows us to anticipate the size of conduits that would be required.

The experience of telephone companies in various cities is the best resource for choosing conduit sizes. As an example, New York Telephone Company planners advise that a single 4-inch ID conduit can accommodate a 3,600-pair cable on a fairly straight run, although 2,700-pair cables are generally the practical upper-size limit due to conduit bends and similar factors. A 3000-line PBX in this high tech building would require 1,500 pairs (2-to-1 line-to-trunk ratio) for connection to the telephone company's central office and one 4-inch ID conduit for incoming trunk lines to the PBX. One additional 4-inch conduit would also be required for eventual connection to the adjoining building or buildings taking service from this PBX system. In addition, still another 4-inch conduit should come into the building to carry the 1,000 lines carried from individual telephones directly to the central office. This now calls for three 4-inch conduits entering the building at ground level or lower.

Additionally, planning for a high tech building should include sufficient additional capacity to provide for future fiber optics network cables, future interconnections to other buildings, and spare conduits accessing the building from different sides, to provide for the redundancy of cables to cover emergency conditions—such as disruptions due to broken water mains and other disasters.

Accordingly, for this 500,000-square-foot office building, the building entry conduits should look like this:

Building Entry Conduits for a 500,000-Square-Foot Office Tower

Function	*Size (inches)*	*Number Required*
Tower PBX	4	1
PBX Interconnection to other buildings	4	1
Local telco lines	4	1
Future fiber optics	4	1
Future building interconnections	4	1
Spares	4	2
Total		7

Sizes of Frame, PBX, and Maintenance Rooms

A review of PBX equipment offerings indicates that a 3,000-line PBX system requires approximately 900 square feet of floor space. To provide space for the Frame Room, Power Supplies, and maintenance facilities, an area of approximately 1,300 square feet should be reserved for the entire PBX system. The 1,300 square feet would be used as indicated in the table below:

PBX Equipment Floor Space for 500,000-Square-Foot Tower

Functional Group	*Typical Room Size (feet)*	*Floor Space (square feet)*
Frame room	15 × 15	250
PBX switch and associated electronics	25 × 25	650
Power supply, batteries, and air conditioning	17 × 17	300
Maintenance facilities, customer services, etc.	10 × 10	100
Total		1,300

Equipment floor loads vary substantially; the heaviest loads result from the standby power supply batteries in the PBX power supply room. Typical floor loads are tabulated below:

PBX Equipment Floor Loads for a 500,000-Square-Foot Tower

Functional Group	*Typical Floor Load (pounds/square foot)*
Frame room	100
PBX switch and associated electronics	100
Power supply, batteries, and air conditioning	300
Maintenance facilities, etc.	100

Electric Power

The 3,000-line PBX system will require approximately 40 kilowatts of AC power; 208 VAC, single-phase power is generally required by the equipment. The standby battery power supply, which typically operates as an uninterruptible power supply (UPS), converts the 208 VAC power to 48 VDC to operate the PBX electronics. UPS systems for PBX operation typically have a full-load duration of two hours when primary AC power fails.

Ventilation—HVAC

OSHA and most city codes require a complete change of atmosphere in the PBX power supply room at least four times each hour. The corrosive fumes emitted by storage batteries should be considered in the design of power supply room ducting, and all ducting should exhaust outside the building.

The 3,000-line PBX systems discussed above will dissipate approximately 125,000 BTU/hour above the ambient level, and this substantial load is concentrated in the room containing the PBX switch and associate electronics. The PBX system environment should be held to a temperature of approximately 70°F—plus or minus 10°—and 50 percent—plus or minus 20 percent—relative humidity (noncondensing). Installation of a Halon fire control system should be considered.

COMMUNICATIONS CLOSETS AND RISERS

Closets

Communications closets are usually provided as small rooms, aligned vertically throughout the building core to permit vertical riser cable installation and tapoff or distribution connections. The size of these closets is determined by the amount of equipment to be installed and the decision as to whether "building space" or "tenant space" is to provide for the equipment.

Figures 13–1 and 13–2 show two general types of closets that serve most ordinary telecommunication needs. Further details are shown in Figures 13–3 and 13–4, where the vertical risers are enclosed and/or exposed throughout the building.

It is strongly recommended that the communications closets be of sufficient size to allow parallel operations of a local telephone company cabling and a private communications concessionaire cabling. For a building of this size, assuming a 35-story building is involved, a 50-square-foot communications closet should be sufficient for the mounting of patch panels, cutdown blocks, and occasional mux/demux equipment, and power supplies. Communications closets should be vertically aligned throughout the building, as closely as feasible, and should be equipped with power and light.

Vertical Riser Cables

Assuming that the building PBX system will operate 1,500 telephones within the tower itself and that the local telephone company will furnish

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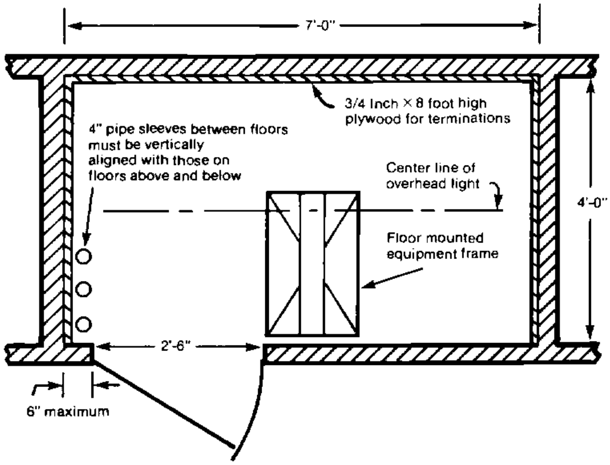
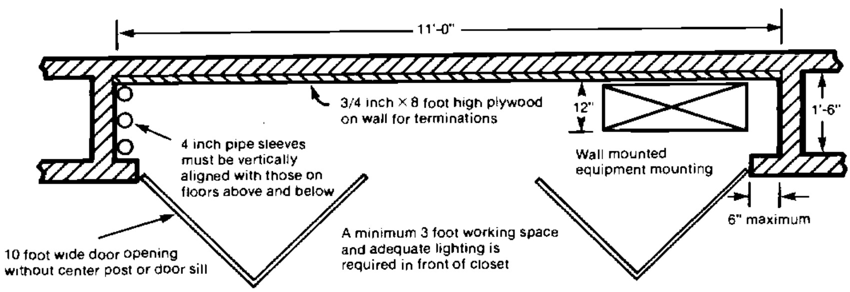
FIGURE 13–1
Walk-in Closet



Note: Typical for 9,000–10,000 square feet of usable floor area.

FIGURE 13–2
Shallow Closet (wall-mounted equipment)



Note: Typical for 9,000–10,000 square feet of usable floor area.

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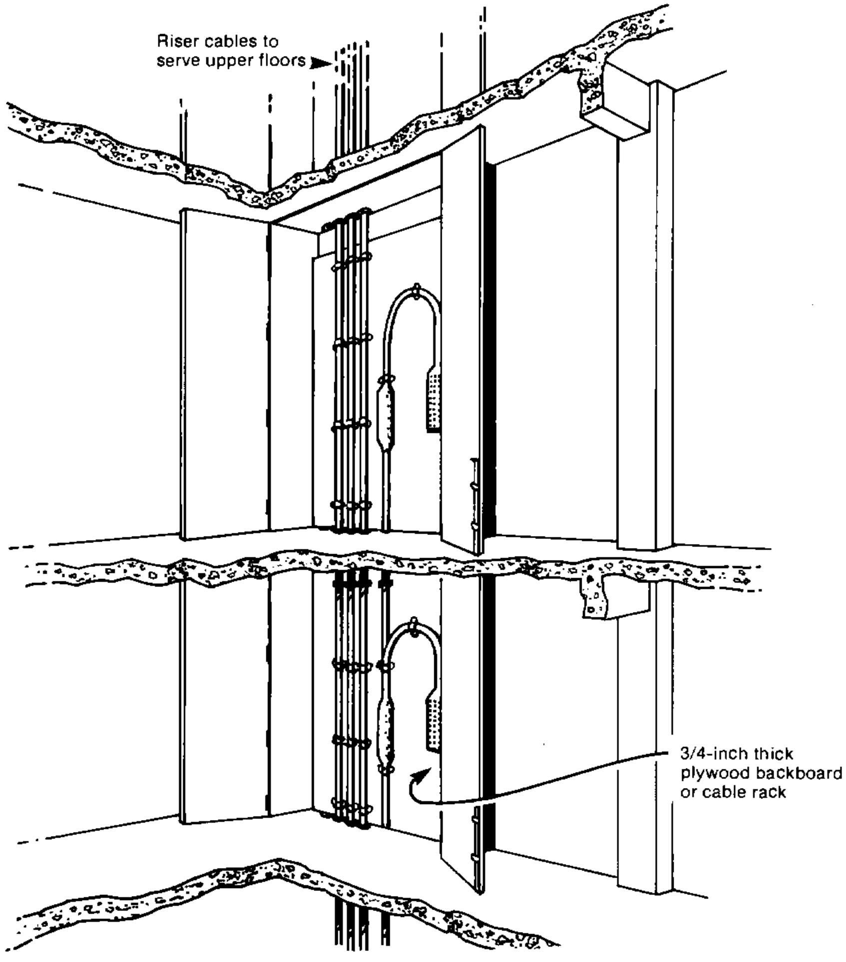
FIGURE 13–3
Closed Riser System



private-line services for 1,000 more, we can estimate the number of telephone risers likely to be installed in the tower. Taking the PBX system first, the 1,500 telephone lines can be assumed to be equally distributed through the 35 floors, so that approximately 45 PBX lines would serve each floor. Each PBX line requires three pairs of conductors, so that each floor would be wired for approximately 150 PBX line pairs.

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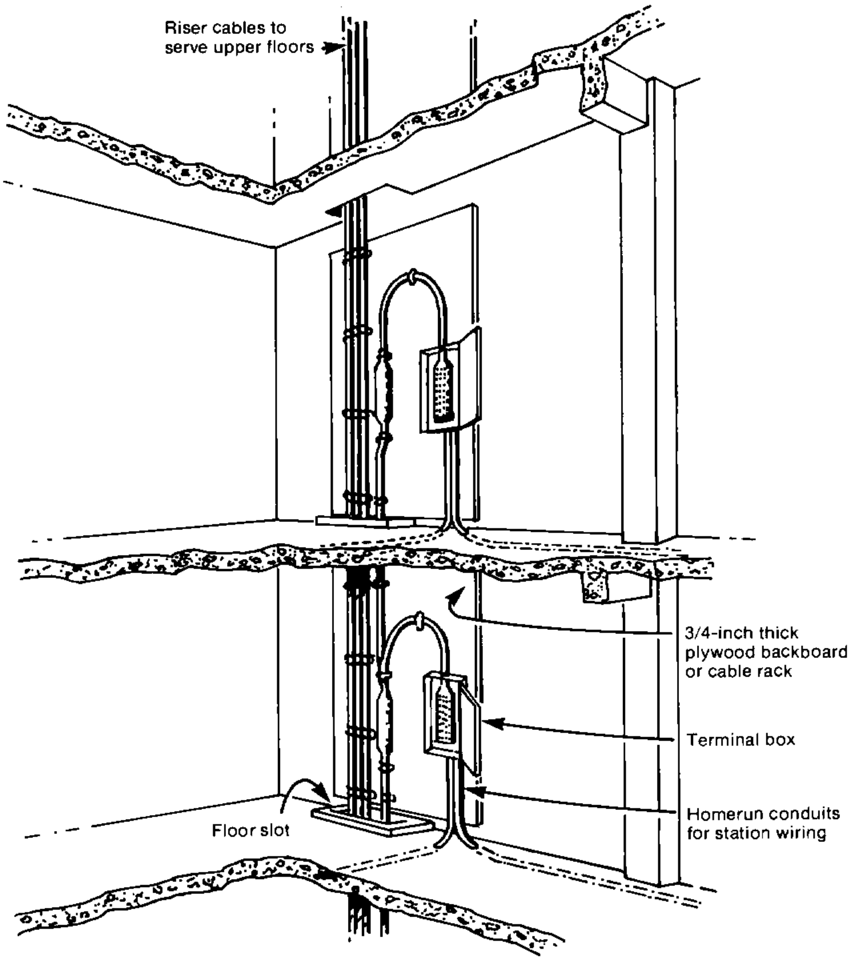
FIGURE 13–4
Open Riser System



The local telephone company private-line service is a bit more difficult to predict because different types of local telephone company facilities may be provided, and these will affect the numbers of line pairs required. Assuming that the 1,000 local telephone company telephone lines are equally distributed through the 35 floors, approximately 30 local telephone company lines would serve each floor. Each local telephone company line may require as few as one or (as in four-wire services) two pairs of wires. Assuming the latter, each floor would be wired for approximately 75 pairs of local telephone company lines.

Based on the foregoing, we would expect to see a total of 5,250 PBX line pairs and 2,625 local telephone company line pairs entering the lowest communications closet from the basement to begin the vertical run. As noted above, a 4-inch ID conduit, or riser sleeve, can accommodate up to a 3,600 line pair cable, with a 2,700 line pair cable being the more common maximum size. The lowest floor communications closet would therefore require four 4-inch ID risers for PBX and local telephone company cables, plus others for future service expansion. It seems reasonable to assume that a total of eight 4-inch risers would be needed in each communications closet for the first 10 building floors, with the number declining as telephone riser line pairs decline in upper floors. A suggested arrangement is tabulated below:

Five Hundred Thousand-Square-Foot Tower Communications Closet Riser Distribution

Floors	*PBX Pairs/Closet Capacity*	*Local Telephone Company Pairs/Closet Capacity*	*Four-Inch Risers/Closet*
1– 7	5,300–4,000	3,500–2,600	8–6
7–15	4,000–2,700	2,600–1,900	6–4
16–24	2,700–1,400	1,900–1,200	4–2
24–35	1,400–0	1,200–0	2

Accessibility

Conversations with telephone company planners indicate that communications closet accessibility is at least as great a problem to them as riser capacity. Telephone company personnel frequently find that pneumatic sensor lines for environmental controls, dedicated security system cables, and similar facilities occupy riser space or closet wall space (or both) to the exclusion of telephone cables. In extreme cases two or three fragile copper pneumatic lines, only a fraction of an inch in diameter, occupy a 4-inch riser sleeve and exclude its use by other services. It is recommended that anticipated communications closet uses be reviewed to optimize the layout of specially dedicated facilities for security, environmental control, and other factors.

ROOFTOP FACILITIES

Among the many requirements of the interior cabling and wiring is the provision of access to the roof level to feed signals to and receive signals from satellite and microwave facilities. The communications closet riser line should extend to the roof level and/or to the level at which communications equipment will be mounted. The building should have provisions for private-leased rooftop facilities. Accordingly, a multiplicity of conduit entries to the equipment area should be provided. In general, a 2-inch conduit would suffice for two-way radio and/or a microwave facility, whereas a 4-inch conduit may be required for ease in running a waveguide connection from the rooftop level down to an equipment room that could be located immediately below. In all of the planning, sufficient sleeves or knockout areas should be provided to allow easy access to the equipment room and/or to the roof area.

Satellite Communications

The placement of a satellite uplink/downlink facility on a rooftop requires a review of the radio-frequency environment, FCC licensing, choice of satellite transponders to be utilized, review of the "visibility" of the satellites desired, and an analysis of the rooftop stability for mounting the satellite antenna.

The first process to be considered is the review of the structural stability of the building and the feasibility of mounting a satellite antenna system on the roof. Generally, the rooftop area is occupied by heat exchangers, window-washing equipment, vents, and occasionally electrical transformer equipment. The space available for a satellite receiving facility is usually constrained.

Since we are assuming a 35-story building, our first investigation will review the stability of the building to see if it can meet the requirements for a business communications satellite—such as SBS operation in the Ku band of frequencies.

Assume that a 5.5-meter antenna will be utilized along with two shelters to be roof mounted, containing all of the electronics and power standby equipment. For the purposes of this analysis, assume that sufficient space is available.

Many of these antennae have been mounted on tall buildings throughout the country. Strict adherence to the structural requirements is mandatory to ensure alignment with the satellite, which is 22,300 miles away. Angular deflection is a critical item in the design of the load frame for the antenna, as it is operationally sensitive to pointing errors.

The vertical rotation of the horizontal plane formed by the front and back footpads of the antenna must be limited to 0.01 degrees. This is to be computed based on the differential deflections of the footpads produced by an operational wind load of 45 mph or 75 km/hr. The architect/engineer may assume the columns to provide an infinitely stiff support.

The horizontal rotation of the building frame at the roof level is not expected to exceed 0.02 degrees under an operational wind of 45 mph. The intent of this specification is not to require the rotational analysis of the building frame. In an SBS installation, however, if the architect/engineer appraisal exceeds this limit on a particular structure, SBS needs to be informed immediately.

Lateral building deflections can be tolerated, but building twist cannot. A review of the vendor's mounting requirements must be undertaken by the structural consultant for the building.

Once it has been determined that the structure is stable enough to accept a satellite facility, a line-of-sight clearance check should be made to ensure an unobstructed view of the satellite or satellites to be accessed.

Once the mechanical matters of mounting and clearances have been completed, applications for frequency coordination and FCC licenses can be prepared. At the same time, a study should be undertaken as to the potential of non-ionizing radiation hazards that might exist in the vicinity of the satellite uplink antenna. Acceptable limits for exposure to workers and the general public vary by location. New York City, for example, has a power density level of 50 microwatts/cm^2 recommended by the Department of Health. Even this low level can be met with standard satellite equipment, simply by providing fencing to ensure that no one can inadvertently enter the area of higher power density.

Future Satellite Services

Although 5.5- and 7-meter diameter antennas are predominant in business communications today, there is a strong movement to make use of still smaller antennas for data transmission between 9.6 and 56 kilobits/second. Two-foot and 3-foot diameter antennas are now being offered for services utilizing spread-spectrum techniques and can provide for uplink and downlink operations in C band and Ku band as well. These systems are being offered by Equatorial Communications and TeleCom General among others as relatively new offerings.

In the near future, small antennas of approximately the same size will be utilized for newly developed satellite transponders in the Ka band operating at 20 to 30 GHz. These small antennas will permit access to new satellites that will have onboard processing equipment to handle switching between various ground stations and handle high-speed data and video as well. It appears that business communications from office towers can be handled very well with a 5.5-meter antenna at this time and will undoubtedly be the location for multiple small dishes in the near future.

Microwave and Two-Way Radio Facilities

A microwave transmit/receive antenna is generally a parabolic-shape "dish" varying in diameter from 2 to 10 feet. Most rooftops have sufficient space to mount these microwave relay antennas. The major criterion is clear-

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ance of the horizontal path, since the transmission is line of sight. Microwave frequencies available for business communications purposes range between 2 GHz and 23 GHz, and the higher frequencies use the smaller antennas.

Main considerations for installation of these antennas, once line of sight has been cleared, are frequency coordination, FCC licensing, and assurance that no non-ionizing hazard exists. Once the frequency coordination and licensing process has been cleared, hazard to human beings can be minimized by mounting the equipment so that the maximum power density level is at inaccessible locations. This could mean mounting the dish on a parapet facing away from the accessible areas or on a penthouse wall or tower so that access is impossible.

Two-way radio antennas, or "whip" antennas can be mounted at many locations on the rooftop. Once again mechanical clearance is the most important factor, since these antennas radiate fairly omnidirectional signals and so not require line of sight to a receiver. In all cases antennas mounted on the roof should be carefully grounded to protect them and the building from lightning damage. Weatherproof connections should be made to bring the antenna cable to the equipment located either in adjacent shelters or on the floor below.

If a tower is considered for the mounting of two-way radio antennas and/ or microwave antennas, consideration should also be given to the need for any aircraft obstruction lighting, a matter totally dependent on the building height and its proximity to airports.

SHARED TENANT SERVICES

There are many pros and cons to the "sharing" of services in one building or building complex among the many tenants. New telecommunications technologies make it possible to share telephone and data switching equipment and computer and processing equipment in a cost-effective manner. In many cases the variation in usage patterns can provide very meaningful cost benefits.

This sharing is possible with the maintenance of the appearance of an individual service, with full security and privacy afforded to each user. Unfortunately, in many cases it is very difficult to convince the user of the degree of security that has been provided.

New computer-controlled PBX systems are available with complete compartmentalization that provides the same privacy in shared switching that would be available in single-purpose, customer premise equipment. There is a physical and economic "pro" in using such a shared service, but there is also a psychological "con" present regarding privacy and security of information.

All of this must be carefully considered in analyzing the method of marketing a shared service. Careful consideration must be given to the fact that a large installation reduces unit cost as well as operation and maintenance costs. Larger installations of the more sophisticated computer-controlled switches also offer a wider range of features and greater flexibility than most smaller units.

Aggregation of communication costs through the sharing of voice and data trunks is another approach to sharing that minimizes trunking, minimizes turnkey installations, and can be a major cost-saving element.

Sharing of computers, data bases and word processing systems has been represented as another potential for major cost savings. This has proved to be of value in the case of multistation access to a mainframe and access to data base nodes, but not in the case of word processing.

Word processing systems proliferate at such a wide variety of prices and with so many competing features that centralization has not proved economical. Multistation facilities within an office, with automatic paper feed printers and high-speed draft printers located on the same floor have become the norm. A central facility serving local printers and local terminals does not provide sufficient economic advantage for serious consideration.

However, computers can be compartmentalized in the same fashion as computerized digital PBX equipment and provide the same degree of security. Having available the capability of large mass storage and high-speed processing is advantageous to many types of business. However, there is also the general feeling of insecurity and a reluctance to store sensitive data in devices not fully under the tenant's control.

Sharing of data bases, however, does appear to be advantageous. The multiple data bases serving U.S. industry generally have nodes in key cities, and access simply requires a local call. The aggregation of such data bases and nodes within the building complex can provide for cost saving and time saving and should be carefully explored.

MULTIPLEXING

A communications channel exists in at least two dimensions—it exists over a period of time, and it has breadth, or bandwidth—its extension in the frequency domain. Additionally, the channel may have spatial characteristics and exist only between distinct points, as in the case of a cable connecting one telephone with another, or a directional antenna projecting radio communications to a favored location. Channels can sometimes be characterized by propagating electromagnetic energy in particular planes or modes—vertical, horizontal, circular—and be distinguished from other channels sharing the same frequency, temporal, and spatial dimensions by virtue of their polarization characteristics.

The two basic dimensions, time and frequency, are often exploited to permit a channel to be shared among several data sources, although the other channel attributes can also be used in the same way. We are most familiar with frequency multiplexing, the division of a channel's bandwidth into subchannels, each having distinct frequency limits or boundaries. Frequency multiplexing is employed to permit the broadcast radio and TV bands to carry the programs of many stations simultaneously; one's radio or TV receiver is tuned to a particular subchannel or frequency to separate the desired signal from all others sharing the same frequency band. The entire electromagnetic spectrum from long-wave radio to optical radiation can be considered as a continuum, and the hundreds of thousands of signals existing therein coexist by virtue of the distinctness of their carrier frequencies or channel occupancy, otherwise known as frequency multiplexing. Telephone trunks often employ frequency multiplexing to combine individual voice signals. The trunk cable has much more bandwidth than is required for any one conversation. Each signal is modulated onto a distinct carrier frequency in a manner similar to that employed by radio stations to place program material on a carrier for radio transmission. Many voice signals are "stacked" in frequency by using closely spaced carriers. The ensemble of carriers and signals are called groups, and groups of groups (supergroups) are sent over the trunk to distant central offices, where the signals are separated by carrier frequency and demodulated before sending over local loops to individual telephones.

Time multiplexing is also a common human experience. We often do several things at once, or carry on two conversations at the same time. We time-share our attention, communicating now with one thing or person and then with another. This is time multiplexing. In simultaneous conversations one time shares aural communications channels—voice and hearing—among several participants. The meaning of each interchange is digested as though attention were individually focused, and there is the *illusion* of simultaneous communication because of dealing with more than one situation in the same span of time. Note that "the same span of time" is not "at the same time," or truly simultaneously. Similarly, one's telephone conversation is sometimes carried over the same trunk cable as those of others by use of time multiplexing. Each voice channel is sampled for an instant and sent, in sequence, with samples from other local voice channels. At the other end of the cable the time-sequential samples are separated, or demultiplexed and reassembled on individual local loops in the recipient's city. If the sampling is done often enough, the reassembled signal contains all of the information sent, and the listener perceives that the connection (or communication channel) with the sender is continuous and exclusive. The fact that rapid sampling of information can substitute for continuous connection is of enormous importance in communications; it was first quantified by Harry Nyquist of Bell Laboratories in the 1920s and is known as the Nyquist sampling theorem.

Spatial multiplexing is also evident in our everyday lives. Home telephones are connected to a central office by means of an individual wire pair. Our wires may cross or be bundled with those of others without interaction because the communications channels represented by each wire pair are spatially separated and distinct by virtue of the insulation covering each wire. Spatial multiplexing also occurs when two radio stations share the same frequency but are separated geographically or transmit from the same location in different directions.

Examples of communications techniques of interest to the designers of high tech buildings employ these various multiplexing methods, sometimes in combination, and are presented throughout this volume. Multiplexing allows voice, video, and data to coexist on the same communications channel and permits exploitation of the available channels to the greatest economic advantage.

LOCAL AREA NETWORKS

Means to interconnect data processing equipment within the confines of an office, hospital, factory building, or building complex are called local area networks, or LANs. Such networks provide resource sharing and communications among these devices at high speeds and are typically owned by the user. The conjunction of high speed and low cost is not contradictory because the transmission paths are short. The paths vary from several meters to several kilometers in length, short enough so that even ordinary twisted pair telephone wiring can support reasonably wide bandwidths, such as 56 kbps. LANs have become important because of the proliferation of the personal computer and its ancillary devices. The mainframe computer of the 1950s became the several minicomputers of the 1960s and 1970s; these, in turn, have been replaced by the microprocessor-based personal computers that inhabit many desks, from executive to clerk. The nature of office transactions has not changed, however. Most of the information generated by an individual is intended for someone within the same office or complex; estimates range up to 80 percent internal distribution. However, now that there are many information-generating devices, computers, and related equipment, the distribution means must accommodate this proliferation.

Direct lines suitable for interconnection of a large computer and its terminals and printers are impractical as a way to interconnect many PCs, since interconnections grow geometrically with the number of PCs. The intraoffice private-branch exchange (PBX) that serves all desks with telephone service is not a good alternative. The data speeds supported by the PBX and its lines are too low in many instances, and several lines in parallel would be required. In addition, the nature of the traffic is different; data communications are conducted in bursts, with relatively long pauses in between. To efficiently use the interconnection system requires that the communications path be relinquished after each burst so that the facilities may be used by others; but the PBX requires several seconds to establish a connection (the dialup time). In contrast, voice conversations are protracted and relatively infrequent; the dialup time is inconsequential and tolerable. Since dialup delay is often longer than the data burst, the use of a current generation PBX and its lines is not practical and would not work with standard data transmission protocols. However tempting, because they are in place, well accepted, and often paid for. A further drawback concerns the network configuration that use of the PBX imposes; all lines lead to a central location—the PBX equipment. If this malfunctions, the entire interconnection system is inoperative.

Local area networks avoid the disadvantages of interconnection through the intraoffice telephone system by offering a communications channel tailored to the special needs of efficient data communications. LANs provide high-speed data transfer, there is low overhead time for establishing interconnections, and they can be configured to avoid centralization and catastrophic failures. Like telephones, most LAN wiring is inexpensive. Careful planning to accommodate future changes and expansion of the system is not needed, and the wiring can be installed everywhere at little additional cost when the office or building is being outfitted.

There are three ways to characterize LANs: by the network layout (topology), by the means by which a device gains access to the network, and by the interconnection medium (wire or cable) and its data capacity. Confusion can result because one characterization does not imply or preclude another, and all three are needed to fully define a LAN. To add to the confusion, standards are slow to emerge, and LANs are further distinguished as general purpose, special purpose, or proprietary—depending on their ability to interconnect any device, a class of devices, or only devices of one manufacturer.

Network Topology

The network topology is partly determined by the type of control intended for the LAN. If the function of one device to be netted is dominant, then control should be centralized at that device and it becomes the master node of the LAN; the master sets the order of "talking" on the LAN and polls the other nodes to find their need to send information. If many devices have equal importance, control should be distributed, and there is no master node; becoming the talker is set by more democratic means, as will be described below. Networks having a master node can effectively use star or tree network configurations of wiring. The master is located at the center of the star or base of the tree. A choice between these two might be dictated by the structure of the building and the ease with which wiring is installed. Ring and bus topologies are suited for distributed-control LANs. There is no dominant node for these configurations. The bus configuration is easily expanded and is tolerant of failures in devices attached to the bus. If distances between devices on the LAN are large, the ring configuration is favored. Each device receives data from one side and reconstitutes it before sending it onto the other side; in this manner, weak signals are constantly being restored. The ring has several disadvantages; failure at any node brings the entire network down; there are delays associated with regenerating the signals; and the devices are more complex and costly because of their active role in retransmission on the network.

Access Methods

There are various methods of network access by which the device at a LAN node takes its turn to transmit on the network and send its data to any or all other nodes. For LANs having master stations, access is usually granted by the master. Each node is polled; if the device at a polled node has data to send, it so indicates, and the master grants access and allows the device to talk. Access is typically granted for a fixed, short time. The device might have much data to send, but it is not permitted to tie up the network until its data are exhausted; rather, the device must wait its turn and send data in many short segments. Distributed-control LANs can grant access by fixed schemes or by random techniques. Among the fixed methods is token passing. A unique data word, the token, is passed from node to node. If the device at a node has data to send, it does so before passing the token onto the next node. An alternative method is the slotted ring; a period of time is divided into segments called slots, and any device having data to send can do so in an empty slot. The device to which the data are addressed "empties" the slot and indicates that it is available by inserting a data word in the slot to indicate that the contents are no longer needed.

If the time required to poll, pass tokens, or wait for empty slots cannot be tolerated, an access scheme called carrier sense multiple access with collision detect (CSMA/CD) is often used. There is no order of access, and any device having data to send can do so if the network is free at the moment. Devices sense carrier energy on the line and refrain from sending data if carrier is present; this is called listen-before-talking discipline and is how most of us conduct ourselves in a group. If two or more devices send data simultaneously because both sense a free line at the same time, data collisions occur, and messages are garbled. Each device's carrier sense circuit now notes excess carrier energy on the line and stops sending its data promptly. After a delay, made different for each device on the LAN, the device again determines if the line is free and then resends its data. With CSMA/CD there is no determined order of access and no minimum waiting time. Devices with more data to send obtain line access more often, and the distribution of access is fairly weighted in accordance with the transmission needs of each node.

Interconnection Media

LANs can be characterized by the amount of data they can carry and the speed of doing so. There are two types of networks under this classification: broadband and baseband. Broadband LANs employ frequency-division multiplexing to partition the spectrum afforded by coaxial or optical fibre cables into a number of channels. Cables are suitable for broadband networks because they can support a wide range of frequencies. Used in the broadband mode, coaxial cable usually has more capacity than is required for the LAN. Some channels can be used for the LAN function and others can be used for distribution of voice and video or for energy and security monitoring. The broadband network is similar to that used in cable TV systems and share some of the low-cost hardware used in CATV practice. Optical cables have very large bandwidths and are suited for multifunction networks and where size and weight of the line are at a premium. Baseband LANs do not divide the spectrum into channels and use the "base" of the frequency band in its entirety for all the data traffic, usually over twisted-pair wiring. Time-division multiplexing must be used so that all nodes can share this single channel; other services cannot share the baseband network. Twisted pair wiring is very low-cost but has low bandwidth and high loss. It is suited for baseband networks that use the ring configuration so that regeneration at each node overcomes the wire's losses. Because of its low-loss properties, coaxial cable is also suited for baseband networks in which long runs between nodes are encountered and in which signal regeneration is not used.

BYPASS

Means of avoiding the use of the conventional telephone network are called bypass technologies. Bypass communications may be an alternative to the local loop between the customer and the telephone exchange, or it may avoid the use of the long-distance telephone network; in some cases, avoiding both is effected. Telephone companies (AT&T, the BOCs, and independents) have responded by offering bypass services themselves and have marketed high-capacity communications alternatives to their own traditional wire-line facilities that have been in place for decades. Bypass facilities can be owned, therefore, by any interested party: the user or user's designate (private systems), groups of users (shared systems and multi-tenant systems), radio common carriers, and wireline common carriers (the telcos that are otherwise bypassed).

Bypass technologies include microwave radio, satellite radio, coaxial cable, and optical fiber cable. Bypass is employed to reduce costs, to provide services difficult to acquire from conventional telco offerings, or most often, a combination of these two reasons. The most common example of the first reason is the use of another long-distance service for home or business, such as MCI or Sprint. Examples of the second reason include video teleconferencing and high-speed data communications. Several types of bypass services are discussed in the paragraphs that follow; both local-loop and long-lines bypass techniques are presented.

DIGITAL TERMINATION AND ELECTRONIC MESSAGE SYSTEMS (DTS/DEMS)

In 1978 the Xerox Corporation petitioned the FCC to allocate a portion of the radio spectrum at 10 GHz (commonly called X band) for a common-carrier broadband network service; Xerox had named its new proposed service XTEN. The FCC responded positively in 1981 with a Report & Order that reserved 130 MHz of spectrum at 10.55 to 10.68 GHz for digital termination systems (DTS) and the digital electronic message service (DEMS), both of which were modeled on the XTEN concept.

Why DTS?

The new service is designed to provide business users with data transmission capacity for intracity communications that are not easily obtained from the local telephone company. In a sense, DTS/DEMS is not a bypass service, since it is not an alternative to an existing, readily available telco offering. Traditional local loops (the telephone line from the customer's premises to the telephone central office) and central office switching equipment are not geared to handle high-speed, high-quality digital data traffic. The service does present a bypass alternative to wideband private lines that can be obtained from the telephone company; these lines are not part of a switched service, however, and the user must have fixed destinations in mind when contemplating their use. DTS is a local distribution service that carries data and other wideband traffic, such as high-speed facsimile and video teleconferencing, between users and central stations called nodes by means of point-to-point or point-to-multipoint full-duplex radio. Traffic can be switched at the nodes, allowing users to treat the system much as the telephone or postal system. Intensive reuse of each operator's radio channel is encouraged by the FCC, and extensive intracity networks can be achieved as in the case of cellular radio for vehicular telephones. Data rates from 75 bps to 1.544 Mbps (T–1 service) can be carried by using equipment now being offered by several manufacturers. Interconnection of DTS nodes is provided by radio channels in the DTS radio band dedicated to intranode traffic. Connections among cities are effected by use of other services—such as long-haul microwave, satellites, and coaxial or fiber optic cables. A DEMS network consists of interconnected DTS nodes, and the DTS links between users and their local node form the local-loop portion of the service. The nodal stations are analogous to the telephone central office, or switching exchange, and the interconnections of the node correspond to AT&T long-lines circuits. DEMS license applicants proposing to build in 30 or more cities can use 5-MHz channels between users and nodes and are classified by the FCC as extended carriers. Others, applying for networks involving 1 to 29 cities, are assigned 2.5-MHz channels and are considered local carriers.

In its first Report & Order, the FCC recognized that 130 MHz of spectrum might be inadequate and that the 18-GHz region would be examined for additional DTS/DEMS allocations. It was also noted that private carriers might be permitted to use the service. A Notice of Inquiry by the commission resulted in the second DEMS Report & Order in 1983 that authorized the service at 18 GHz and modified the rules at 10 GHz. The commission did indeed permit private carriers to operate DTS systems and DEMS networks; further, the distinction between local and extended carriers was removed by allowing all to use 5-MHz channels for user-to-node and node-to-user communications.

The DTS "Local Loop"

Currently, there are two methods of configuring DTS "local loops" between the node and the user; each has hardware available from one or more vendors. The first method is point-to-point radio, for which a separate communications path to each user is established by means of highly directional antennas at both the user and node ends of the path. This method is attractive to private users that have known, specific locations that are to be included in a digital communications network; the cost of such a configuration is relatively low because users have common goals and communications requirements. An implication of this method is that the network protocols can be restrictive; node hardware and software do not need to accommodate service on demand as is necessary with common-carrier systems that cater to many independent user-customers who cannot be expected to coordinate with one another in gaining access to the network. The switching tasks required of the node can be greatly reduced and, in some cases, users can be serviced with private, dedicated lines, and no switching is needed; the node acts solely as a radio station and no value-added services are performed.

The second DTS local loop configuration method involves point-to-multipoint radio, for which the node operates in a manner similar to that of a broadcast station. This approach is suited for common carriers, since they have to serve system customers on a first-come, first-served basis and often do not know where user stations will be located at the time the system's node station is sited and constructed. The node can transmit data to users omnidirectionally, and all user sites within the reliable transmission radius of the node can be serviced. Each user-receiver "listens" to the transmission and recognizes messages intended for it by means of a unique address sent prior to the body of the message. More typically, the node transmits simultaneously in three or four sectors, each covering 120 or 90 degrees of azimuth about the node's geographic location. In this manner the system operator can "reuse" the channel assigned to him/her by properly assigning subchannel frequencies and polarizations within each node and creating a network of nodes, all utilizing the same channel. Such systems combine time-division and frequency-division multiplexing (TDM and FDM) that were explained earlier in this chapter and in Chapter 2 as approaches to sending multiple signals over a channel. The operator divides the channel of 5-MHz bandwidth into three or four subchannels to afford sector coverage about each node (FDM) and then sends different message batches simultaneously in the sectors to reach users known to be located in each of the various sectors. Users wait until the message stream they are capable of receiving contains data addressed to them, at which time the message is extracted from the stream (TDM).

User communications are arranged so that each of many users appears to be continuously on-line, or served by the node. This is possible because the typical rate at which a user can send or accept data is far less than the communications rate over the DTS channel. A typical high-speed user terminal (digitized voice, fast fax, or computer port) will send or receive at 64 kbps; a typical DTS subchannel can support 24 such users simultaneously. Each user's data stream is broken into packets containing several hundred information characters (text or numerical, usually). A packet might contain destination and source addresses and error control data. The aggregate of all noninformation data associated with each packet is called overhead; overhead burdens range from 1 to 10 percent of the total packet. There are several standards that prescribe packet format, and system operators can usually handle one or more of these to meet user requirements. A packet containing 250 characters takes only 1.3 milliseconds to send or receive, and each of 24 users is served with a packet about 32 times per second. A data buffer at each user terminal accepts or prepares the packet for communication at the DTS channel rate, about 1,600 kbps, and presents the data to the user at a 64 kbps rate. From the system operator's viewpoint, the packets are small chunks of disconnected data, each user getting only 1 out of each 24. From the user's vantage, the buffers give the appearance of undivided attention being paid to each user, whereas each user is really waiting about 96 percent of the time.

Packets for a particular user can be assigned a fixed time slot in the frame of 24 allotted for the users. Information is sent to identify the beginning of each frame, and users need not look for their addresses. They always know that the contents of the slot are theirs; this is called fixed-assignment TDM and is a private-line local loop. The slot is always there and the user pays accordingly. Alternatively, assigning slots as the user requires is called demand assignment multiple access (DAMA). The DAMA user is not always occupying a slot and therefore pays less; the operator compensates by making the same number of slots available to more customer/users on an as-required basis.

Either of these time-division multiplexing techniques can be extended in both directions, serving more users at lower rates, and even intermixing data rates. One DTS channel can be used to serve a variety of users, each with widely differing terminals and data rates. The buffer at each terminal is tailored to standardize the data as seen from either the DTS provider's or the user's viewpoint, resulting in great system flexibility.

User-Node Communication

So far we have shown how users receive messages. In order to originate traffic over a DTS system operated by a common carrier, the user employs techniques similar to those used to send a message on a LAN system. If a user has a fixed assignment, there is an allotted time slot in the user-to-node time frame, and permission does not have to be requested or granted to send data to the node. In the more flexible cases, such as DAMA, a portion of the user-to-node time frame is reserved for requests for service. Either users contend for attention during this time, or they are assigned short request slots and make their need for origination service known to the node. The node, listening for collision-free requests, sends grants to users that inform them of the slots reserved for them in the next or subsequent frames. If request collisions occur among users, grants will not be sent by the node, and the users will try again after several frames have been transacted without acknowledgment of their service requests. Sophisticated system protocols will accept and grant requests for service that are rate dependent. A user who has an immediate demand for a high volume of traffic might include in a request, along with identification, an indication of the amount of data to be sent to the node. The node can then grant several slots in the frame or extend slot time and delete others in the frame if other demands for service are low at the moment. The same flexibility can be employed in the node-to-user direction, but is more straightforward than user-to-node to implement, since the request/acknowledge cycle does not have to be transacted. The node can simply pass the incoming volume of data on to the user without further ado, assuming that the user terminal buffer has been sized to accept the largest possible expected burst of data traffic. If the terminal buffer is too small, the node will have to buffer the traffic and send at a lower rate or adjust the user rate in accordance with the amount of undigested traffic in the user's buffer by means of a reverse request/acknowledge transaction.

The Node Station Rooftop Antenna

The radio communications path between each user and the node station must be line of sight; that is, the user and node antennas must be visible, one from the other. This is because, at the high radio frequencies involved, radio propagation is similar to that of visible light, and terrain or building blockage of the path defeats communications. The node station antenna is situated on the roof of one of the highest buildings in the city, or on a high promontory affording a good view of the business district. The node station location is selected with this ability to "see" as many user sites as possible. Of course, node stations for private DTS/DEMS networks may be sited to communicate with known user stations and might not be optimum from the standpoint of a common carrier who should be "visible" to as many potential user/customers as possible. The user antenna is typically located on the roof of the user's building and is usually a 24-inch diameter parabolic dish antenna that is pointed at the node station. The user antenna is used for both incoming and outgoing traffic and can handle any and all data rates or system protocols. The antenna is associated with a radio transmitter/receiver unit, usually located on the roof with the antenna. This unit converts the radio signal to a much lower frequency that is capable of being conducted to the user office by means of low-cost coaxial cable, such as used in cable-TV installations. This cable is only one quarter of an inch in diameter and is easily routed through the building's cable or piping ducts. One antenna, radio unit, and coaxial cable can serve more than one user; each attaches to the cable in a manner similar to that used in LAN networks. Users need not have any communications goals or requirements in common other than that they reside in the same building and wish to reach the same node station. Data rates, usage patterns, types of traffic—all may differ and yet share the same inexpensive cable routed from the roof equipment throughout the building. Users have their own separate terminal equipment that sends, accepts, and buffers their traffic. Access to the node is requested and acknowledged independently of other users, as though each were located in separate buildings and did not share a common antenna, radio, and cable.

MULTIPLE-ADDRESS RADIO

In contrast to the high data capacity of the DTS/DEMS service, the multiple-address radio service (MAS) is a narrow-band alternative available at much lower cost. The FCC was petitioned by the utilities industry for a spectrum allocation to permit remote meter reading and energy load management; the petition was granted in 1981. In early 1982 the FCC released a further Report & Order that provided 14 paired channels and 8 unpaired channels at 900 MHz for other private users (noncommon carriers) to conduct two-way and one-way general business and government-related traffic in addition to the channels set aside for the power industry. This service is similar to DTS in that operations are permitted in the point-to-multipoint node. In MAS radio the concept of the DTS node station becomes that of the master station. In both cases, omnidirectional transmissions emanate from the central station, but the master station is most often at the place of business from which the communications originates and at which responding traffic is to be used. In contrast, the DTS node is only a central gathering point for traffic that is then passed on to other nodes for ultimate distribution to other users, and no traffic originates at the node.

Propagation of radio signals at 900 MHz is quite different from that at 10,500 MHz, at which DTS signals are allocated. The MAS channels are slightly above the UHF TV band and share TV's ability to provide nonoptical (not line-of-sight) communications paths that penetrate buildings to a limited extent. User stations' antennas can be small (typically 4 by 12 inches) and inexpensive ($100 or less); often they can be mounted near a window in the office to be served, even if located on a low floor of a high-rise building among other similar structures. User radios are also small (less than 1 cubic foot) and can be located in the user's office; some have built-in modems that directly interface with telecopiers, computers, or other equipment that has an RS–232 dataport. The master station antenna is best located on the roof of a high building, preferably near the center of the area to be served.

Communications at rates up to 9600 baud can be supported over the 25-kHz MAS channels. Two types of services seem to predominate among MAS license applicants. In one case a central office has data to disseminate that are of interest to its outlying offices; if the data are stock quotations or other general information requiring no interaction with the originator, a one-way channel can be used. In the other case, a central office may wish to monitor conditions at a number of locations or may wish to collect data from them. The master station polls each of the remotes and each, in turn, responds over the remote-to-master paired channel. This is the operating mode for meter reading and load monitoring and is popular for remote security alarm monitoring by such firms as ADT.

SATELLITES AND TELEPORTS

Satellite transmission is an example of long-haul bypass of the telephone network. Satellite transmission as such is discussed earlier in this chapter; we are concerned here with direct user access to satellite services and their efficacy in achieving bypass. There are systems in which satellite transmission is used as part of an end-to-end service, such as long-distance telephone alternatives, or intercity connection of DTS/DEMS systems. These satellite paths are not apparent to customers, since customers are separated by the local loop; a central exchange or node acts as the satellite terminal and combines many local loops for handoff to the earth station. We mention here those bypass approaches in which the user is more directly involved with the satellite portion of the communications link.

High-Volume Users

Users having high data rates or large volumes of data may justify the installation of a dedicated earth station on premises. Such carriers as SBS will install K-band antennas on user's property and offer video or data customer premises services (CPS) in quantities (transponder bandwidth) tailored to the required capacity. The higher-frequency K-band antennas are smaller than their C-band counterparts in most cases because K-band satellites have higher power transponders on board and thus require less antenna gain (and hence size) at the earth station. In addition, K-band earth stations are more readily placed in downtown locations because there is much less spectrum congestion at K-band. C-band channels, on the other hand, are shared with point-to-point terrestrial microwave services. Many of these services are owned or used by the telephone company for long-haul communication to their local exchanges, and microwave paths proliferate in business areas. It is often impossible to locate a C-band earth station at a user's premises without accepting an intolerable degree of interference from previously licensed terrestrial carriers, who are under no obligation to accommodate a new applicant for an earth station requesting spectrum coordination and protection from interference. For users in less congested areas, or who are shielded from terrestrial C-band interference by surrounding buildings or natural features, the use of C-band services can offer a large savings in transponder lease or tariff costs because of the excess capacity now available at C band. This cost advantage will not hold indefinitely, however, as satellites have a definite, predictable lifetime and will not be replaced by spacecraft with similar characteristics, if doing so entails perpetuating a capacity glut.

Cost justification for a dedicated earth station is based, in part, on computing the crossover distance for the expected traffic level. This distance is that at which satellite and terrestrial communications costs are the same, since satellite costs are fairly constant when points beyond the crossover distance are to be linked.

Low-Volume Users

Users unable to justify CPS can use the services of fixed communications networks provided by common carriers and specialized carriers. The capital and operating costs of a dedicated earth station are not borne by the user, but the costs to establish communication channels (microwave, cable, fiber, and so forth) between the user and the carrier's earth station partially offset these savings. Users can contract to obtain full-time, part-time, or occasional-use service from most carriers to suit their needs; narrow channels for voice or teletype or, broadband channels capable of carrying broadcast-quality video. It is easier to generalize about the economics of fixed services, since there are more of them and since tariffs are well established. The crossover distance for a wideband (T–1) circuit varies from 60 to 75 miles, depending on use of C-band or K-band satellites. For a voice-grade circuit, distances from 200 to 500 miles are typical, varying not only with satellite frequency band but also the city to be reached and its associated tariff.

User Earth Stations

Recent developments permit the user with low data rates to have a dedicated earth station. Spectrum spreading is a technique that encodes a low data rate information source in such a way that it occupies a large amount of spectrum. Many sources so encoded can overlap and occupy the same transponder channel. Individual codes allow users to distinguish their data from others'; the narrow bandwidth of the source data permits the user's antenna to be small. The weak signal transmitted and received by the small antenna is enhanced by the processing gain afforded by the coding and by the spreading provided by the modulation technique. Antennas as small as 3 feet in diameter can be employed, which results in low capital and installation costs. Currently, Equatorial Communications is providing this service to small users.

Teleports

Yet another approach to bypass by satellite is afforded by the concept of the teleport. Teleports are facilities that consist of a gathering of earth stations that view satellites over which business communications can be conducted. If only K-band services are provided, the teleport may be located on a downtown building because the antennas are relatively small, and interference is not a significant problem. Teleports offering C-band or both C- and K-band services are often located in an interference-free zone, or they are made interference-free by surrounding the antennae with earth berms or metal fences that block cochannel terrestrial radiation. Frequently, teleports are located on sites of little interest for other real estate development. Teleport facilities can be commercial developments in which users participate as co-owners or tenants and install their own earth station, the developer acting in a management capacity and ensuring that users are properly coordinated, one with another. Teleports located on downtown buildings do not offer this real estate potential. The developer provides the site, equipment, and interconnect facilities with user premises and is compensated accordingly.

■ CONCLUSION ■

With many different transmission facilities available and with the continuing rapid pace of change, no one technology is the panacea in providing high tech telecommunications for a building. However, a combination of some or all of the transmission facilities discussed can both protect the developer from obsolescence and provide a cost effective and profitable approach for services to the building and its tenants.

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With more than 40 years of experience in electronics and communications, Joseph Stern is a nationally recognized authority on broadband communications and emerging technology. He and his firm are actively engaged in consulting for equipment manufacturers, government agencies, cable television operators, investment houses, financial institutions, architects, real estate developers, and specialized common carriers. His experience ranges from the basic design of complex business telephone systems, the design and construction of cross-country microwave systems, 15 television stations, the development of a stock exchange communication system, the development of fiber optics local area networks, to the development of the unique Metropolitan Transmission Center for interconnecting broadband communication systems. He has also been in charge of the engineering efforts undertaken over the past two years in developing the United Satellite Communications, Inc. DBS system. Stern is a regular contributor to engineering handbooks and is a frequent lecturer on the future of communications before engineering societies, industry conventions, and special business communications seminars.

Prior to founding Stern Telecommunications Corporation, Stern was vice president and director of engineering at Goldmark Communications Corporation, a company he helped found in 1972. Before that, he held the post of vice president of engineering for CBS Television Services Division; and for 26 years he held various executive engineering positions at CBS. While there, he had primary responsibilities in broadcasting, cable TV, and facsimile and advanced communications technologies and applications. Prior to joining CBS he held engineering posts at RCA, Melpar, and in the Army Signal Corps, where his primary activity was the design of radio frequency transmission equipment and antenna systems.

Stern received his B.S. in electrical engineering from the University of Connecticut and did graduate work at several other schools. He was the recipient of the first University of Connecticut Annual Engineering Achievement Award.

Robert E. Weiblen
Integrated Systems Planning

Robert E. Weiblen has been a practicing communications engineer for 29 years. Recently, he has been concerned with applications of DEMS and UHF radio to business data communications and wireline bypass. He has filed FCC license applications for pay-TV stations, cellular radio, direct broadcast satellites, and business communications services via domestic and international satellite facilities. Weiblen has developed computer-based microwave data links and has devised programs and algorithms for communications systems analysis. He is a cofounder of Household Data Services, Inc., in Reston, Virginia, and currently heads his own consulting firm in Baltimore. Weiblen holds degrees from Stevens Institute of Technology and Columbia University; he is a licensed professional engineer and is active in several FCC standards committees.

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T. J. Theodosios has more than 22 years of professional management and technical experience in telecommunications and data processing. He started his career in the Air Force at Cape Canaveral, after which he joined NASA, supporting the Gemini and Apollo programs, designing and implementing audio, video, and R.F. communications systems. In 1969 he was project manager for all ground support communications at the Kennedy Space Center for our first moon landing launch. Later, Theodosios spent five years developing systems related to data processing for a major regional hospital in Baltimore. He was also on the faculties of both the University of Baltimore and Loyola College as an instructor of computer science and business administration. Theodosios then joined Commercial Credit Corporation, where he held increased levels of responsibility in telecommunications until his departure, at which time he was manager of telecommunications. In 1974 Theodosios implemented a 1,500-line ESS Centrex, the first in the state of Maryland. He managed the design and implementation of Commercial Credit's Plato system, an on-line educational system designed to be user-friendly.

His last position prior to forming ISP, Inc. was vice president of corporate telecommunications for Alexander and Alexander, Inc., where he created the telecommunications function and organization. During his tenure he also established the administrative services function, which included the purchasing, fleet management, and real estate departments. He was instrumental in implementing a national voice network at Alexander and Alexander, the first in the insurance brokerage industry. He developed a unique telecommunications organization at A&A, which included multidiscipline experts in data and word processing, telecommunications, and strategic planning.

Theodosios received a B.S. in computer science from the University of Baltimore in 1972 and did postgraduate work at Morgan State University.

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A. Sugarman, A. Lipman, R. Cushman

Chapter 14

Operating the High Tech Office Building: Practical Considerations

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Outline

Smart office buildings are no longer the wave of the future; they are today's reality. Hardly a day passes without an announcement of an innovation in the area of telecommunications or data processing. Traditionally, most new innovations are related to specific products and services. Today these announcements frequently pertain to the development of a smart office building providing a full array of high tech services to a building's tenants.

In response to rapid deregulation of the telecommunications industry, to the divestiture of the Bell operating companies by AT&T, and to the rapid pace of technological change in communications and office automation technologies, real estate developers and building owners are bringing to market buildings that meet the communications needs of tenants. Property owners have been prodded by equipment manufacturers and tenant services providers and have become increasingly aware of the painful experiences of their tenants in seeking to provide telecommunications services for themselves. The owners are taking steps to provide communications services in the belief that more and more tenants will demand ease of access to a full array of communications services as well as long-term assurances that their ever-changing and ever more complex communications and office automation requirements can be accommodated within their space.

Property owners and developers believe that buildings providing these services will be positively differentiated in the marketplace, lease up more rapidly, increase tenant satisfaction, and probably keep tenants longer. They also believe that by providing communications services on a centralized basis, the capacity of a building's infrastructure to accommodate the long-term communications requirements of tenants will be assured for the life of the building. Finally, they bring high tech services into their properties to increase profit and enhance the long-term value of their properties.

The tenant services telecommunications industry provides tenants with an opportunity to return to the one aspect of the prederegulated, predivestiture environment they most benefited from: the ability to turn to a single service provider for the comprehensive address of their communications needs and to have those needs addressed in a professional, timely, and cost-effective manner. By recreating the "one-stop shop" providing fully integrated telecommunications services for the life of a building, all of the goals of the developer and all of the benefits sought by tenants can be realized. But it is not a simple undertaking. There is far more to it than simply buying a piece of equipment, installing it within a building, and seeing to its service and maintenance. The tenant services business may be one of the most complex of all service businesses, and it must be approached from a position of competence and understanding, lest it impede rather than promote the ability of tenants to do business.

This chapter seeks to offer such an understanding. It provides a practical discussion of operational considerations of a building fitted to provide tenant telecommunications services; discusses the services that might be offered and how they ought to be provided; offers an opinion of what is the best entity to provide such services; and concludes with suggested clauses for inclusion in the main legal agreements that structure the operational concept.

THE ADVANTAGES OF A QUALIFIED SERVICES PROVIDER

The management and day-to-day operational aspects of running an intelligent building are significant. Proper planning and execution require the development of broad-ranging expertise in areas foreign to the traditional property development and management business. The larger developers, in spite of the breadth of their existing staffs and the "deepness" of their pockets, have been quick to recognize this. They have also been quick to recognize that providing communications services to the business users of a large office building is an extraordinarily complex task, which requires a significant and long-term commitment to the telecommunications industry. It requires a commitment to understanding the complex technological, economic, and regulatory concerns involved in the most rapidly changing industry in the United States.

Consequently, in spite of the very real opportunity that exists to create a new "telecommunications profit center," owner developers are well advised to develop long-term relationships with companies having expertise in telecommunications and data processing, just as they have hired management and engineering companies to address the ongoing management and maintenance of their buildings and their internal systems. More and more, the major concern of developers is that of assuring the quality and long-term interest of their service provider in the provision of services within their building; and less and less is their focus on the magnitude of the profit they can derive in the communications endeavor. Most major developers are recognizing that their return will come in the form of enhanced property values. Interestingly, it is primarily the smaller developers who are purchasing equipment in an attempt to make a go of it on their own without the services of a telecommunications service provider. It is the belief of the authors that such developers may confront significant operational and financial risks and problems that in most instances neither they, nor their equipment vendors, nor their consultants envisioned.

Management and operation of a building's telecommunications system requires an expert, permanent staff with expertise in voice and data systems engineering; network management; cost control and service pricing; system installation, service, and maintenance; tenant marketing; and tenant billing and collection. It requires an ongoing awareness of changing technologies and applications. Further, it requires access to regulatory expertise and an ability to integrate regulatory and business concerns in developing short- and long-term strategies necessary for controlling costs and generating break-even operations—let alone profits over the long term. These considerations will be addressed later in this chapter in detail, but it is important here to note that the technical, managerial, and professional expertise required are a scarce and highly demanded commodity. They are expensive to find, hire, and retain. Once hired, they have a capacity to address multiple buildings and thus must be working on a very large portfolio of properties if their expense is to be truly justified. Given these realities, the largest developers are making a statement to the marketplace that they would rather stick to their primary business—property development—and leave communications to those with the capabilities and long-term commitment to the communications industry in general, and the tenant services industry in particular. Thus service providers are being brought into office buildings; they are being called upon by major developers to address entire portfolios and to take considerable capital risk in so doing. Just as tenants would like a single interface to address their communications needs, developers are inclined to limit their relationships with communications providers with whom they are comfortable doing business; developers would rather not build a new relationship around each new project unless there is a specific reason to do so.

The characteristics of the service provider brought into an office building are extremely important. The range and depth of technical capabilities, the access to available hardware from a multiplicity of vendors, the understanding of the service nature of the business and its relationship to the real estate industry, and the evidenced operating experience of the provider are all important. Equally important is the provider's stability and capital structure. An office building is built to last for generations. The communications system operator must be there to service tenants as long as tenants wish the service to be continued, a period that may well be for the life of the building, particularly in the event of service provision to an anchor tenant. Developers are therefore well advised to seek stable service providers who are as committed to the long-term tenant telecommunications industry as the building developer is to the real estate industry. High tech service industries, particularly in their early phases, are marked by extraordinary shakeup and fallout. A developer who owns a property worth tens if not hundreds of millions of dollars simply can not afford to have a service provider go out of business.

Dealing with a truly qualified and experienced service provider is a form of insurance to the developer/owner, but developers should also limit their legal and financial liabilities in the event of system failure or service interruption. In the franchise relationship described herein, developers are well advised to stand at arm's length from the transaction between the service provider and the tenant, thereby assuring that all liabilities rest with the provider. In turn, the developer should be sure that the service provider is adequately protected from liabilities for service interruptions that fall beyond the control of the provider. For example, under the tariff environment of the early 1980s, neither the local Bell operating companies nor the long-distance transmission providers were liable for interruptions of service. Typically, the only liability has been for a fee reduction proportionate to the time service was down. When a tenant service provider intervenes between the tenant and the underlying transmission carriers, the tenant service provider must ensure that his/her liabilities to tenants are no greater than the liabilities of the transmission and equipment providers to the tenant service provider. The concern is a real one, as literally millions of dollars can be at stake in the event of a large-scale communications disruption. Consider, for example, the number of dollars lost in the event of a communications failure to a trading floor. No developer or service provider can remain healthy accepting liability beyond its ability to control.

Limiting one's legal liability is a concern of "last resort." The day-to-day concern most germane to assuring long-term tenant satisfaction is that of maintaining the quality of operations. This involves not only timely response to routine tenant needs, but also ongoing diagnostics of equipment and transmission lines, and the troubleshooting of service problems. Prior to divestiture and deregulation, the Bell System was the entity that provided for all communications services and was consequently the entity that was able to handle all breakdowns in either equipment or transmission. This is no longer a reality. We are in the era of the multivendor environment, and an expert staff will become continually involved in discerning the nature and responsibility of parties involved in providing for one or another aspect of the complex building system. This is an era, therefore, of potential finger pointing because no less than three, and probably many more, underlying vendors will be intricately involved in any system. In the event of trouble on a line, the network company can accuse the equipment manufacturer; the equipment manufacturer, the wiring contractor; the wiring contractor, the local Bell operating company; and so on. This is not make-believe; it happens daily.

Concerns for liability, for managing the multivendor environment, and for maintaining a responsive, high-quality service are reflections of the underlying fact that the telephone is the lifeline of all businesses. People become both irate and emotional when part of their lifeline has been cut off, particularly when their income stream is affected. Service quality and provider responsiveness to tenant needs will therefore have a significant effect on user satisfaction and in turn upon overall tenant satisfaction in a building. Because developers and building owners require that service quality be extremely high, they must have the expertise and capability of a professional service provider in the communications area.

Another aspect of the tenant services industry that developers desire to leave to others is the responsibility for rendering and collecting telecommunications bills, and this end is also accomplished by dealing with a third-party communications provider. Collection of rent is one thing; the potential coupling in the mind of the tenant of the rent bill with the telephone bill is another, particularly as it may not be uncommon for the expense of telecommunications services to approach if not be greater than the rent for the premises. Notwithstanding legal provisions in a lease or telecommunications service agreement, tenants could attempt to offset rent payment due to concerns with telecommunications service. This would lead to significant potential conflict, jeopardize lending relationships, and so forth. The potential for such problems is greatly reduced by interposing a separate entity in the form of a service provider.

Along with the general concern for billing is the inevitable concern for collection of accounts that are past due. This raises numerous questions regarding liabilities, effect on rent payments, repossession of equipment, and so forth. It is wise to avoid linking the provision of communications services with the provision of space.

This concern for linkage spills over into the marketing area. The developer/building owner attempting to lease space to a tenant will want to emphasize the communications capabilities of a building during promotion of the building. However, neither developer nor leasing agents are likely to have the requisite expertise to discuss the technical merits of the communications offering. Perhaps more important, even if given the capability, it will be extremely important to keep the space leasing transaction from becoming a communications negotiation because telecommunications service is neither the primary purpose nor the primary interest of a developer.

The most positive relationship is one in which (1) the leasing agent is able to call upon the service provider with whom the developer/owner has a relationship (as is beneficial in the context of selling space); and (2) in turn upon entering into an agreement with a tenant, the agent refers the tenant immediately to the tenant services provider for the marketing of the telecommunications services. Dealing with a third party service provider facilitates the ability to keep the transactions clean to the benefit the owner.

It is important to consider the complexity of the processes of equipment selection, the ongoing engineering work that is required to maintain the proper equipment configurations, efficient cost control (which requires that a careful match between installed and utilized capacities and capabilities be retained), the complexity of the marketing of telecommunications services, and the ongoing need to migrate the services offered to new and different services in response to changing technologies on the one hand and changing tenant needs and demands on the other. A wide array of equipment must be available, and an ability must exist freely to select equipment in a knowing way without being constrained by a reliance upon a single equipment manufacturer. All are real concerns in operating a tenant telecommunications service. Consideration of these issues necessarily brings us back to one of the initial concerns—the adequacy of the staff and the degree to which they have a stake in the system.

In order to run an efficient operation and provide adequate service, a broad base of expertise must be available. These individuals demand high salaries and are not easily replaced. It is most risky for a developer either to rely on one individual capable in these areas or to use many people (who may or may not be available when needed) on a part-time basis. Owner/developers cannot be bothered with having to make sure they have the necessary support staffs to keep the telecommunications operations functioning. They must not take the chance that once installed and serving a tenant, the service will be provided in anything other than an exemplary manner.

THE CRITICAL ISSUES FOR OWNERS TO ADDRESS

In spite of the fact that many developers are becoming increasingly seduced by the adventure of being a participant in high tech industry, in the final analysis a developer wants first and foremost a fully rented building whose tenants express a high degree of satisfaction in the building and in the services offered. Developers desire tenants who will seek to remain in the building and renew their leases. The amount of investment in the telecommunications capabilities within an office building is but a very small fraction of the overall investment in the building itself. Likewise, the return on the building investment will be that much greater than the return on the telecommunications endeavor. It therefore follows that although the telecommunications service may have a disproportionate impact upon tenant satisfaction and that although the owner/developer expects the telecommunications undertaking to enhance the building's attractiveness to tenants, it does not make sense for the developer to take substantial financial risk in the telecommunications endeavor.

The developer can effectively enhance the image of the building, both through the range and quality of services provided and through the image and reputation of the telecommunications service provider the developer sponsors within the building.

The developer's long-term interest is best served by a service operation that is sufficiently profitable to maintain the interest of the service provider for the very long term. The value of the communications revenue stream to the developer is meaningless if in the process the quality of service and the level of tenant satisfaction is adversely affected.

The provision of telecommunications services is quite different from other commercial operations within an office building. Normally, retail operations reinforce the commercial viability of an office building by providing independent, stand-alone amenities of use to tenants, the quality of which is largely irrelevant to the ability of another tenant to go about his/her business in an effective manner. Such is not the case with the provision of telecommunications service—in which the quality of performance and the provider's ongoing willingness to continue to invest in enhancing the operation will dramatically affect the ability of tenants to conduct their business. The best financial deal for developers may not, in the end, mean the best service for tenants. A good deal for a building owner could prove very destructive to the long-term financial interest of all parties. One might contend that a service provider would not enter into a business relationship the provider found unsatisfactory, but the economics of the tenant services industry is so complex and so little understood by even the experienced service providers themselves that it is impossible to know the actual parameters defining the limits of a good deal from a provider's point of view. For example, service providers are in many instances willing to offer developers a percentage of gross revenues as a franchise fee without knowing what the relationship is between gross and net. This in spite of the fact that the tenant services industry is a capital-intensive industry that lends itself to providing good returns on equity but very small returns on sale. A developer may view a percentage of gross split to be clean, but it is a very problematic arrangement. In all likelihood the arrangement will have to be renegotiated if it doesn't first so irreparably damage the financial well-being of the provider so as to do injury to the provider and inevitably to the landlord and tenant.

THE CRITICAL ISSUES FOR TENANTS TO ADDRESS

Tenants want service, not technology. They want reliable, cost-effective communications capabilities readily available to them at all times. They want new services when they are available and can be effectively used to enhance the productivity of their business. They want the services made available in a simple and straightforward manner. They want to deal with one entity they can trust, and they want to receive one easily reconcilable bill for all communications expenses.

In today's environment, tenants who for the most part are technologically illiterate are being confronted by an array of complex decisions regarding their communications equipment, transmission provider, and office automation requirements. Tenants desire a clear path through this complexity, one they can trust. They desire competitively priced services from a reliable provider, and from one that will stay with them through time so that they can go about their main line of business without having to worry about whether or not the phone will work. And when equipment has to be changed, traded out, or adapted, they want it to happen simply and efficiently.

Tenants therefore need to be assured that the installation within a building will not constrain their long-term choices, but will expand them. They need to have confidence in the operator of the system and in the operator's capabilities as a communications service provider. They need to be comfortable with the operator's commitment to migrating the systems within the building's overtime so as to bring new capabilities to bear; and with the provider's capital resources as evidence of the ability to do so. What a tenant does not want is a service provider who appears risky, and an installation that is constrained.

It is also worth mentioning that tenants do not necessarily want, nor will they necessarily be attracted by, capabilities and services that are irrelevant to their operations. It must be remembered that the communications technologies available on the marketplace today have capabilities that go far beyond those useful to most businesses. Some firms may take comfort in knowing that such capabilities are there in the event that they may one day be useful, but it is very unlikely that they will pay a substantial premium for feature-rich systems that go beyond their needs while costing considerably more than the alternative stand-alone system they would otherwise have purchased. Generally, tenants will not invest in futures or pay for capabilities they do not need. There is cost associated with unused technologies, and it is in most cases extremely high.

THE SPECIFIC SERVICES TENANTS DESIRE

An extensive array of telecommunications-based services that can be offered within an office building is suggested below. Determining which of these services should be offered within a speculative office building independent of knowing who the tenants will be within the building is extremely problematic. The demand for such services on the part of tenants will range from the universal need for telephones to the highly speculative desire for full-motion video teleconferencing. All tenants will require a telephone, access to local and long-distance transmission, a professional administrative capability, a reliable and well-maintained service, and a comprehensible bill. Which if any of the other services that can be offered within a building will be utilized by the tenants will depend upon their size, the industry in which they are active, the way in which they choose to operate, and the attitudes and characteristics of their principals and staffs.

Particular services can be arrayed along a continuum ranging from those for which there is a universal demand, such as basic voice service, to those for which the demand is highly speculative. Such a continuum is reflected below, and its elements should be reviewed with the following caveat in mind: The provision of most services require capital investment above and beyond that required for basic telephone service. To the degree to which the service is not used, the investment will not show a return, and the investor will lose money. The larger the losses with regard to the provision of any one service, the higher the probability that the overall telecommunications endeavor within a building will lose money. Consequently, a developer is well advised not to force upon the communications service provider the requirement to provide capital-intensive services for which there is no cost-justifiable user demand. At the same time, the developer is well advised to look somewhat skeptically upon service providers who are willing to make significant investments in the provision of highly speculative services. It is to be remembered that the developer has a very real interest in the long-term profitability of the tenant services provider; for if the provider fails, then the problems faced by the developer could be extreme. Given this point, it is also suggested that if the developer seeks the installation of a service capability to enhance the image of the building independent of its validity as a communications investment, then it is the developer and not the tenant services provider who should be willing to stand up to the attendant investment. In such cases it is the developer who expects to realize a return through the impact on the real estate value and not through the realization of telecommunications service delivery profits. Developers must be willing to take significant risks if they alone are the likely beneficiaries of such risks.

Basic Services

The services demanded by virtually all tenants are basic telephone services, which include: terminal and switching equipment; access to the local Bell operating companies; low-cost long-distance transmission; equipment service and maintenance; the administration of system additions, moves and changes; and the compilation of a single, easily reconcilable monthly bill. Even if not articulated by tenants, typically, the provision of this service also should include the capabilities of the feature-rich digital PBXs available on the marketplace, and virtually all proven systems have such capabilities.

Although the basic telephone service as described above suggests a bundled offering, it is very important that the service provider make the offering available on an unbundled basis. This unbundling would mean, for example, that facilities management services would be offered to tenants with stand-alone equipment they migrated into a building or chose to purchase on their own; that corporate networks would be accommodated in the centralized switch as required by individual tenants; that long-distance network services would be provided to stand-alone systems; and so forth. The service provider should be providing service and should not be the vendor of a single solution to all tenants. No provider can be expected to install service and maintain and administer all types of technologies, but the provider should be sufficiently well postured so as to have a reasonable probability of impacting most every telecommunications dollar spent within a building to the benefit of tenants.

Enhanced Services

In addition to the basic service, there are several services for which in all likelihood there is a high probability of user demand in the near term. Such services would include the following:

Data communications. Use of the digital PBX for data transmission within tenant space and modem pools for transmission external to the space are included in data communications. Most data transmission today is very low speed, although with the advent of the personal computer and the increasing networking of these machines, the near-term demand for transmission at speeds of up to 19.2 kbps will increase dramatically. The service provider should be capable and prepared to provide for such transmission and to assist tenants in integrating such data needs with their voice needs.

Message services. Message services are likely to be beneficial, given the message-taking and telephone tag problems that plague most firms. Two types of offerings have potential, but the greatest utility derives from their careful integration in a tenant-tailored mode. The first is an automated message support capability, which is a computer-based system that facilitates an operator's ability to take and respond to phone calls and deliver and receive messages as if the operator were the individual's personal secretary. The second is an automated voice messaging capability, which substitutes an answering machine, albeit a very sophisticated one, for a human interface with the caller. In all office buildings, some combination of centralized message centers, distributed message handling technology, and perhaps electronic voice messaging services will be of some substantial interest to tenants. The actual configuration of the service will depend on the nature and size of the tenants and upon the volume of activity. It is noted that an answering service capability is labor as well as capital intensive, and a certain minimal scale of operations is required if operators are to be supported and if profits as opposed to losses are to be generated.

Facsimile. High-speed facsimile will in particular be increasingly demanded by tenants within buildings. At the same time the cost of the equipment will be dropping. As a consequence it is likely that the larger tenants will for the sake of convenience want to have equipment within their own space. The smaller tenants may wish to avail themselves of a centralized facility. The nature and type of tenants will, again, drive the demand.

Data base access. Tenants will want access to a wide variety of off-site data bases containing financial, news, business, and research information that can be accessed on-line. Arrangements for such facilities can be made on a centralized basis and can be accessed by tenants through remote terminals or through terminals in the office of the service provider. The availability of such services requires virtually no capital investment, and such services can be brought into an office building at little financial risk. However, the way the offering is configured will affect the complexity of billing.

Electronic mail. Capabilities for electronic mail can also be provided by access to an outside service provider, often from the same providers used for data base access. Alternatively, electronic mail capabilities can be provided by on-site processors. Which methodology is utilized within a building is more of an economic than a technical matter. As will be suggested with regard to a number of services, there is nothing magic about having a building-dedicated computer. Electronic mail capabilities can become meaningful adjuncts to message center capabilities.

Speculative Services

There is a range of very speculative services for which it is unlikely that a capital investment can be justified independent of knowing the actual makeup of a building's tenancy. In this category would be included such services as the following:

Computer services and word processing. From the point of view of the office tenant, there is little doubt that word processing, computer storage and electronic filing, data base management, and so forth are tools being used more and more extensively by virtually every firm. From the point of view of the tenant services provider, however, it is suggested that the provision of such services on a buildingwide but building specific basis is very problematic. With regard to word processing, the cost of systems is very linear, and little if any savings can be generated by supplying a building system as opposed to stand-alone systems within tenant space. Furthermore, there are real concerns for security and confidentiality of information. Finally, it is very speculative to believe that tenants moving into new office space will abandon the office automation equipment being used in their previous space. With regard to more generalized computer services, the reason their provision on a buildingwide basis is thought to be problematic is somewhat different. The point with regard to these services is simple: There is really nothing magic about having a computer within a building to serve that building's tenants. Once the machine is removed from the tenant's space and accessed by transmission lines, it could reside anywhere. Consequently, it is likely that service bureaus serving metropolitan areas as a whole will be able to serve the needs of building tenants more cost effectively than will a mainframe computer located within a building. Certainly the costs of a large service bureau will be far less on a pro rata basis than will be the underlying costs of providing such services within a building.

Video teleconferencing. In spite of the amount of publicity, there is to date little use of video teleconferencing for other than intracompany communications applications. The placement of a video conferencing room within a building is today a very speculative undertaking. There is very little probability that the tenants of a given building will have a need to use such a facility to interact with individuals in other cities who are in close proximity to a compatible facility. Recent developments in compression technology may speed the demand for and adoption of this technology.

Broadcast video links. The demand for such capabilities within a given building is also very speculative, and its use is likely a very intermittent event by individual firms. Hotels are significant target locations for such installations, much more so than are office buildings.

High-speed data transmission. The demand for high-speed data transmission is today largely confined to very large data users who have a need for high-capacity computer-to-computer links. The likelihood of there being such a user within a speculative office building is small. In the event such users materialize, the capabilities to provide the necessary transmission links can be ensured if the developer and service provider had the foresight to plan and reserve the requisite space within the building's riser and conduit system.

Nontelecommunication Services

In addition to the above array of telecommunications services, a variety of other services can be offered on a buildingwide basis. The economics of these services will depend upon the nature of the building's tenants and the characteristics of the service provider. Three such types of services are:

General office support services. High-speed printers, graphics equipment, electronic blackboards, interactive writing devices, and conference room/conference call equipment are a few office support services. Service providers may set themselves up to provide such installations on an as-needed basis to tenants, and there is little investment typically required to do so. In all likelihood, some such array of capability will serve the provider and the building's tenants well.

Energy management. Energy management systems can be interfaced with a digital PBX. In some instances it may be beneficial to the tenant and the developer to have the tenant services provider handle such capabilities. Of course the ability of the provider will depend upon the question of how smart the building control system itself is and upon the economics of using the PBX for this function. Typically, it is not cost effective to do so.

Security. Electronic locking systems can be installed in parallel or integral to the PBX of the tenant services provider. Such a service can be provided on an economical basis by a tenant services provider and would be of utility to tenants who otherwise would have to maintain the data base and administer the system themselves. The key economy comes in wiring tenant space simultaneously for both energy management and security, using a common wiring scheme. With regard to complex security systems typically hard wired to on- and off-premises guard stations, it is noted that security firms are typically very uncomfortable when the communications link passes from their control to that of another. Their liability can be extreme if they fail to respond due to an undelivered signal.

Other services. Finally, it is noted that in addition to the array of equipment provided by the tenant services provider in conjunction with the basic telephone system, some providers may choose to be vendors of computer equipment, local area networks, and other types of office automation devices. Such a capability is of particular value to a building's tenants only if the tenant services provider will have the capability to provide the ongoing service, maintenance, and support that is often required by the end user. It is the opinion of the authors that the posture of the tenant service provider as a hardware outlet—independent of providing in-building facilities management along with such equipment—is inappropriate and of little value-added benefit to the tenant community. Such a "sell it and be done" attitude on the part of a service provider could detract from, rather than enhance, the image of the provider, and consequently that of the building.

PROVIDING MARKET-DRIVEN SERVICES

Determining which services to provide in a building requires an understanding of the target market for the building. Further, one must consider the array of existing technologies, their application to tenant needs, and the development of a competitive pricing structure. Although competitive, the pricing structure must also permit sufficiently rapid capital recovery to guard against the downward cost curve of competing technologies and the threat of technology-based service providers addressing the general marketplace in which the building and its tenants are located. The actual provision of services requires that the following functions be performed in a cost-effective and highly responsive manner:

Development of generic system performance specifications to guide equipment, transmission carrier, and service bureau procurements.

Overall system engineering and selection of appropriate hardware.

Equipment and transmission procurement.

Design of equipment space, and space layout in accordance with equipment specifications.

Installation of common equipment and backbone cabling and design and installation of tailored tenant-specific installations.

System diagnostics and ongoing system service and maintenance.

Network design and ongoing traffic engineering and network redesign.

Comprehensive system management, including a tracking of underlying costs for all system components and the maintenance of comprehensive system records, including software status, wiring diagrams, and equipment inventories.

Tenant marketing and applications analysis.

Service pricing on a tenant specific and overall basis.

System administration, including the ongoing execution of adds, moves, and changes in response to tenant requests for service.

User training and ongoing retraining.

Trouble reporting and response.

Local and interstate telco interface (e.g., ordering of local, intrastate, and interstate trunks and tracking their installation).

Identification of new applications needs on the part of tenants.

Generation of user reports, including customized billing and system utilization reports as required by tenants and as beneficial to them in effecting cost control.

Customer billing, collections, and response to billing inquiries.

Comprehensive accounting and financial reporting.

Ongoing monitoring of regulatory and tariff changes.

The complexity of each of the above-referenced tasks and of the overall undertaking is reflected in the fact that—with the probable exception of planning space for equipment and staff—every activity enumerated above is an ongoing daily concern, and none are trivial. For example, a failure to continually engineer and expand or contract system capacity can result in an excess of installed capacity that will increase the average cost of in-place equipment and result in nonrecoverable financial losses. A failure to monitor and continually refigure networks in response to changing traffic volumes and patterns can lead to diminished long-distance margins. A failure to maintain wiring diagrams can lead to an inability to trace and correct problems. A failure to respond rapidly to user requests for service can lead to tenant dissatisfaction with the overall quality of the system. A failure to manage accounts receivable can significantly spike operating cash requirements; and a failure to maintain an awareness of regulatory changes can lead to services being provided in contravention of regulatory requirements, and consequently to service shutdown.

Although as few as two years ago property owners seeking to provide enhanced telecommunications services within their buildings had little choice but to go it alone, today there are multiple providers who will work with developers, have the requisite depth of capabilities, and are willing to assume financial risks attendant to the provision of such services. Developers are well advised to carefully select a system operator with which to deal and in turn to structure arrangements that reflect the mutual interest of the parties. In structuring such arrangements, developers should keep the following in mind.

AREAS OF CAUTION IN STRUCTURING RELATIONSHIPS WITH PROVIDERS

Errors in selecting service providers or in configuring basic systems and the array of offered services can lead to tenant dissatisfaction and significant dollar losses. Caution must be exercised in selecting a service provider. Developers and property owners should determine the financial health and staying power of alternative providers, keeping in mind that their commitment to the building must be for a minimum of 7 to 10 years if any commitment is to make sense. The ability of a service provider to underwrite the significant start-up losses associated with initiating service in a new building must be determined. The developer is also wise to consider the strategic interest of potential providers in the tenant services industry and their commitment to the communications aspect of the business independent of linkages to other lines of business. The potential for conflicts of interest derivative from linkages to equipment manufacturers or transmission providers should be examined. Also, the impact of potential inflexibility on the part of the provider with regard to equipment product lines and underlying transmission vendors should be well understood and addressed in contractual terms—which is hard to do, since such conflicts may be difficult to assess and may have subtle impacts upon responsiveness to tenant needs. Of utmost concern is the need to reflect honestly upon the compatibility of the service provider with the leasing and management staff of the building and to become comfortable with the provider's view of the business, particularly as it relates to the long-term real estate interests of the property owner. There are subtle but real differences among service providers as to approach, background, and orientation; and property owners must become comfortable with the business partner they are choosing to bring into the building, perhaps for the life of the building.

Caution must also be exercised in the marketing of services to be provided in new projects and in the representation of the capacities and capabilities of such installations in promotional materials. This caution relates both to the particular services offered and to the approach to and quality of their provision. If a tenant moves into a building with the assurance that a particular service will be provided on a time-sharing basis at a particular cost, should the developer or service provider not honor such promises, credibility is affected and legal liability could follow. It is also important to provide a level of service that will satisfy tenants. Knowledgeable, technically competent people should be responsible for marketing; the developer is well-advised to have the leasing agents educated to the realities and benefits of the systems. In turn, the leasing agents should speak only superficially about the system's characteristics, leaving the detailed presentations to the trained staff of the service provider.

One is inclined to think about the potential profitability of an undertaking, but one must also consider the possibility of a set of circumstances arising in a particular building that would make operation unprofitable. Unprofitability might be due to the actual tenant mix as it emerges during the lease-up, something difficult to predict accurately in advance. The developer should be aware of such a possibility and should recognize that the profitability of a system could be undermined and that the service provider in such an instance will need the right to discontinue offering service without liability so long as the continuity of service to installed tenants is assured. Allowing for the orderly withdrawal of a provider from an unprofitable undertaking is far better than precipitating extreme provider losses and thereby causing significant problems for the tenants.

The probability of system failure and service disruption must also be considered. In the regulated environment, limited liability for service interruptions was provided for by tariff. To the degree to which such limitations apply in the unregulated environment, they exist between the underlying carrier and the service provider who is the customer of record. Service providers must limit their own liability so as to preclude financial ruin in the event a system failure results in enormous actual and consequential damages to an end user, such as a financial institution whose trading floor goes out for a period of time. Liability limitation clauses must be carefully construed and included in service contracts with tenants, but no matter how well the contracts are written, the possibility exists of legal action as a consequence of service interruptions.

One of the great unknowns surrounding the provision of tenant services is the rapidly changing regulatory environment, particularly at the local level. Service providers must keep abreast of these regulations. Their profitability and continued existence depends upon such an awareness and their timely responsiveness to change in terms of service definition and system configuration. For example, one midwestern state proposed that shared local access should be prohibited. This would substantially increase the underlying costs of service provision, not only with regard to the cost of local transmission, but perhaps more significantly with regard to the cost of requisite hardware to support the service. Also, it must be realized that there are great differences among jurisdictions. Different regulations are enforced by various state public utility commissions, making the rules of the game different in each state. It is necessary to acquire knowledge of the rules in each jurisdiction where activity is anticipated to assure oneself that the service provider has such an awareness.

Finally, there is a most perplexing aspect of the endeavor—the technological environment. Technologies, underlying equipment costs, and user applications are changing so rapidly that a new product, service offering, or assumed pricing structure might be obsolete by the time it is actually implemented. The developer must feel confident that the service provider understands and is able to deal with these realities. Like automobiles, each year additional luxury options are available, yet for economic reasons one must make the best of last year's model. However, the sophisticated equipment selected must have a projected useful life sufficient to permit capital recovery, and thus pricing issues are of very considerable concern. To minimize catastrophic mistakes, one must be aware of the ramifications of a particular hardware decision. A service provider must reflect a keen awareness of such concerns, artfully balancing the technological, service delivery, and economic risks.

RISK ASSESSMENT AND BUSINESS DECISION MAKING

In making the final decisions, three areas must be examined: technical, financial, and legal.

First, because technology changes so rapidly, providers, to minimize economic risk, must be able to rely upon in-house experts to help in procurement decisions. Relying upon hardware vendors for objective assessments is risky, especially since in this market vendors and salespeople appear and disappear quickly. Because developers must meet major capital requirements and preserve their reputation, it is important that reasoned decisions be made with respect to technology implementation. This applies both to the vendor and the product. The viability of the technology over a reasonable useful life expectancy must be assured to the extent possible, and service pricing must take into account the downward price movement of technologies over time. The developer/property owner is therefore in the position of having to defer to the determinations of the well-chosen service provider who is willing to bet its own money and reputation on equipment and product definition recommendations.

Second, significant business planning and investment analysis expertise in the telecommunications industry—in all of its facets—must be brought to bear in analyzing either a potential project or the appropriate financial relationship with a service provider. The determination to proceed with a tenant services installation is ultimately a business investment decision, and not a legal or technological one. Legal issues can be addressed and the ensuing business risks identified and quantified. Technological matters can also be addressed and their implications assessed. However, the key decision depends upon an understanding of the underlying equipment, transmission, and personnel costs as well as evaluating projected revenue streams for the various product and service offerings. Projections of revenue streams are only as good as the assumptions regarding building fill, pricing as compared to the competitive stand-alone offerings, and market penetration. Tenant service pro formas are extremely complex because of the array of underlying costs and revenue elements, and business planning expertise is critical to the ability to make a prudent investment decision.

Finally, attention to the legal issues must be emphasized. Both the real property aspects and the telecommunications aspects of the venture involve complicated legal areas and require high-quality legal representation. If suitable provisions regarding legal risks can be secured, the investment and potential return risks will be minimized. An important aspect of legal expertise is awareness. This applies specifically to the changing regulatory and technological environment. Both regulatory and technological fluidity dictate the level of vigilance necessary. One cannot become too excited by profit potential. If potential is there, much money can be made, but many ventures and much money can also be lost. Thus the legal expertise must be joined with both technological and business planning savvy to guide the venture to its proper construction.

If proper legal, technological, and business planning expertise is synthesized, the profit potential of an undertaking can be assessed and a prudent decision can be made. Services that can be provided and specific applications that can be developed are only limited by the tenants' demands and provider's imagination.

PRO FORMA AGREEMENTS (DRAFTING CHECKLIST)

Two important agreements will be necessary to initiate a telecommunications-enhanced real estate project. One will be between the owner/developer and the entity that is to provide the telecommunications services within the property. The other is between the provider of service and the tenant.

The party providing the services could be the developer; the developer and a service provider in a joint venture, with the service provider being the managing partner of the joint venture; or the service provider alone. In any event, the entity providing the service will be doing so under the auspices of an agreement entered into between the service provider and the venture owning the property. With regard to the structure of a relationship between the service provider and the property owner, the following is noted. It can take the form of a joint venture partnership, a set of contractual agreements, or a specially conditioned building lease. It may make sense not to establish a corporate structure for a joint venture because of the fact that start-up losses will be trapped and the capture of the value of depreciation and investment tax credits deferred.

Regardless of the form of relationship between the property owner and service provider, several material business terms must be addressed in any agreement. The particulars of negotiating the shared tenant service are discussed in another chapter, but the following are general elements that should be considered.

Agreement between Building Owner and Service Provider

Specific property covered. It is important to define in the agreement the specific properties included. Most agreements will grant a particular service provider the exclusive right to provide tenant services within a building. Further, it will be important to both the developer and the provider to address future developments by the same developer. Relationships in this area are complex, and the property owner is well advised not to reinvent the wheel with the development of each new property. Although developers tend to continue to do business with service providers with whom they have established a positive working relationship, the owner/developer may become dissatisfied with the service and may want him to use a different service provider in future projects, or cancel a relationship in an individual property. Provisions for these contingencies should be included in the initial agreement.

Services provided. Each party in this situation has a specific interest. The owner/developer desires to offer potential tenants a spectrum of services. The service provider does not want to provide services that are unprofitable. Some risk can be alleviated by providing only basic telephone and long-distance service initially, backed by a commitment to provide any service in the future for which there is cost-justifiable user demand. In addition, the service provider ought to commit to the provision of any service to a single tenant at a cost no greater than the cost the tenant would have to bear in a stand-alone environment, in the event that only a single tenant requires a particular service. The service provider has the right not to invest in the provision of a service for which there is no economic justification; however, the building owner/developer should reserve two options. First, if a possibility of faster lease-up is foreseen, the developer should have the right to require the service provider (at the developer's risk and for the developers reward) to implement any service of the developer's choosing. Second, in the event another third party is willing to provide the service the service provider is not willing to address, the grant of exclusivity to the service provider should be waived for such a service.

Minimum performance standards. Certain performance standards having to do with service response times, grades of service, and maintenance of equipment and transmission lines in the manufacturer's and/or the provider's specifications can and ought to be drafted. In such cases it is suggested that the standard prevailing within the industry within each specific location constitute the minimum acceptable level of performance. However, in the event of a dispute, the battle of the experts can begin. As a consequence, developers must believe that their service provider is a good partner and must also construe the financial arrangements in such a way as to assure the financial interest of the provider in maintaining a high level of performance quality.

Consideration. The building owner's compensation should be specified in clearly defined terms, and a relatively simple administrative process should be established for ascertaining its amount. It is important that financial reports be prepared on a routine basis by the services provider and that the owner have audit rights. A compensation approach based on a percentage of gross revenues is attractive on the surface and may in fact become the industry norm because of the ease with which the owner/developer can determine the bottom line. However, the approach is extremely problematic and in all likelihood should be avoided unless one wants to court continual renegotiation of percentages or an erosion of provider interest in maintaining exemplary performance. It is difficult to project costs and profits in this immature industry. In a service business with many variables, such as the underlying cost of long-distance transmission and the effect of regulation, it is hard to make cost and profit assumptions; and profit cannot be aligned with gross.

Service providers space and other needs. It is important that the agreement allow necessary space for the service provider to house equipment and staff and to have access to conduits, power supply, and environmental support, such as HVAC. The responsibilities of each party should be precisely defined.

Inside wire. One consideration is paramount. Regardless of who bears the cost of building cabling, in the event a service provider terminates an arrangement with the property, provisions should be made for the title to such cabling to pass to the property owner or, in the case of tenant wiring, to the tenant or owner.

Marketing. Specific provision should be made guaranteeing cooperation between the owner/developer and the service provider in marketing both building space and telecommunications services. Specific obligations should be placed upon the owner with respect to advising tenants of the availability of services and in turn introducing or referring tenants in a timely manner to the service provider. On the other hand, the service provider must be required to support the marketing of space in a reasonable and responsive manner.

Regulatory compliance. The facilities provider must warrant that it will act in accordance with and comply with governmental regulations regarding the provision of telecommunications and enhanced telecommunications services. This may become significant over time as rules and regulations governing tenant services providers are established.

Agreement between the Service Provider and Tenant

Charges. Charges for service will also inevitably be negotiated, as each tenant's installation will be somewhat unique. The competitive marketplace and the existence of stand-alone alternatives will ensure competitive pricing. Provisions for late payment as well as deposits and taxes should be specified.

Installation. Provision should be made for installation in accordance with tenant needs. If there is delay caused by the tenant, provision should be made for payment to the service provider. In addition, provisions must be made to ensure tenant cooperation in the installation of any service-related equipment and to provide necessary space for installation.

Use and maintenance. Obligations of training and maintenance should be placed upon the service provider, and obligations of reasonable use must be placed upon the tenant.

Cancellation. Provision should be made for cancellation charges and necessary notices of termination. These provisions are based upon economic expectations and considerations and are inevitably subject to case-by-case negotiation. Time parameters should, however, reflect the underlying economic factors and the overall marketing strategy for the building.

Limits of liability. The service provider must limit its liability for actual as well as consequential damages resulting from system failures. Such limitation provisions exist in virtually every alternative available to tenants.

Exclusiveness of remedies. Damages should be limited to credit for the service not provided. A clause should also state that there is no right of set-off with respect to obligations under the real estate lease.

Proprietary rights of service provider. In the event that proprietary software is provided to a tenant, it should be specified who has ownership rights to the software.

Assignment. Provision should be made as to assignability of the agreement. It is likely that a tenant will be able to assign to a subtenant after a necessary financial investigation as to ability to pay.

■ CONCLUSION ■

The profit potential in the area of telecommunications-enhanced real estate appears significant, but the environment is extremely complex, and the realization of the potential requires sophisticated system management. Property owners and service providers must carefully analyze each venture, relying upon access to trusted technical, business and, legal experts. In many commercial endeavors, principals can rely on general business acumen. In a tenant services venture, however, vigilance in gathering and evaluating specific tactical knowledge must be maintained to ensure a profitable project. In the end, it must also be realized that the long-term success of a project will depend critically upon the quality of the relationship developed and maintained between the three parties to the transaction: the property owner, the telecommunications services provider, and the tenant. When their interests diverge, dissatisfaction will arise, and significant problems for all will result. Choosing a partner carefully, however, should lead to realization of the endeavor's full potential.

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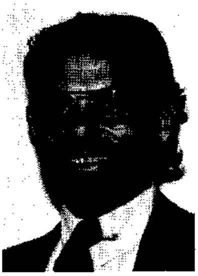

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Chapter 15

Energy for the High Tech Building: Cogeneration and Contextual Energy Management

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Outline

The high tech building provides special opportunities for energy efficiencies. Energy must be delivered to heat, cool, and ventilate the building and to power equipment in the building. The power must be provided economically and, especially in a world dependent upon electrically powered computers and telecommunications equipment, the electric power must be reliable.

The analysis and balancing of the energy needs, outputs and economics of a modern building requires a broad view of the issues and demands contextual energy management. Ultimately, a contextual view of energy in a modern building leads to the topic of cogeneration of energy. This chapter will describe contextual energy management and will explore the ins and outs of cogenerating electric power. Attention to these topics can yield dramatic economic benefits to building owners and developers.

The needs of a high tech building present energy opportunities. Higher air conditioning requirements for computer rooms can provide a balanced thermal (heat) load for a cogeneration system, making such a system more economic. Telecommunications highways within a building provide an ideal path for energy management systems, lowering installation costs and increasing system capability and efficiency. Twenty-four hour operations shorten the payback period for more energy efficient lighting.

Building energy consumption has been revolutionized in the past decade, driven initially by radical price escalations and then carried forward by new technologies (or adaptations of very old ones), competitiveness, and the changing needs and growing awareness of building occupants. Fifteen years ago an office building consuming 250,000 BTUs per square foot for its total energy requirements—principally lighting and space conditioning—was not unusual; today it would be unheard of. Most new office buildings are well under 100,000 BTUs per square foot, and some older ones have been retrofitted down to less than 150,000. Buildings must now accommodate a "CRT on every desk"—the modern office's equivalent to a chicken in every pot. The explosion of information and telecommunications services available for—and increasingly demanded by—tenants can strain older buildings' wiring capacity and requires different construction planning for newer ones.

The environment has fostered the development of essentially "contextual" energy management—that is, considering a building's energy requirements as part of the overall special needs of a high tech building. Three main considerations are paramount in energy planning for high tech buildings. The first is economic efficiency—that the building will fulfill its needs as inexpensively as possible. The second is reliability—ensuring a steady uninterrupted supply of power and cooling for computer-based as well as other operations. The third is compatibility—the new technological needs and developments that are at the heart of high tech real estate can and should be designed with energy provision and management in mind. These considerations can have a large impact on the economics, profitability, and competitiveness of real estate development. Although critical for new development, they are also important for existing buildings and operations. For developers, syndicators, managers, and tenants, energy in the high tech building should be in integral part of decision making.

ENERGY EFFICIENCY ECONOMICS

The first rule is a simple one—be as efficient as possible. It is extraordinary how frequently this rule is violated, out of ignorance or a misplaced desire to cut capital costs. Lack of awareness is in part understandable, for energy per se is not the chief concern or expertise of the builder or the tenant, even if energy is vital to their operations. This information and expertise gap is compounded by a reasonable skepticism about the energy savings marketplace. Indeed a building operator who added up all the claims for potential energy savings might expect to reduce consumption and costs by 130 percent, no doubt giving rise to visions of becoming a net energy exporter. Neither ignorance nor skepticism is tolerable, however, in a competitive marketplace.

There are several aspects to capital cost concerns. A major one is the developer's desire for lower first costs; a second is the tendency to go with the familiar. It is this traditional philosophy that has spawned an entire industry of energy retrofit companies, compensating for the sins of the past while adding to the lifetime capital costs of a project. Energy efficiency equipment, quite simply, does not necessarily cost more than energy inefficient equipment. Even if it does, there are good systems cost arguments for efficient design at the outset of new building construction. Energy efficient lighting can reduce light loads by 40 percent off standard equipment. That reduction in turn reduces the heat emitted by lighting by 40 percent, which can substantially lower air conditioning requirements. Thus, central air conditioning systems can be downsized, reducing initial costs. The same argument holds for insulation and heating plants. Even in cold climates, heat evacuation in office buildings is a much bigger need than heat provision, and designing buildings to use and circulate interior and exterior air optimally is highly efficient but no more expensive than conventional space conditioning designs.

Then there is the, "I don't have the money" argument, which is at times genuine but can also mask an underlying fear of investing in an area where one does not have considerable expertise. The concern has particular force with respect to retrofitting existing buildings. Depending on how severe the capital shortage is, and upon the ownership structure and tax situation of the principals, building owners and managers have several financing options available to them to obtain energy savings or energy efficient operations.

The first is simply a lease; it is generally fairly easy to structure the equipment transaction so that the energy savings are greater than the lease payment, thereby providing an immediate positive cash flow as well as tax benefits.

It is also possible to find companies willing to provide financing for energy efficiency improvements in return for keeping a percentage of the savings generated by the system's installation over several years. Such an arrangement not only eliminates the need for up-front capital investment for the building owner, but also eliminates that financing risk.

An outside investor also can finance the installation of on-site electricity and heating production, such as cogeneration (discussed in greater detail below), meter the delivered output of such systems to the building and/or its occupants, and sell such energy, usually at a discount off conventionally delivered energy supplies. The owner also may find the cash for outright purchase of such systems and achieve all the savings.

There are other economic considerations that should affect energy efficiency investment decisions. If a building is renting for a certain amount per square foot, that price takes into account energy costs, either explicitly or implicitly. By reducing energy costs the owner may increase profit in the master-metered situation; or where energy is a separate cost to the tenant, the owner can charge a higher rent because the building's energy costs are lower. A residential property could support a larger mortgage. More tenant revenues thus go to the building owner, not to utilities or oil suppliers. In the event of a market downturn, the energy efficient building can maintain or even reduce its rents and still retain a relatively higher degree of profitability versus energy inefficient buildings, since the owner has greater room within which to operate. This condition provides both a hedge and a competitive advantage for such buildings.

COST-SAVING OPPORTUNITIES

To provide a context for more detailed specific building needs analysis, it is now appropriate to summarize what can be done to maximize efficiency in high tech buildings.

A building's energy requirements are not mysterious. The proportions of use dedicated to different tasks vary widely by type of operation and project—commercial, industrial, residential or institutional. However, essentially building energy services are: space conditioning—heating and cooling; lighting; hot water; powering other services, such as elevators, compactors, or even golf cart battery charging in the country club; and tenant needs—computers, CRTs and VDTs, blenders and washing machines, or industrial process. Optimal energy efficiency rests upon the choice of equipment for these purposes, the integration of different systems with each other, and management of different loads, especially to reduce peak demand.

Lighting, for example, has been revolutionized in recent years. Screw-in fluorescents can reduce a fixture draw from 75 watts to 13 watts with no effective light reduction. Energy-saving fluorescent bulbs have proliferated. Electronic ballasts reduce a fluorescent fixture's electricity use by around 30 percent with no loss of light output; in overlit situations capacitors also substantially and more cheaply reduce lighting loads while lowering lighting output levels.

Heating and cooling systems, such as staged chillers or modular boilers, can now operate more efficiently over a wider range of temperatures and circumstances, and improved zoning and controls systems can eliminate the problems of one exposure of a building being too hot and another exposure too cold simultaneously. New variable speed motors provide greater efficiency over a range of speeds, such as for the huge fans in a centrally cooled office tower; frequency inverters provide a similar benefit as a retrofit for existing systems.

Relatively low cost computer control systems are often at the heart of efficient building energy use through a combination of sensors to read conditions, programming to establish building parameters, and heuristic capabilities that enable the computer system to learn from experience. Such systems are particularly effective in limiting the peak demand in a building, avoiding the costs of excessive demand charges, which in some areas are paid for through a "ratchet" on a year-round basis. Microprocessor control systems are used to start and stop equipment, duty cycle it on and off, control areas for lighting, optimize heating and cooling systems, and provide building management with a quick and effective tool to determine the status of their facility and diagnose problems rapidly and inexpensively. The building manager can have a CRT that displays the conditions of the building, and from which changes can be made to adjust for altered building circumstances, such as unusual weekend activity.

One relatively new capability for energy management systems is both digital and analog capability. Digital controls are fine for on/off-type needs, and so-called direct digital control uses sensors and decision-making capabilities to provide a spectrum of control needs. Analog controls are continuous readouts and are especially useful when a wide variety of readings and settings are required, such as temperature readings and the degree to which a damper is opened or closed. New control systems generally possess both analog and digital input and output points to cover a broad range of potential control applications.

Computer control systems are explicit evidence of the integrated nature of building energy systems. As already described, for example, when lighting loads are reduced, the amount of heat that must be removed by air conditioning systems is also lowered. When planned in conjunction, such a combination can lead to smaller, and thus less expensive, cooling units as well as lower operating costs. The amount of interior building heat to be evacuated is less, requiring less air movement, and perimeter winter heating loads will also be marginally affected. A full consideration of building energy efficiency opportunities is the first step in considering the energy needs in a high tech building.

RELIABILITY AND COGENERATION

Although low initial and operating costs are important elements in building development and management, high tech buildings in particular require other considerations. No tenant with extensive computer operations will care how low costs are if a sudden power failure wipes out computer memory or leads to inadequate cooling that threatens the equipment itself. Thus not only are operating energy needs rising, but also the need to provide that energy with complete reliability has become critical.

Since utility energy sources are beyond a single user's control, the key to reliability is redundancy—developing alternate sources of power to protect the building's energy users. The good news is that the very energy intensive activities that create the need for redundancy also, because of their constant nature, provide the opportunity to create low-cost, on-site power generation in many situations.

One typical alternative is cogeneration—the simultaneous production of electricity and useful heat through the sequential use of energy. Installing an on-site cogeneration system does more than provide a backup for the utility. Instead, such a system if installed should be run as often as possible, with the electricity either consumed by the building or sold to the utility, depending upon economics. The key to the overall economics of most cogeneration systems is having a use for the heat; the more such use exists, the greater the overall system efficiency and the lower the relative cost of providing electricity and heating services for the building.

The more balanced a heat load—by time of day and year round—the more efficient the systems operation will be. Here again, the particular needs of computer operations provide an excellent energy economic opportunity. Computer operations require more cooling capacity—15 to 30 percent more than ordinary office environments—and the cooling is needed 24 hours a day, 365 days a year. Heat-driven absorption chillers thus provide an excellent consistent use for the heat output of a cogeneration system; given this use, a properly sized cogeneration system can operate at peak efficiency a good part of the time, minimizing energy costs for the property. A more recently introduced means of providing a particular form of reliability is ice storage, where ice is made during off-peak periods and stored to be used either for emergency backup or on a daily basis to shave peak cooling demand. Another means to enhance cogeneration reliability and minimize operating costs is by installing systems that can burn either oil or gas, providing greater resiliency and flexibility in the face of price differentials or sudden disruptions.

The cogeneration system, the utility, and batteries, used in that order, provide triple redundancy, sound economics, and good reliability for meeting most of the energy needs of a high tech building.

Compatibility

The design and installation of energy management systems in high tech buildings does not take place in a void. High tech buildings have several attributes with which energy management systems can be made compatible, lowering the relative installation cost and increasing the economic efficiency of each. In particular, sophisticated communications services are the essence of a high tech building. A wiring network that connects to every tenant is ideal for energy management.

By piggybacking on the telecommunications network, the energy management system installation costs can be dramatically reduced. The same computer that controls telecommunications services can control energy management. Management of the high tech building can thus be directed from one centralized source. Central control requires less personnel to handle various functions than do individual systems. These economies are available not only in new buildings but in old buildings that are being retrofitted with high tech wiring and equipment.

THE HIGH TECH RETROFIT

Possessing the most up-to-date energy systems, equipment, and production capabilities may not in and of itself makes an old building high tech in the full sense of the term; what is clear is that substantial economic opportunities abound through increased energy efficiency in any building. Increased efficiency can increase the market value of a building because net operating income is generally a determinant factor in market value; market value is a multiple of between 8 and 16 times the net income. For example, it may require a capital investment of $3 to provide $1 a year in energy savings, thereby increasing net income by $1. As a result, the market value of the building could jump by $8 to $16. One of our recent analyses showed that we could cut the $4 million annual energy bill of a 60-story New York City office building by more than $800,000, achieving a two-year simple payback, or a 50-percent return, while increasing the value of the building by more than $10 million. It is possible to obtain insured guarantees for such savings, so that the building owner can obtain a minimum return on investment of 33 to 50 percent, and a maximum of up to several hundred percent, for a basically risk-free investment. Clearly, an owner considering selling should consider the leverage offered by an energy related investment.

Furthermore, many energy systems are eligible for investment tax credit and accelerated depreciation, unusual in real estate deals, further enhancing both the value of the syndication and the level of syndicator fees.

Energy efficiency can solve other problems of existing buildings trying to cope with a transition to newer purposes. Few existing buildings were designed with the microprocessor explosion in mind, and the proliferation of small computers, their screens and other peripherals can severely tax the circuitry capacity of an existing building, necessitating costly rewiring on the part of the owner to keep old tenants and attract new ones. One way to avoid or lower such costs is through increasing the building's energy efficiency, thereby freeing up capacity in the existing wiring. We have already noted that energy efficient lighting can reduce lighting loads by 30 to 40 percent; lighting can account for 50 percent of a building's electricity consumption. The resultant reduction in air conditioning needs can be further enhanced by retrofitting with new variable speed motors or frequency invertors in existing motors, to lower their draw. Also of help are variable air volume systems and a computer control system to limit the peak electric demand such systems require, in turn freeing up more capacity that otherwise would have to be held in reserve for peak summer use. In this manner a building can accommodate new unforeseen loads while avoiding much of the cost that can otherwise accompany doing so.

For buildings being called upon to house extensive computer operations for the first time, installing a cogeneration system can support such use, enhance reliability, and cut operating costs. The new computer rooms will require more round-the-clock cooling than did previous uses. By adding new absorption chillers, the building creates an excellent balanced thermal demand, which enables a cogeneration system to operate at high efficiency and lowers building electricity costs. For large buildings, meeting the nighttime thermal load can result in generating electricity in excess of the building's needs, facilitating a potentially profitable sale of such electricity back to the utility.

Cogeneration systems are also microprocessor controlled, and can be tied-in either to energy management systems or to general computer controls of a high tech building. Sales of electricity to the utility can be made at or close to the utility's "avoided cost"—the cost of the last, and most expensive, block of electricity that the utility itself would have had to generate were it not for the cogeneration. Such sales can be quite profitable for the cogenerator. Indeed, a cogenerator might find it desirable to sell all of its electricity to the utility and maintain the cogeneration unit to ensure reliability and to gain economic leverage with the utility in bargaining for rates for purchased electricity.

ON THE HORIZON

So far what we have discussed relies on existing systems and equipment, although their uses and configurations require site-specific design. Several developments are less generally employed or not fully developed but should be kept in mind for their potential.

Direct use of solar energy continues to expand. The broadest commercial application in the widest variety of climates has been for hot water production. Although it is rare to find economic benefits from solar power as great as those from energy efficiency and cogeneration, there are economic benefits that can be attractive when augmented by additional federal and state tax benefits or alternate financing methods. Residential applications are the most common, but solar-heated water can also be used to preheat boiler or process hot water in industrial applications. Solar space heating is less common, since the recoverable energy is generally insufficient to meet a large portion of the heating requirements in areas with the greatest needs, but it does have its applications. In areas with very low electric rates, solar-assisted heat pump systems that essentially extract heat from the air day and night can also be economically attractive.

Photovoltaic cells, which convert sunlight to electricity, are the subject of intensive research and development efforts. Their most immediate economically based use (as opposed to space satellites or remote areas) will probably be for shaving peak demand.

One highly attractive energy cost saving system that is difficult to implement, although it uses known technology, is a district heating system—the central production of heat distributed by pipes to multiple users. District heating systems have numerous advantages: Larger systems can spread the cost of pollution control over a broad user base, so they can burn cheaper fuels and still be cleaner than individual systems left to the vagaries of different building staffs. By including different users, they can balance their loads, using capacity more efficiently, thus lowering each user's costs. Whereas each individual user has to supply thermal generation redundancy in case of a boiler breakdown, a central system can use several units for efficient load management and lower total backup costs, savings which again can be passed on to the user. A multiparty cogeneration district heating system can reliably and cleanly provide low-cost heat and electricity for users.

An astute developer could enhance the economics of a project by building new loads or finding existing ones to balance each other. A residential project's peak heat demands occur at different times than industrial or commercial operations; serving different users off the same system can lower both initial capital and ongoing operating costs. Shopping malls are simple examples of a multiuser cogeneration system application; huge new development covering many acres and hosting many uses are ideal for serving as the focal point for a central energy production system. The greater the control a single developer or owner has over the different users, the easier the installation of such a system will be. District heating systems involving many users require a degree of cooperation that is unfamiliar to most U.S. real estate or other business operators; these systems are far more common in European, Scandinavian, and Japanese municipalities. Interest in them is growing in this country, however, and the technologies to support such systems are on the rise here.

Down the road, on-site waste recovery and use may play an increasing role in the provision of energy services. One sign of the post-OPEC world is that things that used to be thrown away are now potentially valuable. Most resource-recovery plants are large-scale municipal operations, but increasingly smaller modular units are becoming available. Industrial applications where large amounts of waste are generated and much energy is needed will probably lead the way, particularly for burning waste to make energy. Methane recovery from decomposing waste is occurring at some landfills, and in the future may also hold smaller-scale applications potential.

REGULATORY INCENTIVES FOR PRODUCING YOUR OWN POWER

At the turn of the century, cogeneration accounted for as much as half of all power generated in the country. The rise of utilities and their success in providing power has lowered that figure to around 5 percent today. Yet the Public Utility Regulatory Policies Act (PURPA), prompted by the 1970s energy crisis, is putting cogeneration and small power production back into the limelight.

Before the enactment of PURPA in 1978, a cogenerator or small power producer desiring to interconnect with a utility faced three major obstacles: (1) Utilities were generally not required to purchase or pay appropriate rates for the electric output; (2) some utilities charged unreasonable rates for backup services required by cogenerators and small power producers; and (3) a cogenerator or small power producer could be considered an electric utility, subject to state or federal regulation. Sections 201 and 210 of PURPA and the Federal Energy Regulatory Commission (FERC) regulations implementing the Act are designed to remove these obstacles and help promote energy-conserving electric generation technologies.

The FERC regulations provide incentives for qualifying facilities—those cogeneration and small power production projects that meet the established definitions and criteria. The criteria include, depending upon the type of project, efficiency and operating standards, maximum capacity and fuel use restrictions, ownership requirements, and simple procedures for obtaining qualifying status. The incentives include utility obligations, notably to purchase qualifying facilities' energy at a high marginal cost rate, and exemptions from federal and state utility regulation and federal energy restrictions.

QUALIFYING STATUS

Cogeneration Facilities

The regulations define a cogeneration facility as "equipment used to produce electric energy and forms of useful thermal energy (such as heat or steam) used for industrial, commercial, heating, or cooling purposes, through the sequential use of energy." 18 C.F.R. § 292.202(c) (1984). A cogeneration facility must produce *both* electricity and some form of thermal energy, and not two different forms of thermal energy or mechanical energy, or only electric power. In a recent decision, FERC refused certification for a facility using steam to drive a sewage pump, ruling that such a use was a mechanical application and that the steam must be used in a thermal application to be considered a thermal energy output. *City of San Diego,* 26 FERC ¶ 62,206 (1984).[1]

A cogeneration facility must also use energy sequentially, in effect using it twice to produce electricity and thermal energy. Although energy losses occur within a system, the facility still qualifies as long as a part of its energy input is used sequentially and as long as it meets the applicable operating and efficiency standards. Preamble to Order No. 20, 45 Fed. Reg. 12959, 12961 (1980).

The criteria for qualifying cogeneration facilities depend on whether the facility involves a so-called topping-cycle or bottoming-cycle process. In a topping-cycle facility, the energy input is first used to produce electricity, and the reject heat is then used to provide useful thermal energy. A topping-cycle facility could in practice produce trivial amounts of either useful heat or power, so an operating standard was established to prevent token, or substantially single purpose, facilities. Under the standard, the thermal energy output must constitute at least 5 percent of the total energy output. 18 C.F.R. § 292.205(a) (1984).

In addition to the 5 percent requirement, there is an efficiency standard that applies to cogeneration facilities that use any oil or natural gas and is designed to ensure efficient use of these fuels. (Apart from these efficiency requirements, which are triggered by the use of oil or natural gas, cogenerators are free to use any fuel that they wish.) For facilities installed after March 13, 1980, the efficiency standard requires that the electrical energy output plus half of the useful thermal energy output equal no less than 42.5 percent of the total energy input of natural gas and oil to the facility (the requirement is 45 percent if the thermal energy output is less than 15 percent of the total energy output). 18 C.F.R. § 292.204(2) (1984).

In a bottoming-cycle facility, the energy input is used first to provide thermal energy and then to generate electric power. There is no operating standard for bottoming-cycle facilities, since electricity is produced from otherwise wasted heat, and there is not the same potential for token production. An efficiency standard applies only if natural gas or oil is used for supplementary firing. In a bottoming-cycle facility, this means the heating of water or steam in the electric generating stage of the cycle to supplement the wasted heat recovered from the thermal output stage. In such a case the useful power output of the facility must be at least 45 percent of the energy input of the natural gas and oil used for supplementing firing.

The operating and efficiency standards can be waived upon a showing that the facility will produce significant energy savings—as yet an undeveloped standard. 18 C.F.R. § 292.205(d) (1984).

Small Power Production Facilities

Small power production facilities—facilities other than cogeneration facilities—must meet both size and fuel use criteria to become qualifying facilities. There is no requirement to produce any useful thermal energy, only electricity. The power production capacity of a small power producer may not exceed 80 megawatts at one site. The 80 megawatts limit includes the capacity of all other generating facilities that are owned by the same person, use the same energy resource, and are located within the same site, defined as a distance of one mile from the facility for which qualification is sought.

The fuel use standard mandates that at least 75 percent of the facility's total energy input come from biomass, waste, renewable, or geothermal resources. Regardless of the fuel mixture, oil, natural gas, or coal may not exceed 25 percent of the energy input during any calendar year. 18 C.F.R. § 292.204(b) (1984).

Biomass is any organic material not derived from fossil fuels. Any energy source that, on the basis of energy content, is at least 50 percent biomass is considered biomass for purposes of this fuel-use criterion (as well as for determining the eligibility of certain larger facilities for exemption from state regulation, discussed below). *Waste* is defined as "by-product materials other than biomass." 18 C.F.R. § 292.202(b) (1984). The Commission considers a fuel to be waste if it is a by-product material and has no commercial value (apart from its value as a fuel in a qualifying facility). A by-product is an incidental product, "considered to be unessential and subordinate to the overall economic goal of an industrial process." *Kenvil Energy Corp.*, 23 FERC ¶ 61,139 (1983). At the time of investment, the by-product cannot have been a significant economic incentive for the investment.

In a FERC decision involving flared and vented natural gas from an oil well, the release of the natural gas was considered a likely result and a product that could be marketed commercially, and thus did not qualify as waste. *Tulsa Energy Corp.*, 19 FERC ¶ 61,331 (1982). Whether or not a fuel has commercial value is determined largely by its quality and the existence of a market. *American Lignite Products Co.*, 25 FERC ¶ 61,054 (1983).

Ownership Criteria

The purpose of the ownership requirement is to limit the benefits of qualifying status to facilities that are not owned primarily by electric utilities or their subsidiaries. Companies primarily engaged in generating or selling electric power, except for power solely from cogeneration or small power production facilities, cannot own more than 50 percent of the equity interest in a qualifying facility.[2] The electric utility's percentage includes any ownership interest by wholly or partially owned subsidiaries or holding company. 18 C.F.R. § 292.206(a) (1984). The regulations nevertheless allow for a variety of ownership possibilities, including joint ventures involving utilities.

Many commentators urge that PURPA should be amended to allow 100 percent utility ownership of qualifying facilities in order to increase cogeneration's market potential and the amount of electricity generated by that means, as well as to lower electricity rates. Opponents cite anticompetitive effects and have blocked several legislative attempts to change the statute.

Procedures for Obtaining Qualifying Status

Projects often have three procedural options for obtaining qualifying status: (1) qualification by notice, (2) certification by application, and (3) certification by state agency. The first option is straightforward. The facility's owner or operator need only furnish notice to FERC that the project meets all the criteria for qualification. The risk that the applicant is in error and that the facility fails in some way to meet the qualifying criteria remains with the applicant (and its investors). 18 C.F.R. § 292.207 (1984).

The application option is somewhat slower but safer, especially where there might be a challenge to the facility's qualifying status. FERC has 90 days within which to act before certification is automatically granted, but such action could be limited to setting a hearing date. Although there is the potential for long delay, the applicant could always withdraw the application and file a self-qualification notice instead. The application route offers the advantage of certainty. Unless a utility had mounted a timely and successful challenge to FERC's certification, the utility would be obligated to deal with the facility as a qualifying facility under PURPA.

The third option is only available in states that have regulatory agencies that grant certification. These independent state procedures can be simpler and less expensive than FERC's.

Environmental Criteria

In addition to the FERC criteria, cogenerators and small power producers must also meet applicable Environmental Protection Agency (EPA) regulations. The environmental standards that apply depend on the size, equipment, and location of the facility. The facility may be subject to one or more of the Clean Air Act provisions, including New Source Performance Standards (NSPS), and may need National Pollutant Discharge Elimination System (NPDES) permits under the Clean Water Act.

THE BENEFITS

Once deemed qualified, a facility can enjoy numerous benefits under PURPA and other laws. Utilities are obligated to interconnect with, purchase electricity from, and supply backup service to qualifying facilities. Most qualifying facilities are exempt from regulations and prohibitions under four federal acts and from state laws regulating the rates, structure, and financing of utilities. In addition, qualifying facilities are eligible for several tax incentives, which can be enhanced through intelligent project financing and lease relationships.

Utility Obligations

Under PURPA, every electric utility is required to purchase power from, and supply power to, qualifying facilities at prescribed rates, and to make necessary interconnection with the facilities to carry out the mandatory purchases and sales.[3] The utility obligations were challenged but upheld by the Supreme Court in *American Paper Institute* v. *American Electric Power Services Corp.,* 76 L.Ed. 2d 22 (1983). The utility obligations, especially the requirement to purchase power, are generally viewed as the most important factor in overcoming reticence to cogenerate. During 1983, filings for cogenerators and small power producers almost doubled, from 249 in 1982 to 443 in 1983.[4]

Avoided cost. The prescribed purchase rate is based on "avoided cost," defined as "the incremental costs to an electric utility of electric energy or capacity or both which, but for the purchase from the qualifying facility or qualifying facilities, such utility would generate itself or purchase from another source." 18 C.F.R. § 292.101(b)(6) (1984). Thus avoided costs are marginal costs—the costs of the last block of electricity—which are the highest costs. Avoided costs therefore will ordinarily be higher than the rate the qualifying facility pays to purchase electricity. PURPA allows the qualifying facility to sell all of its electricity to the utility and meet its own needs by purchasing from the utility at a lower price.

FERC establishes guidelines for determining avoided cost, but the details of implementation are left to the states or to private agreements. The incremental costs, which the utility would incur but for the qualifying facility and which constitute the avoided cost standard, are divided into energy and capacity components. Energy costs are the variable production costs of electricity, primarily the fuel costs and some operating and maintenance expenses, that the utility no longer incurs. Capacity costs are the capital costs of generating and owning facilities that the utility could avoid by reducing loads on various parts of its system or by not having to invest in new generating capacity (sometimes this cost is zero when the qualifying facility is not sufficiently reliable to allow the utility to reduce generating capacity). The qualifying facility is also entitled to credit for purchased power that the utility, but for the qualifying facility, would have to purchase in order to serve utility customers. To help estimate avoided costs, and thereby facilitate investment decisions by prospective cogenerators or small power producers, FERC requires electric utilities to make available data concerning present and anticipated future system costs of energy and capacity. 18 C.F.R. §§ 292.302(b)–(d) (1984).

Obligatory sales. Not only can a qualifying facility sell its electricity to a utility at will and at the highest price, but PURPA also allows it simultaneously to buy power back—at lower, system average costs. The qualifying facility can request that the utility provide power under four different rate categories: (1) standby, for unscheduled shutdowns; (2) supplementary, to make up the difference between power produced and power regularly demanded; (3) interruptible, which the utility may interrupt upon specified conditions; and (4) maintenance, for scheduled outages. The utility must charge the qualifying facility at the same rate that the utility would charge any other customer with similar demand characteristics. 18 C.F.R. § 292.305.

Regulatory Exemptions

PURPA's other major incentive for qualifying facilities is the exemptions it provides from state regulation as a public utility and from four major federal regulatory statutes.

Federal regulation. Qualifying cogeneration facilities and eligible qualifying small power production facilities are exempt from most of the Federal Power Act (FPA), including the sections that comprehensively regulate the sales of electric power for resale in interstate commerce. Such facilities are relieved from FPA regulations (implemented by FERC) regarding the rates for such sales, adequacy of service, issuance of securities, and recordkeeping and reporting. 18 C.F.R. § 292.601; 16 U.S.C. § 791 *et seq.* This PURPA exemption is not available to an otherwise qualifying small power production facility (as distinguished from a cogeneration facility) with power production capacity in excess of 30 megawatts (unless the facility uses geothermal resources, which is highly unlikely except in a very few locations in the United States.[5] However, under its general FPA authority, the commission may waive the application of portions of that act with respect to 30- to 80-megawatt small power producers. See *Resources Recovery (Dade County), Inc.,* 20 FERC ¶ 61,138 (1982).

Most qualifying cogenerators (but not small power production facilities) are exempt from the incremental pricing of natural gas under the Natural Gas Policy Act (NGPA). Incremental pricing takes several categories of high-cost gas out of the regular pricing scheme, which averages gas costs among all users, and instead passes through the high costs exclusively to large power plants or industrial boiler users. PURPA exempts natural gas used in cogenerators from such pricing, except for some gas used in bottoming-cycle facilities and where natural gas is used for supplementary firing. 18 C.F.R. § 292.205(c). Waivers of these limitations are possible.

Under certain conditions, qualifying cogenerators are also exempt from restrictions on the use of oil and natural gas under the Powerplant and Industrial Fuel Use Act (FUA). As implemented, FUA prohibits the use of natural gas or petroleum as a primary energy source in new electric powerplants and new major commercial or industrial boiler installations. FUA authorizes permanent exemptions from this restriction for new cogeneration facilities if they will consume less oil or gas than the electric and thermal equipment they displace or if they are otherwise in the public interest. 10 C.F.R. § 503.37.

The final exemption under federal law involves regulations of utilities by the Public Utility Holding Company Act (PUHCA). Qualifying cogenerators and eligible qualifying small power producers are exempted from the PUHCA definition of *electric utility company*, and thus the facilities and any companies that own them are relieved from all the accompanying federal utility regulations, including stringent SEC requirements. 18 C.F.R. § 292.602(b) and 15 U.S.C. § 79. An otherwise qualifying small power production facility (as distinguished from a cogeneration facility) with power production capacity in excess of 30 megawatts is not entitled to this exemption under PURPA unless the primary energy source of the facility is biomass. (Other fuels may be used for such auxiliary purposes as flame stabilization or start-up.) Again, a facility not qualifying for this automatic PURPA exemption may seek a waiver under the PUHCA itself.

State Regulation and Retail Sales

Eligible qualifying facilities are exempted from state rate, financial, and organizational regulation of electric utilities.[6] The exemption can be limited in appropriate cases and of course does not extend to those state regulations implementing the FERC regulations. 18 C.F.R. § 292.602(c).

One issue left open by the exemption from state regulation is the question of retail sales. PURPA protects qualifying facilities from utility regulation when power is sold to utilities, but was not intended to authorize FERC to exempt retail sales to nonutility customers from state regulation. It is up to states to exempt from state regulation if they choose to do so.

FERC explicitly confirmed early in 1984 that qualifying facility certification neither authorizes nor precludes retail sales and that each state may establish its own policy regarding the regulation of such sales. The commission emphasized that PURPA does not limit a state's authority to permit retail sales by qualifying facilities. *PRI Energy Systems, Inc.*, 26 FERC ¶ 61,177 (1984). At least one state, Massachusetts, has already passed legislation allowing retail sales without utility-type regulation. Such legislation clearly increases the market potential for cogeneration and small power production facilities. In such a state, an owner of a high tech building can sell either at retail or to the utility, depending upon which is more favorable, without being subject to utility-type regulation in either event.

■ CONCLUSION ■

Today's high tech may be tomorrow's commonplace. In that context, the goals of building management should be for flexibility and resilience in the face of changing circumstances and needs, to keep costs low and remain competitive. The key to powering the high tech building is to use appropriate technologies for particular needs and opportunities and to qualify for all regulatory benefits. Today's state-of-the-art energy technologies can meet the needs of a high tech building efficiently and at lower cost than before, even with new demands and uses. They can provide the increased reliability necessary for ongoing high tech building operations, supported by technology and a regulatory structure that increases the economic benefits from such systems. Current energy management and production systems are more than compatible with the internal configuration and needs of high tech buildings; they are virtually synonomous with such a building and must be included to ensure that a high tech building is fully supportive of the operations it houses.

■ NOTES ■

1. Another recent decision held that the thermal use requirement was satisfied where the thermal output was to be used for seasonal space heating, and thermal energy would be recovered for only 180 days a year. *George W. Teagle,* No. QF 83-203-000, 25 FERC ¶ 61,226 (1983).

2. If all of the electricity generated and sold by a utility is derived from cogeneration or small power production, the facility can be 100 percent utility owned and still be a qualifying facility. *Lawrence Park Heat Light & Power Co.,* Docket No. 25 FERC ¶ 61,315 (1983).

3. If the qualifying facility agrees, a utility can "wheel" the facility's energy or capacity to another electric utility. The utility receiving the transmission is subject to the same obligations as if it were receiving the facility's energy directly. 18 C.F.R. § 292.303(d) (1984). An emerging issue is whether the qualifying facility can compel the utility to wheel power to a different facility having the same ownership as the qualifying facility. The Florida PSC recently held that such wheeling would be considered case by case. If such wheeling involved more than one state, additional issues would arise relating to state authority over such transactions.

4. FERC, *1983 Annual Report.*

5. FERC does not determine a facility's power production capability simply by looking at its nameplate or nominal rating. It determines instead "the maximum net output of the facility

which can be safely and reliably achieved under the most favorable operating conditions likely to occur over a period of several years." *Occidental Geothermal, Inc.*, 17 FERC § 61,230, ¶ 61,445 (1981). A facility is not disqualified (or ineligible for exemption) if the 30- or 80-megawatt limits are expected to be occasionally exceeded because of unusual circumstances. Ibid.; *see also Massachusetts Refusetech, Inc.*, 25 FERC ¶ 61,406 (1983).

6. The statutory exemption does not exempt from other types of state laws regulating, for example, environment, land use, construction or operation.

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Chapter 16

Labor Law Aspects of High Tech Buildings

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Outline

The development of a high tech building represents an amalgamation of several substantially different work forces, from a labor relations viewpoint. Basic office construction in major metropolitan areas (including substantial rehabilitation work) has historically been the exclusive province of powerful construction craft unions, which have detailed work rules, jealous regard for their jurisdictional prerogatives, and a high hourly scale of wages and benefits. Conversely, computer manufacturers, vendors, and installers have tried, with a fair measure of success, to emulate the nonunion situation of companies such as IBM, under which an employee's duties may be redefined at any time at the company's wish and under which the reassignment of tasks to different workers (or to outside vendors) is a management prerogative. In the middle ground between the extreme opposites just described are the telephone utilities, which generally have had a few unions representing a given work force in a geographic area and which normally have had some flexibility in introducing new labor-saving technology and in reassigning and redefining job duties.

Even before the advent of the interconnect industry and the recent trend to include a "state of the art" electronic infrastructure in new buildings, jurisdictional disputes occurred from time to time in the telephone industry—particularly when the phone company sought to bring in-house to its own union employees work historically performed by other unions.

The labor relations field is one in which many false impressions exist as to the legal rights and obligations of unions, employers, and customers. The most important example of such misinformation is the blanket assertion that all telephone work or cable pulling in a given building *must* always be done by a particular union. Much of what passes for learning on these issues is really closer to bluster.

Although this chapter will focus on the relationship between an independent telephone interconnect vendor and other participants in a project (e.g., general contractor, owner, tenant, and union), an independent supplier of any other high tech segment of a project (e.g., energy control system) can normally be substituted for the interconnect company for analytical purposes.

It is beyond the scope of this analysis to provide guidance on how best to manage a work force, negotiate a union contract, or respond to union representation demands. The labor law considerations described here are based on U.S. laws and may not, and quite probably will not, apply in similar fashion in other countries.

THUMBNAIL DESCRIPTIONS OF KEY PLAYERS IN HIGH TECH LABOR RELATIONS

Before discussing the legal relationships of the participants in a typical high tech building, a brief description of the key unions and responsible governmental agencies is in order.

Unions

International Brotherhood of Electrical Workers, AFL–CIO. This international union is composed of many separate locals, each of which has a more-or-less defined geographic jurisdiction. The IBEW represents construction and maintenance electricians. Before the advent of large nonunion construction firms and the entry of the Teamsters into the construction trade, the IBEW represented the vast majority of all construction electricians working on major office building and public works projects. The IBEW is still the major union representing such workers. The IBEW historically has also represented field service and installation employees for many telephone utilities, and it represents the installation and maintenance employees at various telephone interconnect companies. The IBEW also represents maintenance technicians employed in certain regions by the service departments of various computer companies.

Communications Workers of America, AFL–CIO. This union, like the IBEW, represents many field installation and maintenance employees of telephone utilities and telephone interconnect companies. The CWA has an extensive presence in the routine operations part of the business (e.g., telephone operator, clerical and marketing-related positions) as well as a presence in craft jobs. Like the IBEW, the CWA is part of the AFL–CIO. Thus both the IBEW and CWA are obliged under provisions of the AFL–CIO Constitution to respect each other's existing collective bargaining relationships. The bulk of the Bell System's unionized employees (both pre- and post-divestiture) were and are represented by the CWA.

International Brotherhood of Teamsters. At the present time, this union is not part of the AFL–CIO. It, too, represents construction electricians (and other construction trades) and thus competes with the IBEW and other AFL–CIO-related construction trades unions.

Independent unions. Some telephone utility workers have historically been represented by unions that do not belong to the AFL–CIO or to the Teamsters International. Such unions are often generically described as "independent unions." The legal rights and status of a union vis-à-vis an employer do not depend on whether or not the union belongs to the AFL–CIO.

Joint boards for the settlement of jurisdictional disputes. On both a metropolitan area basis and a nationwide basis, the AFL–CIO construction craft unions have developed a variety of nongovernmental tribunals to resolve jurisdictional disputes between various construction unions (e.g., competing claims of Boilermakers and Operating Engineers to the same work). General contractors that are party to collective bargaining agreements with the various AFL–CIO construction trades unions do, at times, accept the resolutions of such AFL–CIO panels, which thereby gives the panels some effective power to award disputed work to one of two or more competing unions. Such panels may, therefore, have a role in resolving disputes when a general contractor introduces new technologies and procedures, though the result may not be responsive to the contractor's needs and desires.

Governmental Agencies

National Labor Relations Board. The NLRB is the primary referee and adjudicator of legal rights and relations between unions and employers. It enforces those provisions of the federal labor relations laws that limit a union's use of strikes, boycotts, and other coercive tactics to assert jurisdictional and similar claims. At present, the NLRB has divided the country into 33 separate geographic regions, and the initial analysis of unfair labor practice charges, union representation petitions, and any other cases falling under the board's jurisdiction is dealt with at the regional office level.

U.S. District Courts. These courts have the power to grant temporary restraining orders and preliminary injunctions against the continuation of alleged unfair labor practices on application by the NLRB. District courts do not, however, review the NLRB's ultimate decisions in a case. Parties other than the NLRB cannot apply for injunctive relief against unfair labor practices, but private parties can file suits alleging breaches of collective bargaining agreements on their own initiative, including both requests for damages and for orders compelling a union to cease breaching the collective bargaining agreement. U.S. District Courts also have jurisdiction to hear claims for damages caused by unfair labor practices involving *secondary boycotts* and *jurisdictional disputes*—terms described in detail below.

U.S. Courts of Appeals. These courts hear appeals from decisions by the U.S. District Courts and consider challenges to the correctness of federal agency decisions, such as those of the NLRB. All cases are entitled to be considered on appeal in a U.S. Court of Appeals, but it is entirely up to the discretion of the U.S. Supreme Court itself to determine whether such labor cases as are discussed here will be further reviewed in the Supreme Court.

BASIC LEGAL PRINCIPLES CONCERNING ASSIGNMENT OF WORK TO A PARTICULAR UNION OR GROUP OF EMPLOYEES

As a general proposition, it is accurate to state that a purchaser of materials and/or services may award all the work in a project, or any segment of it, to any willing vendor the purchaser chooses without regard to the union representation, if any, of the vendor's workers. This assumes that the purchaser (ultimate customer) does not itself have a collective bargaining agreement with a union covering the work in question and that this ultimate customer is not encumbered by some other preexisting contractual or legal obligation limiting its discretion, such as a lease restriction on selection of vendors or a statutory obligation to pay the "prevailing" wage.

To give a specific example, a project developer (which is not itself subject to collective bargaining agreements) erecting a building with a PBX for shared use by all tenants may, if it sees fit, (1) award the basic construction work, including electrical power work and all other conduit work, to a general contractor that will use IBEW electricians, (2) award the telephone cable pulling to a telephone interconnect company using CWA-represented labor, and (3) award the actual furnishing and installation of the PBX itself to a nonunion contractor. The legal right to parcel out the work to different unions or to nonunion shops might well be lost, however, if the project developer awarded the totality of the work to the unionized (IBEW) general contractor and asked the general contractor itself to subcontract telephone cable pulling and PBX installation to the same CWA and nonunion shops. The general contractor might already be committed by its collective bargaining agreement with the IBEW not to subcontract any electrical/telephone-type work to non-IBEW shops.

Assuming, however, that a developer has awarded one segment of the work to a contractor using Union A workers and other work to a contractor using Union B, the National Labor Relations Act prohibits many of the pressure tactics commonly used by unions seeking to claim work that they or their employers did not get.

The key legal provisions are found in the Taft-Hartley Amendments to the National Labor Relations Act (NLRA). These amendments, adopted in 1947, set forth in general terms a variety of acts that are illegal unfair labor practices if engaged in by labor organizations. The NLRB is solely empowered to investigate and prosecute such cases. Three separate unfair labor practices are of primary interest in the high tech construction/telephone interconnect area. They are commonly known as:

1. Secondary boycotts.
2. Jurisdictional disputes.
3. Illegal recognitional picketing.

Conduct that constitutes a violation of one of the three prohibitions will also commonly constitute a violation of one or both of the other prohibitions. As discussed below, the mechanics for enforcing charges regarding illegal jurisdictional disputes are, however, somewhat different than the procedures used in the other two situations. Another distinction among these statutory

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provisions is that a suit for damages can be brought for secondary boycotts and jurisdictional disputes but not for illegal recognitional picketing.

Secondary Boycotts

This provision, like the others discussed below, is often referred to by its section number—8(b)(4)(B) of the NLRA.[1] Although the statutory language does not specifically use the term *secondary boycotts,* that is the name universally given to this provision. The secondary boycott provision prohibits a union from in any way inducing any employee, regardless of whether that employee works for the union's own employer or some other employer, to strike or refuse to handle or work on any particular goods or to refuse to perform any services where the object of the union's inducement is to force any employer or entity to cease doing business with another employer. Equally prohibited under this section are union efforts to "threaten, coerce, or restrain" any employer or entity for the same object. Unions are not, however, prohibited from doing those things that are otherwise lawful in connection with "any primary strike or primary picketing."

To give a specific example, assume that Union A has no dispute with its own employer but seeks to gain additional work by "freezing" an interconnect contractor using nonunion labor out of a project. The illegal secondary boycott could come about in a variety of fashions, any one of which would constitute a violation in and of itself:

1. It would be illegal for Union A to stop performing its own tasks and announce that it would not resume them until the nonunion interconnect company was removed from the project.
2. It would be unlawful for Union A to refuse to install the conduit needed for the interconnect cabling (assuming that the conduit was in the Union A contractor's work). Circumstantial evidence of the "object" in this case would be so apparent that no official announcement of the union's purpose in undertaking its actions should be necessary.
3. It would be unlawful for Union A to threaten or coerce nonunion interconnect company representatives with future trouble unless the interconnect company gave up the work.
4. It would be unlawful for Union A to threaten or coerce the nonunion interconnect company's customer with future trouble unless the customer cancelled the interconnect company's contract.

Numerous other similar instances of strikes, picketing, slowdowns, and coercive tactics would also be illegal, and conduct that arguably may not be illegal in its own right may well be important as supporting evidence.

Conversely, suppose Union A had an actual dispute with its own employer, collective bargaining talks had failed to produce a new agreement or the employer had violated a lawful prohibition on the subcontracting out of work. In this case it would not be an unlawful secondary boycott for Union A to strike and picket its assigned work entrance and the work entrance of any substitute contractor performing the struck work.[2]

Jurisdictional Disputes

The jurisdictional dispute provision of the NLRA, § 8(b)(4)(D),[3] substitutes a different prohibited "object" for that prohibited in the secondary boycott provision, although in all other respects it uses the same language as the secondary boycott provision described above.[4] The prohibited union objective here is the desire to force an employer to assign particular work to employees represented by one union rather than another. A traditional example of a jurisdictional dispute is a situation in which two different unions working for the same employer claim the right to work on a new machine or process (as, for instance, when a TV station's two unions make competing claims to operate new portable videotape minicams that replace photographic film cameras for location shooting). Whenever an employer has two or more unions representing workers performing closely related tasks, or whenever work is geographically relocated, jurisdictional disputes are possible.[5] Union efforts to claim work performed by others can also constitute an illegal jurisdictional dispute, even if the effort is in reality an attempt to take work away from another employer's workers. It is particularly in this area where secondary boycott violations can overlap with jurisdictional disputes; for example, violations of both § 8(b)(4)(B) and § 8(b)(4)(D) might exist if a union refused to perform its tasks until its demand was met that another contractor using another union on a different part of the project be removed.[6] It is important, however, for an employer to be aware that in any such overlap situations it may well be to the employer's advantage to characterize the union's activities as a § 8(b)(4)(D) jurisdictional dispute rather than a § 8(b)(4)(B) secondary boycott. The advantage of proceeding under § 8(b)(4)(D) is that the NLRB, in granting injunctive relief, will often disallow all picketing by the union, whereas in a § 8(b)(4)(B) case, the NLRB in some circumstances may permit some union picketing to persist, albeit at restricted areas. In some cases it may be desirable and entirely logical to file charges under both sections.

The NLRA does not prohibit the mere making of a claim for the work; rather it is the use of the specifically prohibited tactics of strikes, partial strikes, slowdowns, picketing, threats, and coercion are prohibited. A contractor or other construction employer confronting any of these prohibited tactics should immediately file an unfair labor practice charge before the NLRB, since the board is empowered to resolve jurisdictional disputes under § 10(k) of the NLRA. Two prompt, favorable results routinely follow from the filing of a § 10(k) charge by the construction employer. First, the NLRB will make a formal award of the disputed work prior to its issuing any complaint. Although the Supreme Court has directed the board to make any § 10(k) awards "on the merits,"[7] and although the board has a list of factors it formally applies case by case,[8] the board, in practice, has affirmed the employer's assignments of work in an overwhelming majority of cases involving the construction industry.[9] Those few cases in which the board has overturned the employer's assignment have generally involved a union that has some contractual rights to the work. The second positive consequence of initiating a jurisdictional dispute charge before the board (or, for that matter, a secondary boycott or illegal recognitional picketing charge) is that the regional director, upon finding reasonable cause to conclude that an unfair labor practice has occurred, generally will seek under § 10*(l)* of the NLRA a preliminary injunction in federal district court on behalf of the charging party. Alternatively, the regional director can seek a temporary restraining order against the union(s) protesting the work assignment, with the order to last no more than five days if issued without notice to the union charged with the unfair labor practice. Section 10*(l)* injunctive relief has often been granted by federal courts in a number of contexts involving work assignment disputes.[10] In fact, the jurisdictional disputes need not be between unions for the § 10(k)/10*(l)* process to result in an injunction. For example, a federal court issued a § 10*(l)* injunction against a union that was picketing at a construction site in the aim of forcing an employer to assign work to union members rather than to the employer's unrepresented employees.[11] In light of these two consequences, developers, contractors, and other employers at the construction site should realize that the NLRB can be an important ally in promptly and favorably resolving jurisdictional disputes.[12]

Illegal Picketing for Recognitional Objectives

This provision, also known as § 8(b)(7), specifically prohibits picketing or the threat of picketing where the object of the picketing or the threat of it is to require the employer to recognize a given labor organization in any of three different circumstances:

1. Where the employer has already lawfully recognized another union and it is not the appropriate time for a competing union to try to oust the incumbent union (such appropriate time generally being a 30-day period that occurs close to (but not exactly at) the end of a collective bargaining agreement).
2. Where there has already been an NLRB-conducted union representation election within the preceding 12 months (e.g., where either a "no union" sentiment or sentiment for another union was in the majority).
3. Where the picketing has continued without a petition for an NLRB-

sponsored election having been filed "within a reasonable period of time not to exceed 30 days from the commencement of such picketing."[13]

Here, there must be the fact of picketing or the threat of it plus an intent (object) of thereby coercing recognition. On some occasions, unions will picket with "area standards" signs that do not overtly state a demand for recognition. Such messages commonly read something like: "John Jones Company is paying below-standard wages and benefits. Amalgamated Union of XYZ." If conducted in this fashion and without any evidence of an intent to organize, such picketing does not violate § 8(b)(7). Nevertheless, it might be possible to prove a violation if oral recognition demands were made by the picketing union, if there had been recognition demands made in prior dealings between that union and the employer, or if the picketing union did not in fact know about the actual terms and conditions of employment of which it purportedly complained.

Enforcement Procedure

Claims of unfair labor practices must be filed with the appropriate region of the NLRB within six months of the date of commission. The person filing the charge (charging party) need not be the employer of the workers whose union will be charged. The class of persons and businesses that can file a charge relating to any given alleged unfair labor practice is broadly defined, which is to say there is broad standing.

Perhaps the most critical part of the enforcement process from a developer's or a contractor's point of view is the ability to obtain quick interim injunctive relief against violations of § 8(b)(4)(B) (picketing with a secondary boycott objective), § 8(b)(4)(D) (picketing in furtherance of a jurisdictional dispute), or § 8(b)(7) (illegal recognitional picketing). As noted previously, § 10*(l)* of the NLRA is the statutory provision establishing the procedure by which an NLRB regional director, following a preliminary investigation of a charge alleging any one of these three unfair labor practices, petitions a federal district court for appropriate injunctive relief pending a final resolution by the board of the charge. In those situations, the director need not even issue a complaint before filing for such injunctive relief. Unlike the treatment of injunctive relief in other parts of the NLRA, under § 10*(l)* the regional director need only conclude that reasonable cause exists to believe that one of the unfair labor practices covered by § 10*(l)* has occurred before petitioning a court for an injunction. The reasonable cause standard has often been interpreted liberally by the regional director and the courts, which works in favor of the charging party. In fact, it has been held that the reasonable cause predicate to an injunction is met whenever the factual allegations and legal propositions underlying the regional director's petition are not insubstantial or frivolous.[14] Once a regional director does find that reasonable cause exists, § 10*(l) requires* that (s)he seek injunctive relief. A failure of the regional director to so act is appealable to the NLRB general counsel, who has the power to order the regional director to seek an injunction on behalf of the charging party. Given this low reasonable cause threshold under § 10*(l)*, developers and contractors should be encouraged by the high likelihood of achieving the interim injunctive relief that is needed to keep to a minimum losses arising from any of these unfair labor practices.

Throughout the § 10*(l)* enforcement process, charges involving illegal recognitional picketing, secondary boycotts, or jurisdictional disputes assume priority over all other types of charges handled by the NLRB. Although priority status does yield a quicker preliminary investigation and a quicker resolution of the charge than would otherwise be the case, it is nevertheless good practice for the charging party to maintain constant pressure on the NLRB to investigate and to take action. Widespread experience has shown such continuous pressure is needed not only to prompt results that minimize losses, but also to ensure that the board will acquire all of the facts before witnesses are lost or witnesses' memories fade.

Either before obtaining an injunction or shortly thereafter, the board will issue a complaint should it continue to believe that the charge has merit or if there appears to be a credibility question that will ultimately determine whether or not a charge has merit. Hearings are then held in or near the regional office before an administrative law judge (ALJ) several months after the complaint is issued, and there is generally little or no formal discovery. The general counsel of the board (now functioning as prosecutor) and all other parties appearing in the case may subpoena witnesses and documents nationwide on condition that witness fees are paid. The charging party may, but need not, actively participate in the hearing. The decision by the ALJ is final unless one of the parties files timely exceptions with the five-member NLRB itself in Washington, D.C. If exceptions are filed, all parties have an opportunity to file briefs with the board, which will rule on the exceptions on the basis of the briefs, transcripts, and exhibits. The board itself does not hear live testimony of witnesses or otherwise receive new evidence. The board's final order is not self-enforcing; thus in cases where compliance is not forthcoming, the board will petition in a U.S. Court of Appeals for a judicial decree enforcing its administrative order. All proceedings after the ALJ decision are analogous to an appeal of a trial court's decision, with only limited reconsideration of those issues (especially factual issues) decided at the hearing.

As noted above, one procedural difference does distinguish the cases involving jurisdictional disputes. Here there is an additional preliminary step during which the board will make a formal award of the disputed work prior to the issuance of any complaint alleging a union unfair labor practice. Yet, it should be reemphasized that the board places substantial weight on the employer's own assignment, especially where there is a reasoned basis for it. It should also be noted that in those cases where the "losing union" consents in writing to the preliminary award, the case will be closed without issuance of a complaint.

PRACTICAL CONSIDERATIONS RELATING TO WORK ASSIGNMENTS

We have shown the ways in which a project developer or any other customer for construction and telecommunications work can exercise its own discretion in awarding part or all of a project to any contractor it wishes regardless of the union affiliation of that contractor's employees or the lack thereof. Having shown this, it is appropriate to note some of the problems that may arise when customary arrangements are altered or disregarded or when a union decides to reach out for new work.

Strikes and Work Slowdowns

A project is vulnerable to work stoppages when an entrenched union sees something that it considers to be its own work performed by others. Whether the problem is manifested by a complete strike, a partial strike, or a work slowdown by the disenchanted union, the problem is always a serious one. The NLRB is obliged by statute to seek preliminary injunctive relief promptly following the filing of any meritorious charge concerning this class of cases. In most cases the board will seek the initial court injunction within a few working days. As previously noted, under the statutory formula, the NLRB is in general likely to succeed once it submits its request for a preliminary injunction, since the board need only show its own reasonable cause to believe that a violation is occurring. In some cases, however, the mere filing of a charge may have the desired restraining effect on the continuation of the unfair labor practice. In addition, in cases of secondary boycotts and jurisdictional disputes, an injured party may seek to obtain leverage by putting the offending union on notice of the injured party's intent to file a damage action.

Another consideration is that it is not always easy to prove a union is actually behind a job action, especially if it consists of isolated acts of harassment, a partial "sick out," or a work slowdown.

Sabotage

High tech buildings are by their nature susceptible to sabotage, both during construction and afterward. In cases of antagonistic unions doing interrelated tasks (e.g., installation of conduit and cable pulling), the opportunities for adroit, anonymous sabotage are boundless—most often in the form of cable cutting.[15] Finding the culprit or culprits behind a cable-cutting episode or other act of vandalism is normally quite difficult, if not impossible, and the best defenses are preventive security in the form of (1) roving security patrols, (2) closed-circuit television coverage of critical facilities and access paths, (3) tight perimeter security, and (4) careful control of, and record-keeping regarding, access to the project site. Alternatively, if it is feasible from an operational point of view, problems tend to be reduced when the project can be scheduled in such a way that the two different work forces expected to be antagonistic are not on the site at the same time. For example, one might complete all electrical and conduit work before a different union proceeds to do telephone cable pulling and PBX installation. Stated differently, labor problems are much rarer where someone is installing a new system in a building in which no major construction or rehabilitation work is under way.

Economies of Scale and Value of Coordinated Responsibility; Availability of Vendors

Although the desire to reduce the amount of work assigned to high-cost construction trade unions may argue in favor of splitting up a project between several vendors, competing considerations obviously exist. The economies and efficiencies of having a single general contractor responsible for a larger scope of work may argue in favor of assigning the contractor responsibility for additional tasks, particularly all prewiring, even though the hourly wage rate of the workers used is higher.

In addition, for legitimate business reasons, prospective vendors (general contractors, telephone interconnect suppliers, or other) may not be interested in assuming responsibility for successful installation and operation of a project for which they are in part (if not primarily) responsible unless they control all relevant phases of the work. Therefore, they may be unwilling to accept a contract with the parameters that a project developer or some other customer would seek to apply.

Conversely, the ability of a general contractor to contract for the entirety of a project may be limited by prohibitions on subcontracting to which it is bound. There may be a key nonunion supplier of an element in a project that is considered necessary for the successful completion of the work. A general contractor that accepts an award of the work and then seeks to subcontract it could find itself violating a subcontracting prohibition in its own existing collective bargaining agreements.

As new technologies and services are introduced into basic construction, care will have to be given to proper resolution of these competing considerations.

Preexisting Limitations, Express or Implied, on Customer's Right of Selection

A project developer may not always have unfettered selection in its choice of contractors.

Where the project has a close relationship with a federal, state, or city government (i.e., if it is covered by the federal Davis-Bacon Act or a state or city counterpart to that law), consideration must be given to the applicability of prevailing wage laws and regulations or similar provisions. These laws do not explicitly state that unionized labor or unionized labor from a particular union must be used, but they do prohibit the use of a vendor with below average labor costs. Although such a vendor can sometimes modify its normal pay scales so as to comply with the legal requirements by paying employees additional compensation for working on a covered project, this option may be unattractive to the prospective vendor because of its long-term impact on established wage scales. In any case, such a step reduces a price advantage that might otherwise exist.

In somewhat different fashion, a tenant may be obligated under the terms of a lease to use only "compatible labor," or words to similar effect. Federal labor law generally protects a customer's right to choose any contractor to perform work without having itself or the contractor subjected to secondary boycotts and illegal jurisdictional disputes. Therefore, a cogent argument can be made that any contractor's labor is compatible as long as the workers behave in a civil fashion while on the work site and so long as the prospective contractor's own workers are not themselves on strike and thus not going to introduce a lawful primary labor dispute to a site where none otherwise would exist. Notwithstanding the force of this logic, many people construe such clauses to represent a de facto requirement by the landlord that the tenant only deal with contractors whose workers are represented by whichever union is most powerful and deeply entrenched in a given location. Tenants presented such clauses in draft leases should, therefore, determine explicitly the landlord's interpretation of any such clause and be sure it will not prevent use of their intended contractors.

In other situations, landlords may reserve to themselves the effective right to select the unions to be used by insisting that they, as landlord, be the party which lets all construction contracts. Here again, the terms of the lease will merit careful review.

■ CONCLUSION ■

Developers and tenants selecting vendors for high tech installations have more freedom of choice in their selection of suppliers than is often perceived.

Entrenched unions often have little or no legal right to claim work automatically, even in situations where this view is pervasive in the business community. In particular, contractors and other employers involved in high tech construction should not hesitate to be aggressive in their work assignments and in defending those work assignments, for the NLRB, in the absence of express contrary contractual rights, will most often affirm the employer's assignment. Given the priority status that can be assigned to jurisdictional dispute, secondary boycott and recognitional picketing cases before the NLRB, an employer will also often gain the benefit of a prompt preliminary injunction enabling it to minimize losses at the construction site. Of course, there may be instances wherein an employer cannot even afford a short period of illegal picketing or strikes, in which case the employer must admittedly be more sensitive to potential work assignment problems.

The trend toward more extensive prewiring will likely lead to the assignment of this work to the general contractor's workers and the deletion of such work from the scope of the work performed by telephone interconnect workers. Therefore, the trend toward prewiring will generally benefit building construction trade unions and disadvantage other unions.

As new technologies and skills are brought into the basic construction process, the likelihood is great that new jurisdictional disputes will arise. Project developers and employers intending to introduce new technologies and new vendors into the basic construction process will need to consider carefully the labor relations issues when deciding whether to award all of the work to a single general contractor as the choice may have a substantial impact not only on cost and timing but also on the ability to use potentially key nonunion high tech suppliers to accomplish needed elements of the installation.

■ NOTES ■

1. The relevant full text reads as follows:

> 8(b) It shall be an unfair labor practice for a labor organization or its agents—
>
> > (4)(i) to engage in, or to induce or encourage any individual employed by any person engaged in commerce or in an industry affecting commerce to engage in, a strike or a refusal in the course of his employment to use, manufacture, process, transport, or otherwise handle or work on any goods, articles, materials, or commodities or to perform any services; or (ii) to threaten, coerce, or restrain any person engaged in commerce or in an industry affecting commerce, where in either case an object thereof is:
> >
> > . . .
> >
> > (B) forcing or requiring any person to cease using, selling, handling, transporting or otherwise dealing in the products of any other producer,

processor, or manufacturer, or to cease doing business with any other person, or forcing or requiring any other employer to recognize or bargain with a labor organization as the representative of his employees unless such labor organization has been certified as the representative of such employees under the provisions of section 9: *Provided,* That nothing contained in this clause (B) shall be construed to make unlawful, where not otherwise unlawful, any primary strike or primary picketing;

. . .

[Jurisdictional Dispute provision follows]

(D) forcing or requiring any employer to assign particular work to employees in a particular labor organization or in a particular trade, craft, or class rather than to employees in another labor organization or in another trade, craft, or class, unless such employer is failing to conform to an order to certification of the Board determining the bargaining representative for employees performing such work:

Provided, That nothing contained in this subsection (b) shall be construed to make unlawful a refusal by any person to enter upon the premises of any employer (other than his own employer), if the employees of such employer are engaged in a strike ratified or approved by a representative of such employees whom such employer is required to recognize under this Act: *Provided further,* That for the purposes of this paragraph (4) only, nothing contained in such paragraph shall be construed to prohibit publicity, other than picketing, for the purpose of truthfully advising the public, including consumers and members of a labor organization, that a product or products are produced by an employer with whom the labor organization has a primary dispute and are distributed by another employer, as long as such publicity does not have an effect of inducing any individual employed by any person other than the primary employer in the course of his employment to refuse to pick up, deliver, or transport any goods, or not to perform any services, at the establishment of the employer engaged in such distribution.

29 U.S.C. § 158(b)(4)(B),(D).

2. Absent an actual or impending strike, it is common for many contractors to share a common entrance for employee access and freight deliveries. In the event of a strike by a single trade, however, a general contractor or other site manager can normally create additional separate entrances ("reserve gates") and assign one or more gates to the struck subcontractor (and any substitute contractor) and explicitly assign other gates to the nonstruck contractors only. If this is done, it is generally an unfair labor practice—secondary boycott—for the striking union to picket the entrances assigned to the nonstruck subcontractors (so long as none of them is used to do the struck work). NLRB v. Denver Building & Const. Trades Council, 340 U.S. 675 (1951). The NLRB has modified at various times the factors that determine whether a dispute is "primary" or "secondary" in nonconstruction settings, but it has consistently followed *Denver Building Trades,* thus making use of reserve gates feasible in construction. See, e.g., Sacramento Area District Council (Malek Construction Co.), 244 NLRB 890 (1979); Building & Const. Trades Council (Markwell & Hartz, Inc.), 155 NLRB 319 (1965), *enforced,* 387 F.2d 79 (5th Cir. 1967), *cert. denied,* 391 U.S. 914 (1968). A union-sponsored bill that would have allowed common situs picketing of a construction site whenever a union had a

dispute with any one contractor or subcontractor working on the site was passed by the House and Senate in 1975 but vetoed by President Gerald Ford.

3. 29 U.S.C. § 158(b)(4)(D).

4. For simplicity's sake, therefore, the text of subsection (D) is included above at footnote 1.

5. A union can also commit a jurisdictional dispute violation by claiming work done by a group of unorganized employees.

6. In a 1971 decision, the Supreme Court held that §§ 8(b)(4)(B) and 8(b)(4)(D) are not exclusive of each other, so that the same union conduct could violate both provisions. NLRB v. Local 825, Operating Engineers (Burns & Roe, Inc.), 400 U.S. 297, 305–306 (1971).

7. NLRB v. Radio & Television Broadcast Engineers, Local 1212 (CBS), 364 U.S. 573 (1961).

8. Such factors include: *(a)* skills and work involved, *(b)* company and industry practice, *(c)* terms of the relevant collective bargaining agreements, *(d)* any agreements between the unions, *(e)* efficiency and economy of operations, and *(f)* the employer's assignment.

9. See NLRB v. Longshoremen Local 50 (Brady-Hamilton Stevedore Co.), 504 F.2d 1209, 1220 (9th Cir. 1974), *cert. denied* 420 U.S. 973 (1975) (Ninth Circuit, upon reviewing the board's § 10(k) cases, found that the board's award of disputed work coincided with the employer's preference in nearly every case).

10. E.g., Johansen v. International Association of Bridge, Structural & Ornamental Iron Workers, 71 Lab. Cas. (CCH) ¶ 13647 (S.D. Cal. 1973) (union enjoined from picketing, which was aimed at forcing the assignment of any new construction to its members rather than to members of another union); Douds v. Wood, Wire & Metal Lathers International Association, 245 F.2d 223 (3d Cir. 1957) (general injunction against two unions upon showing by Regional Director of a real danger of picketing or strikes following any work assignment of the type involved in the dispute).

11. NLRB v. United Brotherhood of Carpenters & Joiners, 316 F.Supp. 426 (W.D. Pa. 1970).

12. As previously noted, there are private mechanisms for settling jurisdictional disputes. In particular, the AFL–CIO has established private arbitration panels, which are designed to resolve jurisdictional disputes between affiliated unions. Occasionally, such panels will successfully resolve the dispute to the satisfaction of all parties. The conclusions of such panels, however, will neither bind the employer nor the Board unless the employer has expressly agreed to abide by this process of settlement. NLRB v. Plasterers Local 79, 404 U.S. 116 (1971).

13. The relevant full text reads as follows:

> 8(b) It shall be an unfair labor practice for a labor organization or its agents—
>
> > (7) to picket or cause to be picketed, or threaten to picket or cause to be picketed, any employer where an object thereof is forcing or requiring an employer to recognize or bargain with a labor organization as the representative of his employees, or forcing or requiring the employees of an employer to accept or select such labor organization as their collective bargaining representative, unless such labor organization is currently certified as the representative of such employees:
> >
> > (A) where the employer has lawfully recognized in accordance with this Act any other labor organization and a question concerning representation may not appropriately be raised under section 9(c) of this Act,
> >
> > (B) where within the preceding twelve months a valid election under section 9(c) of this Act has been conducted, or

(C) where such picketing has been conducted without a petition under section 9(c) being filed within a reasonable period of time not to exceed thirty days from the commencement of such picketing:

Provided, That when such a petition has been filed the Board shall forthwith, without regard to the provisions of section 9(c)(1) or the absence of a showing of a substantial interest on the part of the labor organization, direct an election in such unit as the Board finds to be appropriate and shall certify the results thereof: *Provided further,* That nothing in this subparagraph (C) shall be construed to prohibit any picketing or other publicity for the purpose of truthfully advising the public (including consumers) that an employer does not employ members of, or have a contract with, a labor organization, unless an effect of such picketing is to induce any individual employed by any other person in the course of his employment, not to pick up, deliver, or transport any goods or not to perform any services.

Nothing in this paragraph (7) shall be construed to permit any act which would otherwise be an unfair labor practice under this section 8(b).

29 U.S.C. § 158(b)(7).

14. San Francisco–Oakland Newspaper Guild v. Kennedy, 412 F.2d 541, 544 (9th Cir. 1969).

15. Contracts for the sale and installation of telephone interconnect systems and like projects should, therefore, be carefully drafted and scrutinized for their "risk of loss" provision with an eye to its applicability in event of sabotage. Appropriate arrangements for insurance should be made if a party with the risk of loss does not desire to retain the exposure.

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Chapter 17

Inside Wiring for the High Tech Building

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Outline

FCC DEREGULATION POLICIES
- CC Docket No. 79–105
- CC Docket No. 82–681—Intrasystem Inside Wire

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- Building Codes and Standards
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  - Unlimited access (raised floor)
  - Underfloor conduit systems
  - Poke-through
  - Ceiling distribution systems (exposed)
  - Ceiling grid system
  - Surface raceway (exposed)
  - Flat undercarpet cabling systems
  - Satellite closets

HIGH-RISE BUILDING WIRING—SHARED COMMUNICATION CABLING NETWORKS
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- IBM Cabling System
- Optical Fiber Systems
  - Fiber types
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  - Fiber cables

Communication systems are playing an increasingly important role in our work environment and have imposed new requirements on building technology. A multitude of new communication building blocks have emerged, such as computers, information storage terminals, digital switching, and fiber optic cables. Coupled with these technological improvements are changing telecommunication regulatory policies and changing economics. All of these changes have brought to the forefront a major issue in the design of modern buildings—the wiring for advanced telecommunications systems. In this chapter, we will provide a comprehensive discussion of this highly important subject: inside wiring. Developers need to become familiar with this subject. Buildings that are designed and built in ignorance of this subject may yield unexpected and expensive lessons to the developers, or may turn into dinosaurs before the 21st century arrives.

In charting a course in telecommunications today, it is no simple task to determine a starting point. Probably more than anything else, deregulation policies have provided numerous opportunities and alternatives for communication systems within these buildings. For that reason, we will begin our discussion of inside wiring with a review of the regulatory environment.

FCC DEREGULATION POLICIES

The Federal Communications Commission (FCC) in recent years has taken numerous actions to foster additional competition in the provision of telecommunications services and equipment. One of the biggest alterations in the telephone business in recent years has been the FCC's ruling CC Docket 79–105, allowing expensing of station or telephone connections. It used to be that the excess cost of telephone installations was paid by all telephone consumers and absorbed into the telephone company's rate base. Today, telephone companies are asking state regulatory bodies for the right to recover the full cost of the telephone installation from the outset when the customer has equipment installed. Local telephone companies (Telcos) desire that consumers provide and pay for their own wiring. The Telcos do not wish to continue to provide the capital and financing for the inside wiring located on the customer's premises. For a developer of a new high-rise office building, this means that the developer must pay as part of the initial cost of the building the substantial cost of wiring that the Telcos used to do for "free." This is an issue that underlies the esoteric regulatory proceeding to be described: Who pays and how and when. Major steps in the Commission's deregulatory process applicable to inside wiring for the high tech building are FCC's CC Docket No. 79–105 and CC Docket No. 82–861, which are discussed below.

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CC Docket No. 79–105

In the FCC's First Report and Further Notice in CC Docket No. 79–105, the Commission directed each Telco or carrier subject to its jurisdiction to divide its wiring investment in Account 232 into at least two subclassess: Station Connections—Inside Wiring and Station Connections—Other (drop, block, and protector portion). The commission also required all subject carriers to expense to Account 605 items under Installation Repairs of Station Equipment, the inside wiring portion of telephone connections. Carriers may phase in the expensing of station connections over a four-year period (25 percent per year increments) or, upon state regulatory approval, carriers may expense these costs on a flash-cut basis. Existing or "embedded" wiring must be amortized over a period of 10 years, starting October 1, 1981. Subsequent to the issuance of Further Notice in CC Docket No. 79–105, the Commission initiated separate proceedings to examine accounting and regulatory issues for one- and two-line business and residential wiring (CC Docket No. 81–216) and inside wiring for multiline business systems (CC Docket No. 82–681).

Of late, the FCC has concluded its second reconsideration of this expensing order. Its initial action was not intended to preclude state utility commissions from using other depreciation or accounting procedures for interstate rate making. Its second reconsideration indicated that the most logical and reasonable interpretation of Section 220(b) of the Communications Act is that state regulators may not depart from FCC-prescribed depreciation rates for classes of property. Thus the expensing order is binding on the state public utility commissions. The FCC added that even if Section 220(b) is assumed not to preempt state regulatory commissions, the FCC would act under its authority to preempt state actions that interfere with the accomplishments of federal policies and objectives. However, the Internal Revenue Service still insists that inside wiring be treated as a capital asset for federal income tax purposes (IRS Ruling 84–24).

Thus the FCC order is consistent with current deregulation philosophy in that it:

- Calls for prices to be based upon actual costs.
- Allows for unbundling of historical embedded premises wire costs previously part of the Telco's rate base.
- Separates rates for deregulated competitive services from those for regulated monopoly services.

CC Docket No. 82–681—Intrasystem Inside Wire

At this time, the FCC is not considering deregulating the portion of inside wiring for private branch exchange (PBXs) and key systems that are not

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already included in the FCC registration program (Part 68). In other words, common wiring from the riser cable to the telephone network interface point for complex business systems will continue to be regulated. However, in this proceeding the commission is proposing that this capital wiring portion of Account 234 now be expensed to Account 605.

The FCC on October 11, 1982, released an opinion for customer-owned systems that Part 68 of its rules should be read as permitting parties other than regulated telephone companies to install intrasystems consisting of "common equipment" (a switchboard or switching equipment shared by all stations), station equipment (usually telephones or key telephone systems), and wiring connecting the common equipment and the station equipment.

Intrasystem wiring would include all cable and wire and its associated components (i.e., connecting blocks, terminal boxes, conduit between buildings on the same customer's premises, etc.).

Two sections of the FCC's rules establish equipment configurations and criteria under which parties other than a regulated carrier may operate. Section 68.2 includes new and "grandfathered" PBX systems to the commission's interconnection rules. Section 68.215 requires that the installation, connection, reconfiguration, and removal of some inside wiring (other than fully protected) be performed under the supervision and control over a supervisor who has met one of the following requirements:

- Has had at least six months of on-the-job experience in the installation of telephone terminal equipment or of wiring used with such equipment.
- Has been trained by the registrant of the equipment to be connected.
- Has received written authority from the registrant to assume installation will comply with the rules.
- Is a licensed professional engineer in the jurisdiction where the installation will take place.

The FCC rules do not supersede any existing state requirements, for example, requiring nontelephone company personnel to pass a state electrical code examination.

CODES AND STANDARDS

Building Codes and Standards

Early in the planning stage of any construction, expansion, or alteration one should review not only the FCC regulations but also applicable building codes and standards. The purpose of building codes and standards is to ensure construction quality and to protect life, limb, and property. Jurisdiction in almost all areas of the United States are regulated by state or local governing bodies who establish building codes and standards and issue applicable permits. Some states have adopted statutes establishing minimum conditions under which a local government may permit construction to occur. There are four major building codes and standards documents upon which state and local regulations are based:

1. Uniform Building Code—produced by the International Conference of Building Officials (ICBO), 5360 South Workman Mill Road, Whittier, California 90601.
2. The BOCA Basic Building Code—produced by the Building Officials and Code Administrators (BOCA) International, Inc., 17926 South Halsted Street, Homewood, Illinois 60430.
3. Standard Building Code (SBC)—produced by the Southern Building Code Congress International, Inc., 900 Montclair Road, Birmingham, Alabama 35213.
4. The National Building Code (NBC)—produced by the American Insurance Association, 85 John Street, New York, New York 10038.

Fire codes

Concern for building environment safety has increased markedly during the past several years due to highly publicized fires. One should become familiar with the National Fire Protection Association (NFPA) standardized fire codes, which include:

Description	*NFPA Number*
National Electrical Code (NEC)	70
Central Station Signaling Systems	71
Local Protective Signaling Systems	72A
Auxiliary Protective Signaling Systems	72B
Remote Station Protective Signaling Systems	72C
Proprietary Protective Signaling Systems	72D
Automatic Fire Detectors	72E
Protection of Electronic Computer/Data Processing Equipment	75
Lightning Protection Code	78
Life Safety Code	101

National Electrical Code (NEC)

The purpose of the National Electrical Code is to identify minimum provisions necessary to safeguard persons and property from hazards arising from use of electricity. Its handbook is published by the NFPA, and the 1984 edition was adopted on may 18, 1983; it was approved by the American Standards Institute and is known as ANSI/NFPA–70–1984. The 1984 edition supercedes all previous editions, the most recent being 1981. Many states and cities adopt the NEC as their standard code, and others add more or varied requirements.

One should have a working familiarity with the NEC code. The following chapters of the code are especially pertinent to planning and placement of communication systems:

Chapter 2—Wiring Design and Protection—covers detailed grounding method information and terminal identification methods.

Chapter 3—Wiring Methods and Materials—covers open and concealed wiring system methods. Basic wiring materials and insulations, raceway system, hardware, and other elements are described. Temporary wiring is also discussed.

Chapter 5—Special Occupancies—covers wiring systems and equipment restructions in hazardous areas and special occupancy areas.

Chapter 6—Special Equipment—covers electrical installations of manufactured wiring systems, data processing systems, and other special equipment.

Chapter 7—Special Conditions—covers installation of electrical systems operating at less than 50 volts, which is important for planning signaling systems. Class 1, 2, and 3 remote-control, signaling and power-limited circuits; and fire protective signaling systems are discussed.

Chapter 8—Communications Systems—covers installation requirements of communication circuits, radio, television equipment, CATV, and radio distribution systems.

Other Codes

Part 68 of *FCC Regulations* issues requirements for telephone wiring and equipment that is connected to the public switched telephone network.

The National Electrical Safety code (ANSI Standard C2, which is the formal identification of the document by the American National Standards Institute) principally established installation and maintenance standards for exterior power and communications. This code is produced by the IEEE, and the 1984 edition is structured in the following way:

Section 1 is an introduction to the code.

Section 2 defines special terms.

Section 3 lists reference documents.

Section 9 gives grounding methods for electrical supply and communications facilities.

Part 1 lists rules for the installation and maintenance of electrical supply stations and equipment.

Part 2 lists safety rules for the installation and maintenance of overhead supply and communications lines.

Part 3 lists safety rules for the installation and maintenance of underground electric supply lines and communications lines.

Part 4 gives rules for the operation of electric-supply and communication lines and equipment.

Some of the other more notable codes include:

Fire stops. Exit/entry through fire rated walls and floors must be properly sealed with approved materials.

Air plenum handling areas. Open wiring (except those U.L. classified or approved under NEC codes) in spaces used for the alternate use of transport of environmental air is generally prohibited. Approved plenum wire and cables are discussed later in this chapter.

Vertical shafts. Vertical shafts, including their access openings, must be constructed to provide a particular fire rating.

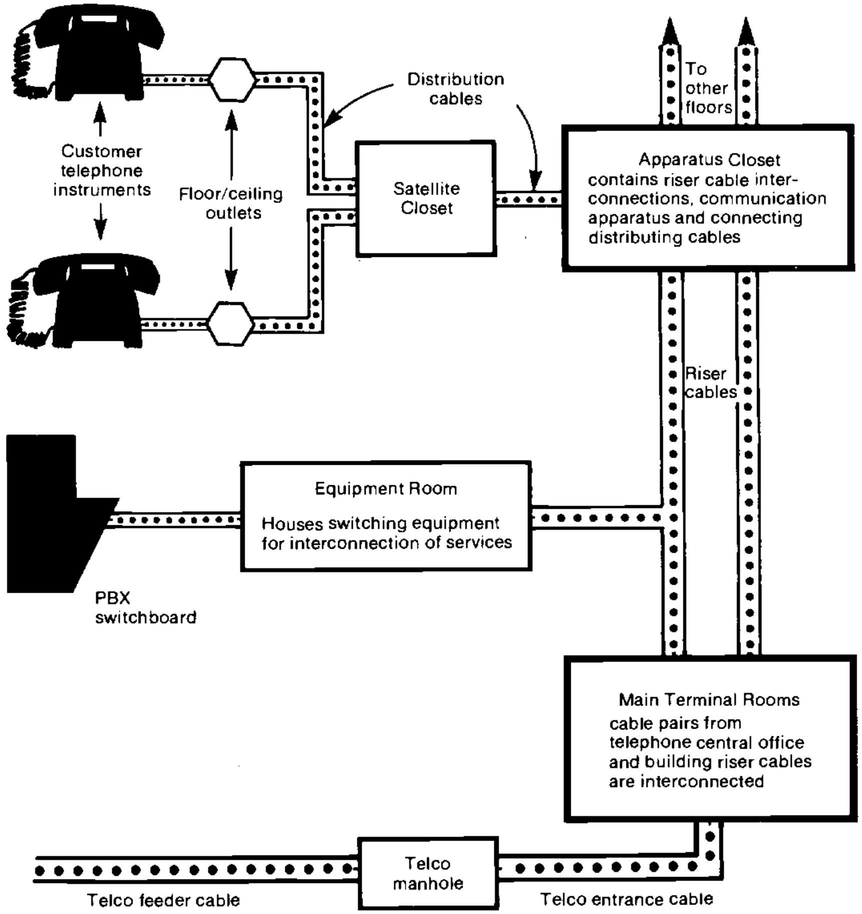
Safety. The NEC code specifies working clearance requirements in Article 110 and elsewhere. Adequate spacings to safely service wiring and equipment need to be provided in any building environment.

CABLE AND WIRING SYSTEMS

Optimally, new cable should be installed when a new communication system is installed. An alternative for an existing high-rise building is the purchase of the in-place cable when it is not cost effective to install new cabling. However, not knowing how long the cable has been in place or whether the cabling has been damaged could lead to serious problems. A thorough cable continuity test should be performed to verify cable and cable pair integrity prior to any purchase or equipment installation.

Such factors as cost, speed, reliability, and the operating environment must be considered by system and communication developers when selecting a proper, yet economical, cable network design. It is not unusual for 50 percent of the installed telephone and data terminals to be moved each year. Building wiring must be planned to accommodate this factor plus account for inevitable future growth. Figure 17–1 illustrates a simplified telephone cabling system within a high-rise building. It is presented only to show the interrelationship of the basic elements of in-building communications facilities. Overall, these

FIGURE 17–1
High Tech Building Communication System



elements must be combined to afford the various occupants an information-movement capability that will meet their original needs, yet be capable of being changed and expanded efficiently and economically.

In the past, telephone companies have generally installed wire exposed. Concealed telephone wire was installed if the means of concealment provided by either the building owner or the end-user was satisfactory to the telephone company.

It is still the responsibility of the building owner (sometimes the tenant) to provide a satisfactory means of entrance into the building, as well as to provide adequate space (closets) for mounting the necessary cross-connecting of switching, power, and telephone equipment. Space is also necessary to provide a means to reach each floor and each suite, office, or apartment on each floor requiring telephone service. In addition, it is the building owner's responsibility to:

Arrange for drilling of holes in reinforced concrete floors or walls in buildings.

Remove ceiling tiles when necessary.

Provide all service fittings, conduits, and sleeves that form parts of the building cable riser and distribution system.

Local telephone companies are still responsible for extending their outside cables to the building property line and reserve the right to determine the type and location of facilities to be provided to this point.

Communication system companies, interconnects, and telephone companies—all are dependent on other trades before installation of their equipment can begin. Walls, ceilings, lighting, and power outlets and floor coverings are necessary in main telephone terminal rooms, apparatus (user), and satellite closets. Sleeves or conduit (as required) are needed for vertical riser locations. Access to the horizontal cable distribution system and service fittings are needed at the individual telephone locations.

In order to meet building tenants' communications needs upon move-in, the following are suggested minimum periods for placement of any communication system.

Eight to 12 Weeks Prior to Occupancy

1. Finished main terminal room(s), entrance facilities, equipment room(s), apparatus, and satellite closets.
2. Light and power installed and usable in these rooms.
3. Storage space for the communication company to securely and safely store material and equipment.
4. Elevator service.

Six Weeks Prior to Occupany: Access to floor openings in underfloor raceway systems are available.

Five Weeks Prior to Occupancy: Installed floor standards (service fittings) and floor covering in office areas completed.

These requirements should be discussed at the outset and agreed to by all parties concerned. When questions arise, they must be resolved between all parties—who can include the architect, general contractor, building owner, tenant, and communication consultant. Before any joint use of communication raceway is considered, possible sources of difficulty to the telephone company equipment and to private communications systems should be discussed with the building owner. Where separation of system components and associated wiring are not identified in local codes, installation cables should be in accordance with NEC Articles 725 of Chapter 7 and 800 of Chapter 8. Installation manuals for the particular system being installed should also be consulted for minimum separation distances between power and communication cables.

Communication wiring within a high-rise building performs three different information-carrying functions. Wiring ownership varies among the building owner, tenant, and communication supplier (interconnect company or the local telephone company). Wiring functions and their interrelationships are described below following the path illustrated in Figure 17–1.

The Service Entrance Cable

The point at which the local telephone company cable enters the building site depends on their local cable distribution patterns and central office facilities. The local telephone company building industry consultant can tell the developer whether the cable will enter aerially, through underground conduit, or by direct burial and will also furnish advice while selecting sites. Whatever the entry, suitable prior plans should have been made for appropriate opening (with sleeves or conduit) through the building wall well in advance of the construction start date.

A spare entrance with suitable sleeve or conduit is always recommended for growth of future communication needs and/or emergency purposes. A means of bonding, grounding, or insulating cable inside the building is necessary. A three-fourths-inch conduit should be provided for the ground wire.

Buildings served by underground conduit entrance. An underground conduit entrance consists of a buried conduit that protects the cable and minimizes the need for possible subsequent repairs to the service entrance. Plastic and fiberglass conduit should be encased in concrete for extra security and protection. The conduit is provided by the building owner and extends from the building to the property line.

Size, number, and location of conduits should be planned well in advance. Construction plans often provide for more than one conduit extending from the property line to inside the building for protection against service interruptions and possible subsequent repairs to the property. The number of conduits depends on the size of the building. The minimum number is two, and at least one conduit is a spare. A conduit having a 4-inch inside diameter is the minimum recommended size.

Other considerations for underground entrances include:

Corrosion-resistant conduit should be used.

The conduit run should not have more than two 90-degree bends. For long runs, manholes are recommended.

Galvanized steel with asphaltic coating applied, plastic, and fiberglass conduits are acceptable. Metallic conduit needs to be reamed, bushed, or capped.

Where applicable, place rigid metallic conduit sleeves through the foundation wall. To prevent shearing, the sheeves should extend 2 feet beyond the foundation wall and reach undisturbed soil.

Wall sleeves with annular rings or other type seals should be considered to prevent water leaks through the foundation wall.

Bury conduit a minimum of 18 inches deep or to a depth that meets local codes. Cable that is buried under a paved road used for vehicle traffic should be placed in metallic conduit buried below the frost line or at least 24 inches deep.

Conduit on private property must not be terminated in manholes used jointly with electrical cables.

Separate telephone conduits from power conduits by at least 3 inches of concrete or 12 inches of well-tamped earth.

Advantages:

Conduit provides the best mechanical protection for the cable.

The cable can be placed in open conduit at any time.

Extra cable or replacement cable can be easily placed in the conduit.

Aesthetics.

Disadvantages:

The underground entrance is costly to the building owner for provision of the trench and conduit.

Buildings served by buried cable. Buried cable is increasingly popular. Cable buried under paved roads used for vehicle traffic should be placed in metallic conduits buried below the frost line or a minimum of 24 inches deep.

Advantages:

A buried entrance provides weather protection for the cable. In rodent-infested areas, cables with armor protection is required.

Aesthetics

Less costly to install than a underground conduit system.

Disadvantages:

The building owner pays for the trench if the cable is not plowed in.

Cable placement is more difficult to schedule.

Cable addition or retrofit are difficult and expensive.

Damage by water, burrowing animals, excavation, and cold flow from rocks is more likely.

Buildings served by aerial cables. Telephone cables (while extremely doubtful) could be supported on poles and enter a high-rise building aerially. Proper safety clearances between telephone cables and power cables must be in accordance with telephone company standards, the National Electrical Code, the National Electrical Safety Code (ANSI C2), and any local codes that may apply.

Generally, the maximum span of an aerial entrance from pole to building is between 100 and 150 feet. It is dependent upon cable weight and weather loading of that particular area.

The building owner provides the entrance facilities into the building. The entrance should be water tight and can be either wall sleeves or conduit.

Advantage:

Little or no cost to the building owner.

Disadvantages:

No mechanical protection; continuous weather exposure.

Poor aesthetics.

For basic telephone service, the rule of thumb is to provide 8 to 10 telephone cable pairs per 1,000 square feet of usable floor space. This rule of thumb needs to be reconsidered if data or other services will use these facilities.

Main Terminal Room

Telephone company outside-plant cables usually enter a building directly through conduit provided by the building owner and on to a main terminal room. At this location electrical protection is provided, and cross-connections are made with the riser cable system that runs throughout the building. A distinct functional separation between the telephone company central office lines and the in-building riser cable is made at the main terminal room. The ownership demarcation zone may be established at this point. This is where the building owner, tenant, or communication company would place in-building communication network cables to serve the high-rise building. For speculative buildings today, the telephone company generally provides the riser cable network, although this may not be true in the future.

The main terminal room can also house communication equipment. If telephone company equipment is to be installed, the telephone company's building industry consultant should be contacted for recommendations. The building owner is responsible for ensuring that the necessary space and the right environmental conditions are present for the communication cable termination frames and/or equipment.

The size of a main terminal room depends on how much space is needed for the terminating frames that cross connect the entrance cables and the in-building riser cables to provide for inevitable growth. The rule of thumb for commercial buildings of more than 100,000 square feet is to provide a room that is a minimum of 8 feet wide and has 1 square foot of floor space for each 2,000 square feet of usable floor area in the building. For buildings of more than 800,000 square feet the rule of thumb is 1 square foot for each unit of 3,000 square feet. If communication equipment is to be mounted in the room, extra space must be added for this equipment. Thus the total size of a main terminal room will depend on the type of equipment installed. Where equipment is to be installed, vendor requirements should be met. Refer also to the equipment room comments in this chapter.

The main terminal room should be located as near as possible to the center of the riser cable distribution system and is usually located where the floor space is less valuable (the basement). This room is the heart of the in-building communications system. The location should be in an area not subject to flooding and must be easily accessible to communication maintenance personnel at all times.

If the main terminal room is to house terminating frames only, two walls in the terminal room should have at least one 120-volt duplex convenience outlet for two-pole, three-wire grounded plugs and should be completely lighted. Ceiling height in the main terminal area should provide a minimum of an 8-foot clearance. The walls of the equipment room should extend to the structural ceiling.

In-Building Riser Cables

The riser cable system consists of the facilities for bringing cables from the main terminal room to the various floors of the building. In other words, central office lines are extended vertically via riser cables from the main terminal room to apparatus closets in the floors above in multistory buildings. Riser cables form the backbone of the communications system.

These cables are extended most satisfactorily by means of riser shafts that are either closed or open. The closed shaft-riser system consists of a series of vertically aligned closets on each floor. The closets are connected by pipe sleeves or conduit through the floors. An open-shaft-riser system consists of an area where the riser cables pass from floor to floor without being enclosed in a closet. A open-shaft system has strict fire code requirements and is much less flexible than a closed-shaft system.

As expected, risers can be placed singly or in multiples. The advantages of a single riser are:

Since all telephone cables come to a single lcoation, better utilization of all riser cable pairs is achieved.

Selection of cabling methods is expanded.

A single riser overcomes the problem of restricted access between building floors.

Advantages of the multiple-riser system include:

Splicing individual riser cables to each floor may require less labor cost at each floor.

Riser shafts can be smaller per each riser system.

The cable pairs required between closets is reduced.

Regardless of the type of riser system selected, it must be large enough for the required cabling system (communications plus data) being installed plus allow for future additions and rearrangements. When a building is served by more than one riser system, the floor area served by each of the systems must be calculated separately. The number of sleeves or conduits required per group of floors in the riser system is determined by the area they serve.

Sleeves used in a riser system are short pieces of pipe or conduit that are installed through the floor structure. When sleeves are used in a riser system, the rule for copper cable network communication systems is to provide two 4-inch sleeves, plus one spare, for up to 50,000 square feet of horizontal usable floor space. For additional space up to 100,000 square feet, provide one additional sleeve. For the next unit of 100,000 square feet (or any portion thereof) provide an additional sleeve. For every additional 200,000 square feet, add two additional sleeves. This method permits the cable riser system to serve several floors from one cable by means of cable stubs. The advantages and disadvantages of using sleeves are these:

Advantages:

Cheaper than conduit.

They are easy to fireproof.

Many sizes of cables can be placed in one sleeve.

It is easy to support the cables.

Disadvantages:

Cables must be sealed.

Cables must be supported by special devices.

An alternative method for extension of riser cables is via metallic or nonmetallic conduit. Conduit should connect riser closets that are not vertically aligned in the shortest route possible. The maximum continuous length is dependent on:

Cable pulling method.

Conduit supports.

Conduit encasement type.

Cable sizes to be placed.

Number of bends required in the conduit.

No section of conduit run should be longer than 200 feet nor contain more than two 90-degree bends unless pull boxes are placed in the run. Bends in the conduit should be long-sweep radius bends. However, in no instance should the inside radius of the bend be less than six times the internal diameter of the conduit. Advantages and disadvantages of a riser system using conduit are these.

Advantages:

Easy to support cables.

Protection in that conduit provides unobstructed housing for the cables.

Conduit is easy to fire stop.

Disadvantages

Conduit confines the size(s) of cable that can be placed.

Expensive to install.

Guidelines in determining pair sizes required for riser cables network based upon building density, generally allow for 15 cable pairs per 1,000 square feet of usable floor space. Economic factors to be considered for the number of cables per floor placement include:

The cost of the cables.

The cost of the splices.

The cost of growth and expansion.

The two options in riser cable design are having one cable serve each floor or having one cable serve more than one floor. The recommended design is the single-floor-per-cable design. Normally, when the riser cable distance is short, the single-floor-per-cable design is the most economical. Over relatively long distances, the multiple-floors-per-cable design may be the most economical.

Equipment Room

Digital communication equipment today is a delicate piece of computer equipment, and installation represents a critical phase in its life. Each manufacturer provides detailed specifications and data concerning environmental conditions for equipment. Concerns for optimum equipment operation include heating and air conditioning, electricity, room size, static and dust, and radiation.

Heating and air conditioning. A temperature range of 59° to 86°F must be maintained. Humidity levels must stay between 20 and 55 percent. In many installations, these requirements will not allow use of an existing or shared use of an equipment room.

Switching equipment systems generate heat. Most of the heat is generated from rectifiers (power distribution panels that convert alternating current to direct current and their number is based on how many shelves in the equipment it must support. A rectifier may power anywhere from 8 to 10 shelves. With five to six 25-amp rectifiers, plus heat thrown off by the equipment's central processing unit, the room can get quite hot. A rectifier puts out about 3,400 BTUs of heat energy per 1,000 watts of electricity.

One should be aware that not all communication equipment systems throw off the same amount of heat. In many instances, communication companies recommend a backup air conditioning system for the equipment room in case the building system fails during the hot summer months.

Electricity. Adequate amperage is vital, since an underpowered communication switch will not function. Each rectifier must be connected to a 208-volt, 30-amp independently breakered circuit.

Room size. A typical central processing unit cabinet measures 6 feet high, 4 feet wide, and 4 feet deep. Large office installations with two or three thousand terminals or telephones may require a dozen or more cabinets.

Static and dust. The equipment rooms need to be relatively dust free, be finished with painted walls, and have either sealed or tiled floors. To protect sensitive equipment components from static electricity, carpeting should not be used. Each system should be grounded.

Radiation. No photocopying machines should be placed within 10 feet of the central processing unit. They generate enough radiation to interfere with and corrupt the data within the equipment.

Other. Equipment rooms should be well lighted and situated in building areas not subject to dampness or flooding. The room should not be one used for storage (a common violation). Entry needs to be restricted to authorized personnel. Floor-loading requirements will be determined by the equipment installed. Fire protection and devices must be considered and meet applicable codes. The equipment area must be free of corrosives, explosives, or such gases as ammonia, acid, or petroleum vapors.

Since communication equipment and services will vary according to building type and end-user requirements, each equipment room must be individually designed. If the communication equipment has batteries for stand-by power, a separate room should be provided for the batteries. Close coordination with the proposed communication equipment supplier or consultant is mandatory at the outset, through the selection process, and through eventual installation. Advice should be sought in the earliest stages of planning.

The building owner is responsible for ensuring that the necessary environmental conditions are present for the communication cable terminations and equipment. It is surprising that a building owner or tenant will spend $1 million on a communication system and balk at spending additional monies to provide a proper size room with adequate ventilation. Manufacturer specifications should be met to assure proper operation of the equipment over its lifetime.

Apparatus Closets

Apparatus closets are suitable enclosures large enough to contain communication system apparatus and power equipment terminating facilities for communication system stations and services, as well as some data, video, and telephone central office lines.

Cables from the riser system are interconnected by means of connecting blocks to relay and power equipment, as well as to the distribution cable pairs that radiate from the closet to station locations throughout the floor. These closets may be called equipment closets, zone closets, or riser closets in that they interconnect with a horizontal cable distribution system and/or another cable riser system. Apparatus closets have become more of an equipment room due to deregulation of the telephone industry. Demarcation between the telephone company and nontelco communication supplier can also occur at this point. Space allocation for the apparatus closet is up to the building owner or tenant. When equipment is installed, manufacturer specifications should be met.

The area served by a single apparatus closet should ordinarily not exceed

10,000 square feet, but one closet may serve a floor area of as much as 20,000 square feet, provided the greatest distance from equipment in the closet to any telephone on the floor does not normally exceed 200 linear feet. This limitation is made necessary by the significant-current requirements of the circuits serving the busy visual lamps on the multibutton telephones.

Space allocation of apparatus closets is a necessary planning step and should be accomplished with the assistance of a communications facilities management consultant or other applicable communication representative to meet the unique characteristics of the building and the tenants' varied communications services.

Apparatus closets should be properly lighted, well ventilated, equipped with power facilities, as dust proof as possible, and situated in building areas not subject to dampness or flooding. The room should not be one used for storage, and entry should be restricted to authorized personnel.

Cable Distribution Systems

Generally, horizontal communication cables and wires radiate from the apparatus closets to the various communication terminations throughout the usable floor area.

The communications capacity and flexibility must be considered; otherwise, the distribution wiring plan will become inflexible and obsolete. It must be flexible enough to accommodate periodic office rearrangements, additional offices, or added communication services. These percentages will help you determine cable distribution capacity requirements:

There is a 15 percent annual growth in electronic office equipment.

Office rearrangements and workstation additions today are occurring at a rate of up to 50 percent annually.

Where changes, rearrangements, and additions occur, they must be accomplished with minimum effort in a cost-effective manner. The initial cost of any wiring plan is only one cost factor. Future relocations or additions must be considered in terms of the labor expended, office downtime, and additional material required. Thus the actual cost of any wiring network must be viewed in its life-cycle cost. Simply, a cable distribution system involves all expenditures required to install, maintain, and expand that communication wiring over the life of the building. Other factors worthy of consideration include security and aesthetics.

Security. Use of data processing equipment has generated the need of protecting data transmission paths and networks from electromagnetic interference and unauthorized access. Separate raceways should be provided for electrical and communication/data cable networks.

Aesthetics. Appearance is a consideration both in initial construction and for future rearrangements. Design freedom can have considerable influence on aesthetics.

The major types of cable distribution methods are:

1. In-floor systems (cellular and duct).
2. Unlimited access (raised floor).
3. Underfloor conduit systems.
4. Poke-through.
5. Ceiling distribution systems (exposed).
6. Ceiling grid system.
7. Surface raceway (exposed).
8. Flat undercarpet cabling.

A brief explanation and merits of these cable distribution methods are given below. For more specific information and details, one should consult with appropriate manufacturer's catalogs, representatives, or consultants.

In-floor systems (cellular and duct). How to plan an in-floor system (cells or ducts) layout compatible with office partitions to optimize space usage is not a skill quickly learned. Planning should always include professional assistance. Placement should be such that it is on both sides of planned interior partitioning and close to exterior walls. Additionally, these systems should be located to give easy access to planned workstation locations within the usable floor area. A properly designed system must accommodate the cable needs for the life of that building.

Cellular. These consist of either a cellular floor raceway or an underfloor duct system. Cellular floors form a ready-made raceway for distribution of power and communication cables. Alternating the power and communication cells can provide a flexible layout. A cellular raceway system serves as the structural floor and acts as a distribution system for communication and power cables. It may be constructed of steel (most predominate) or concrete.

Advantages and disadvantages of a cellular floor raceway are these:

Advantages:

Aesthetics.

Flexibility is more than an underfloor duct system because of typical 1-foot center-to-center spacings.

Capacity is greater than traditional underfloor duct systems.

It adds to structural strength of a building. Thus part of its cost is for structural use.

Disadvantages. Same as those for an underfloor duct system.

Duct. Underfloor duct systems are not normally part of a structural floor system and are assembled at the time of building construction. The underfloor duct systems consist of a header trench and distribution ducts, junction boxes, access units, accessories, and service fittings; and these metal raceways are embedded in the concrete. Duct is available with various cross-sectional areas.

Depending on floor structure, they may be designed into a one- or two-level system. Provide 1 square inch cross-sectional area of distribution and header trench per 100 square feet of usable floor area. Other guidelines include:

Header trench size. The typical cross-sectional area today varies approximately from 40 to 100 square inches. Theoretically, header trenches can serve the total floor area. Companies have recommended that 1 square inch of cross-sectional area of header trench be furnished for each 100 square feet of usable floor area. Assumption is that a potential desk and telephone will be required for each 100 square feet of usable office space. For power, a general rule is to furnish one square inch of cross-sectional area of raceway for each 1,000 square feet of usable office area. This does not cover high-use areas, such as data processing environments.

Distribution duct size. The cross-sectional area varies today from 3 to 18 square inches. Normally, one communication cable per desk or 100 square foot floor area is considered a standard design criterion.

Since there is virtually no potential for adding an underfloor duct system in an existing building, the overall structural design must be engineered to accommodate the duct system. Because of the dependency on the structural design, it is common practice to work out the duct direction in a new building to accommodate structural limitations and later to work out core arrangements and closet locations to complement the duct pattern. Associated service fittings (electrical and communication outlets) ideally should be located under desk pedestals to eliminate wires and fittings in aisles and other undesirable locations.

Advantages and disadvantages of an underfloor duct system are:

Advantages:

Aesthetics.

Flexibility: Moves, changes, or new additions are easily provided.

Security: Provides electromagnetic noise interference (EMI) and prevents unauthorized access.

Wire management: Distribution wire runs are separated between power and telephone.

High Tech Real Estate Dow Jones-Irwin 1985
A. Sugarman, A. Lipman, R. Cushman

Disadvantages:

Floor monuments from underfloor duct may be unsightly and unsafe (danger of tripping). These should be located under desks or other furniture which limits furniture rearrangement possibilities.

High initial cost until floor space is occupied.

Junction boxes or header duct must be accessible even when covered with carpet.

Expansion is difficult. The concrete floor has to be drilled to place afterset inserts or collars.

Abandoned access locations may be costly to repair properly, especially where carpeted.

Unlimited access (raised floor). The concept of utilizing above-the-floor space is being given increased consideration by building designers and planners, especially in computer facilities used in high-rise buildings. This approach provides for virtually complete flexibility for communication and data cable distribution.

The raised floor is assembled from a series of removable square modules of metal or concrete panels interlocking into and resting upon adjustable metal supporting pedestals approximately 4 to 12 inches above the structural floor. Each panel can be covered with carpeting or tile. The panels (2 by 2 feet) may also be covered on site with magnetic-backed carpet tiles, free-lay laid carpet, or carpet tile held in place with nonsetting glue. Either method allows carpet removal for access to the floor. A wire management plan should be initiated and maintained due to the flexibility of the raised floor system.

The floor must be grounded for safety reasons and for data transmission.

Advantages:

The raised floor method has high capacity. The entire floor is totally accessible. Cable can be laid or pulled into place and be dedicated to a specific area.

Cable placement is quick and relatively safe.

It is probably the most flexible of all wiring designs. Relocation costs are minimal, and subsequent wire addition costs are low.

The raised floor may qualify for ITC and fast depreciation.

Disadvantages:

The cost of floor material is initially high.

It requires a depressed slab or ramp up from the raised floor core area.

Power wiring requires metal conduit.

Periodic floor leveling is required.

Safety problems may be encountered when plates are removed for maintenance.

There is limited security due to easy access of the cable network.

Underfloor conduit systems. An underfloor conduit system consists of a number of conduits built into the floor radiating from a communication closet location to potential phone locations in the floor, walls, or columns of a building. Proper conduit sizing and routing for present and future growth is of utmost importance. This system finds favor for relatively small buildings or small work environment areas in high-rise buildings having a need for few telephones.

These are some general guidelines for underfloor conduit placement.

Underfloor conduit should be placed in shortest straight runs wherever possible.

No section of conduit run should be longer than 100 feet or contain more than two 90-degree bends unless pull boxes are placed.

Bends in conduits and in particular conduits larger than 2 inches should be long-sweep radius bends wherever possible and practical. In no instance should the inside radius of bend be less than six times the internal diameter.

A pull wire should be left in all conduit runs exceeding 100 feet in total length.

Don't place conduits over or running adjacent to boilers, incinerators, hot water and steam lines, or storage of flammable materials.

PVC conduit should not be placed in the floor slab.

Aluminum conduit should not be used in sizes greater than 2 inches.

Advantages

There is low initial cost for low concentration of telephones—public phones, information desks, and so on.

Underfloor conduits can be used to extend underfloor ducts to an outlet location.

Disadvantage: Limited flexibility

Poke-through. Poke-through is a wiring distribution system (power or telephone) in which through-floor penetrations are made, allowing wire and cable to pass from the floor above to the air handling or ceiling areas of the floor below. It can be used in either steel or concrete structures.

Advantages

Initial costs are low. Costs are delayed until occupant is ready to move in.

There is design freedom to place initial services exactly where desired.

Disadvantages:

Capacity is limited. U.L. Fire Code restricts poke-throughs to one per 65 square feet and no closer than 2 feet on center.

Structural damage is caused by hole drillings.

Employees are disrupted; there is noise from core drilling and frequent movement of personnel.

Relocation costs are very high on a per-unit basis. Frequent relocations can expect high life-cycle costs. Also, core drillings are expensive.

There is a limited ability to penetrate floors in certain areas, such as over beams or column caps.

Concrete floor may need to be thicker to maintain structural integrity.

Occupants on one floor may refuse to allow disruption by workers who are providing service to the occupants on the floor above.

Limited security since cables may be accessed from floor below.

Ceiling distribution systems (exposed). Cables and wires are placed within the ceiling space and are brought down to the user locations inside telepower poles or in either fixed or movable wall partitions. Ceiling systems should be carefully planned by the architect, consulting engineers, or owner to assure that all services are to be placed in it. It should provide a suitable method for supporting telephone cables from terminal to floor area to be served.

When the air plenum area normally above the false ceiling grid is to be used as a wiring distribution system, the local and applicable NEC codes should be investigated. Fluoropolymer plenum cables and/or providing conduit is required. Plenum cables are discussed later in this chapter.

Ceiling tiles to be selected should be easily removable, such as lay-in type on either single- or double-T rails. Lock-in type, not readily removed, may require additional labor efforts to access the cable network.

Advantages

Ceiling distribution is an aesthetically pleasing alternative method of concealing most cables.

Distributing the cables to user locations is flexible.

Cable lengths are kept to a minimum.

Cable can be dedicated to serve a specific floor area.

System cables and wires can be quickly and easily placed at required locations before a ceiling is installed.

Additional wires and cables can be easily placed with a minimum of inconvenience. However, the ceiling area must be easily accessible.

Disadvantages

Inadequate clearance may exist to route wiring (less than 3 inches) under air conditioning ducts, electrical boxes, or lighting fixtures in some types of luminous ceilings.

Telepower poles may be aesthetically unacceptable.

Electromagnetic interference (EMI) may be experienced, especially with data transmission picked up from some electrical fluorescent fixtures.

Other workers in the ceiling area may interrupt communication services.

Moving power poles may damage ceiling tiles. The repair of the ceiling may cause a patchwork effect in the ceiling. Also, dirt and debris may be deposited on surrounding furniture when ceiling tiles are removed and replaced.

Office employees may be exposed to safety hazards and work interruptions when workmen are working on ladders during normal working hours.

Ceiling grid system. A ceiling grid system is comparable to the underfloor distribution system (consists of header and distribution ducts), except they are mounted in the ceiling space. The cables can be placed into this duct system by removing the ceiling tiles. Planning requirements are the same as those for the ceiling distribution systems (exposed). The cables are brought down from the distribution ducts by using telephone take-off fittings and utility poles or conduits.

Advantages

Advantages are the same as for ceiling distribution systems (exposed).

It can also be used to energize lighting as well as to provide cabling to communication devices.

Disadvantages

The disadvantages are the same as for ceiling distribution systems (exposed).

Surface raceway (exposed). Exposed surface metal raceways (can be a combination of communication and power cables) can be placed around the perimeter of rooms or offices if all communication devices can be served from the wall. Raceways are mounted to walls and ceilings and provide a variety of outlet boxes for activation of services. Wire access is facilitated by removable coverplates. Communication cables should use metal raceway for shielding and are usually fed via cables in conduit. This system is a primary means for adding services for renovation and refit where placement in walls would be cost prohibitive.

Advantages

Security is provided by offering a raceway to store communication cables.

Wire management is accomplished. Accessible raceway channels are provided.

Initial costs are low. Installation on walls much easier than within wall.

Renovation/retrofit costs are low. Relocations are eased with an easily accessible raceway.

Disadvantages

Capacity is limited. This system is best used as a supplementary distribution system, not as a primary feeder system.

Flexibility is limited. Services are limited to wall mountings.

Aesthetics are poor where the raceway does not blend with other office systems.

Flat undercarpet cabling systems. This system represents the latest technology for horizontal wire distribution methods for both power and communication cabling. This cable wiring system is designed to be installed directly on a smooth structural floor in conjunction with modular carpet tiles having compatible components (i.e., connectors and accessories). Cabling is secured to the floor by tape. Special metallic shielding is required for power wiring. The entire undercarpet cable concept requires individual design considerations that involve connection to round distribution cables being interconnected to flat undercarpet cables via flat cable transition boxes.

Care must be exercised in layout so the undercarpet power cabling does not cross over itself or other cables and so the number of duplex recepticles per run remain within the electrical code guidelines. Telephone and coaxial data cable design should marry itself to the initial power layout.

Utilization of this cabling system also requires a close coordination of all the general building trade workers. It is imperative that workers be through and out of an area before placement of undercarpet cabling. Power wiring traditionally gets placed first, followed by the communications and data wiring. The only jobs that should remain after the cables have been installed are afixing modular carpet tiles over the cables and placing office furniture and equipment.

Undercarpet cabling systems require proper wire management. Future flexibility of office rearrangements will rely heavily on this concept.

Advantages

Flexibility, easy installation, and economy are the essential benefits.

The office planner is allowed the ultimate in design flexibility. Power, telephone, and data equipment can be placed virtually anywhere on the floor, depending upon user needs.

Flat cable may qualify for both accelerated depreciation and investment tax credit.

Undercarpet cabling is surface mounted, thus the floor integrity is preserved. Fireproofing costs are substantially reduced and in some cases eliminated.

Disadvantages

Incremental cost of carpet tiles required by the National Electric Code for the power wiring is usually higher than that of broadloom carpeting.

Aesthetics may be reduced by the requirement of pedestal floor monuments.

Stacked cables can cause lumps or read-through in the carpet and bring about nonuniform carpet wear.

Satellite closets. A satellite closet is a suitable enclosure for terminating horizontal cable facilities. Its purpose is to minimize lengths of communication station cables within a floor area. Unlike apparatus closets, satellite closets usually do not contain communication relay and power equipment. Their primary use is to provide cable terminating facilities (i.e., connecting blocks) for minor telephone system services, station (telephone) and central office, PBX, or centrex lines.

HIGH-RISE BUILDING WIRING—SHARED COMMUNICATION CABLING NETWORKS

Communication Cables

Voice networks usually include telephone, intercom, and paging service combined into one system. This voice or telephone network includes the switching equipment necessary to connect the telephones in the network to each other and to telephone company central office lines. For high-rise buildings, these generally consist of a digital Private Branch Exchange (PBX) switching system.

A PBX consists of common equipment (a switchboard or switching equipment shared by all stations), station equipment (usually telephone or key telephone systems), and wiring connecting the common equipment and the station equipment.

In the past, cable's sizes could be as large as 400 pair. The cable was unshielded and usually was in 25-pair increments to interface between the console, the switch, and the telephone. Often it was standard to wire business locations with 25-pair cables to all telephones. Telephones could then be installed with minimum effort, and no further wiring would be required in the future. It worked well for the telephone company, since the cable was in their rate base. However, four contributing factors have changed this philosophy to favor installation of smaller-sized cables today:

Increasing equipment vendor competition.

Technological advancements are short lived and take two to three years to develop.

Deregulation of station wiring previously discussed and removal of the wiring from the telephone company rate base.

Technological digital electronic advancements.

Digital electronics has substantially reduced cable pairs required for electronic systems in the marketplace today. These digital advancements have increased the demand for unshielded three- and four-pair inside cables and four-conductor station wire.

Today, in high-rise buildings shared communication systems have begun to predominate because:

Proliferation of equipment, terminals, and workstations that create pockets of automation.

Emerging higher data speeds and packet switching.

Long-term multivendor environment dictating format/protocol conversions.

Advantages of sharing expensive resources via switching that includes modems, time-shared ports, and protocol converters.

Shared communication services include:

Voice communications.

Long-distance communications.

Data communications.

Message centers or centralized answering.

Voice mail.

Switching and Local Area Networking (LAN).

Teleconferencing.

The use of shared communications or shared tenant services is successful because "sharing" is transparent to the user, which results in an integral enhancement of the office work environment. Cost benefits are realized universally when one cable network is shared, utilizing one communication system. The concept is simple: one buildingwide system is installed by the building owner or by a third party; it is then remarketed by the owner or third party to the building tenants. Through deals with real estate developers, some shared tenant services installations have become known as intelligent buildings. These buildings are networked for voice and data communications during construction and the services are sold along with the office space lease. Many people predict that integrated voice/data networks built around advanced digital PBX technology is key to the evolution of shared tenant services and automation.

Before becoming enthralled by the buzzwords *tenant shared telecommunications* and intelligent buildings, one should keep in mind that 80 to 90 percent of in-building communication traffic will be voice grade, requiring only unshielded metallic paired communication cables. One may also wish to consider Planning Research Corporation's (PRC), a large consulting research engineering and development company, new headquarters building leased from Farm Credit Administration in the Tyson-McLean Office Park in McLean, Virginia. See Chapter 9.

Polyvinyl chloride materials. High tech buildings commonly require a large number of stations or telephones. Therefore, it is desirable to use multipaired inside cable constructions in lieu of many individual station wires bunched together. Designs of this type are commonly referred to as unshielded inside wiring cables. They are generally used today in sizes ranging from 3 through 25 pairs, depending on tenant end-use requirements. Inside wiring cables are composed primarily of 24-AWG copper conductors insulated with flame resistant, semirigid polyvinyl chloride (PVC), which encounters harsh compressive and abrasion forces when being terminated in distribution boxes and cabinets. Essex Telecommunication inside cables—type Inside Cable Positive Identification (ICPI)—have their cable pairs "positive identified" by colored insulation on the conductors and band markings. Color coding is helpful in the event that conductors of a pair become separated during installation. A staggered-pair lay system is utilized to minimize cross talk between circuits. Usually the core is held together by means of a nonhygroscopic yarn or polypropylene core binder tapes. A high-strength polyester rip or slitting cord is placed parallel to the core, over which a neutral colored (beige or gray) PVC outer jacket is applied. The slitting cord is used as an aid in removing the outer jacket during wire termination.

Communication cable design-fill capacities—enclosed raceways. The cable design-fill capacity for communication cables with a closed raceway, such as duct and conduit, should be limited to 50 percent of the cross-sectional area of that raceway. This would also include a combination of cable sizes being placed within a raceway. This is to allow for frequent rearrangements and additions normally required for those wiring networks. The cross-sectional area of typical communication cables used today are shown below:

Description	*Number of Conductors*	*Approximate Cross Section (square inches)*
4-conductor 22 AWG Station Wire	4	0.02
6-pair 24 AWG Inside Cable	12	0.04
12-pair 24 AWG Inside Cable	24	0.07
25-pair 24 AWG Inside Cable	50	0.12

Typically, the number of inside communication wiring and cables recommended for conduit applications are:

	Conduit Size (inches)								
Description	*¾*	*1*	*1¼*	*1½*	*2*	*2½*	*3*	*3½*	*4*
4-conductor 22 AWG Station Wire	6	8	16	20	30	45	70	90	135
6-pair 24 AWG Inside Cable	3	6	10	15	20	30	40	55	77
12-pair 24 AWG Inside Cable	2	3	6	7	14	17	30	35	42
25-pair 24 AWG Inside Cable	1	2	3	4	7	12	17	22	30

Fire codes: Fluoropolymer materials. Concern for building environment safety has increased markedly due to recent highly publicized fires. One result has been increased attention to the plenum area or chamber of these commercial and industrial buildings. Defined as the space between the drop ceiling and the floor above, plenum space is continuous throughout the length and width of each building floor, which is illustrated in Figure 17–2.

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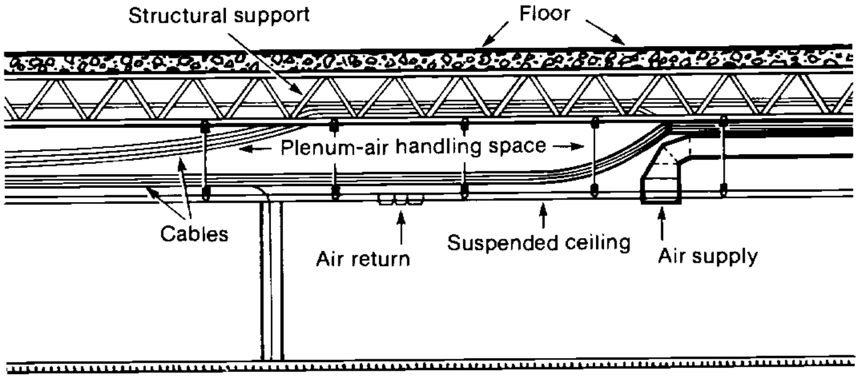
FIGURE 17–2
Building Plenum Area



Courtesy of Allied Fibers & Plastics.

Plenum chambers, when used for heating and cooling systems, can spread fire quickly. The presence of large volumes of air limits the effectiveness of emergency signaling equipment wired through this area. The areas also generate large amounts of smoke on upper floors. Thus flammable material inside the plenum should be of low flame and low smoke generating materials.

The National Fire Protection Association in 1975 recognized the potential fire hazard of the plenum area. Their National Electrical Code (NEC) asserted that all electrical cable used in plenums must be either metal sheathed or placed in conduit (Articles 300–22 [b] and [c]). Included was cable for the following uses: telephone, data, fire alarm, burglar alarm, Muzak, signal.

An exception to that code allowed use of a low-voltage or signal cable when developed without conduit if it "classified as having adequate fire resistant and low smoke producing characteristics." This exception was affirmed in 1978 by the code writers, who added the term *listed* to the exception to signify that an authority must test and approve such cables. These exceptions in the 1978 NEC Code included: Article 725–2b (Remote Control Signaling and Power Limited Circuits); Article 760–4d (Fire-Protective Signaling Systems); Article 800 (Communication Circuits); and Article 820–15 (CATV).

In 1978 Du Pont and others with Underwriters Laboratories designed the test method to measure flame spread and smoke generation of wire and cable used in plenum areas without conduit. This test (a variation of ASTM's E–84 and UL 723) was called the Modified Steiner Tunnel Test, or UL's

910 Tunnel Test Method. The same year Du Pont received approval for their Teflon material. Teflon is the Du Pont brand name for their flouropolymer material. The test has now been accepted by the National Fire Protection Association as the classification system for plenum cables.

Since that time other fluoropolymer materials have been approved:

Chemical Designation	*Trade Name*	*Manufacturer*
FEP, fluorinated ethylene propylene	Teflon®	Du Pont
ECTFE, ethylene chloro-trifluoroethylene	Halar®	Allied Company
ETFE, ethylene tetrafluoroethylene	Tefzel®	Du Pont
PVDF, polyvinylidene fluoride	Kynar®	Pennwalt
PVDF, polyvinylidene fluoride fluorocopolymer	Solef®	Soltex

Numerous states and cities subsequently approved use of plenum cable without conduit. However, approval does not necessarily mean it is required in those places. The National Electric Code is a model code, and therefore its provisions are only applicable when adopted by local building authorities. Some locals still require a variance before fluoropolymer plenum cables can be placed.

Plenum cable pair sizes and gauge duplicate those being offered with PVC jacket and conductor insulations previously discussed. The only exception is that pair sizes generally stop at 100 pair.

Data Networks—Coax and Shielded Cables

Local Area Networks (LANS) are providing for the integration of computer and communication technology for efficient information (or data) processing, handling, collection, and distribution. Regardless of the LAN topologies (such as the bus, ring, tree, or star network), cabling is the key element that provides for distribution and communication throughout the LAN. Both coaxial and twisted-pair cables (shielded or unshielded) are utilized after a careful study of system data speed and electrical requirements. Most Local Area Networks are proprietary, although connections to equipment by many vendors is possible. Ethernet and Wangnet are examples.

Shielded cables come in many constructions. There are cables with aluminum/polyester foil shields, braided copper shields, spiral copper shields, and shields made of semiconductive textiles and tapes. Each type has its own distinctive set of physical and electrical characteristics. For example, braided copper shields have high tensile strength, whereas spiral copper shields usually provide better coverage in flexing applications and are also easier to terminate. Both are recommended at audio frequencies, but the requirements of the application dictate which one to use.

A single shield is all that's required in many types of applications. However, in applications where the protection of signal integrity is critical, the use of multiple-shield configurations is often recommended. For example, braided copper shield provides good protection against electromechanical interference (EMI), whereas aluminum/polyester foil shielding is better at screening out radio frequency interference (RFI). It often takes a combination of both types of shielding to provide computer cable with adequate protection against both EMI and RFI.

Where the type of data communications system to be installed is known, the installation and physical planning manuals for that system should be used. Using vendor manuals assists in determining the wiring configuration and the number and type of cables to install.

Data cable design-fill capacities—enclosed raceways. The practical design-fill capacity of enclosed raceways for data communications cables should be limited to 40 percent of the cross-sectional area of that raceway. As with voice communication systems, data communication networks normally have a high amount of rearrangement and additions. Initially limiting the fill capacity to 40 percent allows future retrofit and expansion of the data communication system. The following example shows the cross-sectional area of some typical data communication cables used today.

Cable Type	*Cross Section (square inches)*
Data twisted pair (two pair)	0.070
Coaxial	0.046
Twinaxial	0.096

IBM Cabling system

IBM introduced the IBM Cabling system in 1984 to meet today's trend of more and more users accessing on-line information for payroll accounts receivable, and order entry applications. Today, as this trend continues, data terminals and peripheral devices are appearing in nearly every work space, necessitating more complex interconnection combinations.

The IBM cabling system provides for the interconnection of a variety of data information processing equipment located in a building or a group of buildings at a specific site location. It can optionally provide elements of the telephone wiring system of a building.

The cabling system is not a local network but a cabling plan based on balanced twisted wire pairs that will enable users to contend more easily with cabling problems associated with the proliferation of end-user devices. Once installed, the wire would be ubiquitously available and would eliminate the need to run cables every time new terminal equipment or small systems are installed. The basic premise behind this system is to provide an outlet in each office into which devices can be plugged. These outlets are connected via a standard type of balanced twisted wire pair to distribution cables, which are connected to a central computer room. It's comparable to telephone system wiring. According to an IBM statement of intention, the cabling system will eventually serve as the medium for a token-ring LAN that the company will provide within two to three years.

IBM indicated that this uniform cabling system allows a building to be prewired for data devices during building construction or renovation. Benefits of a prewired building include the following:

- New devices can be quickly installed.
- Devices can be easily relocated from one work area to another work area.
- Networks can be readily reconfigured at wiring-concentration points.
- Costs of device installation, relocation, and reconfiguration can be reduced in many cases.

One disadvantage noted already is relative inflexibility when being relocated. In addition, the system does not include coaxial cable that is the standard for communication with IBM mainframes.

The IBM Cables are available for data and telephone communications. Cables are available in a plenum version for installation in plenums, ducts, and spaces used for environmental air. The IBM cables also come in a nonplenum version, and in an outdoor version. IBM also offers versions which include up to two optical fibers along with the twisted pair copper wire.

Optical Fiber Systems

The use of optical fibers within a high-rise building has received considerable media attention of late. However, it appears that use of fiber cables for this purpose is somewhat limited now and in the foreseeable future. Their use would be for LANS in limited specific locations and for vertical-riser communication and data cable placements. The high bandwidth (range of frequencies within which a fiber optic cable or terminal device performs) is not necessary for a majority of installations.

A typical optical communication link transmits conversions in the following manner: Customers' voices entering an optical link first pass through a "pulse code modulation" system that converts their normal analog speech signals into "binary digits"—pulses—which are assigned to individual "time slots" for transmission to the other end of the cable. The streams of very short electrical pulses, similar to those used in computers, then enter a tiny laser, which transforms them into infrared light pulses and sends them through the glass fiber.

At the receiving end, the light pulses are "seen" by a light detector—photo diode—and converted back into electrical digits, which are fed into another pulse code modulation system. This PCM equipment decodes the electrical pulses and reconstructs the customers' voices, which then are routed through the communication network to the listening parties.

Conversations are carried over two fibers working in pairs: one strand transmits voices from one end of the link, while the other carries voices from the opposite end.

Fiber types. The fiber commonly used for high-rise building applications is multimode, graded index fiber. Multimode fiber has a relatively large core and allows light pulses to zig-zag along many different paths. It is ideal for light sources larger than lasers, such as light-emitting diodes. This fiber offers low loss and high bandwidth. It costs only slightly more than plastic fibers and has much better performance, which allows a tremendous increase in system information capacity and flexibility of application.

Single mode systems, although offering more bandwidth, are prohibitively expensive for use in LAN applications, primarily due to the cost of single-mode lasers and connectors. Single-mode fibers have a very slender core that confines light to a single path. Therefore, the most cost effective fiber (and system) able to support typical system loss and bandwidth requirements incorporates multimode, graded index fiber.

Signal sources. Light Emitting Diodes (LEDs) are the sources usually used in these applications. They are cheap, have long life, and are capable of supporting typical system data rates. Lasers, the other principal fiber optic signal sources, are expensive, are temperature sensitive, and have shorter lives.

Fiber cables. A wide variety of cable designs and sheaths match the fiber count requirements and location requirements of the cables in the high-rise building. These cable types include:

Riser cables. These handle large fiber counts (more than 12) and have heavy, flame retardant sheaths. They can be in stranded or ribbon configuration. They are used in buildings and can support their own weight in a vertical position. They are used in riser shafts, in conduit, or in floors. They can be used for distribution between or among floors.

Distribution or drop cables. These have medium fiber counts (generally up to 12), medium sheath strength, and are flame retardant. They have buffered fiber, permit direct termination with connectors, and are used as a distribution cable within a building.

Jumper cables. These have low fiber counts (up to four) and relatively low sheath strength. They are flame retardant, and the connectors can be mounted directly. They are used for short interconnections between equipment. They are used principally in floors, on floors, in conduit, and from wall jack to equipment.

Plenum cables. These carry a medium fiber count (up to 24) and are medium strength, low smoke, and flame retardant. They offer buffered fiber and stranded designs to permit direct termination with connectors. They are used in plenum (ceiling) and/or walls as distribution, feeder, or interconnection cable.

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Chapter 18

Legal Issues Involved in Real Estate Telecommunications Ventures

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Outline

The deregulation of the telephone industry, the breakup of AT&T, the rapid development of new telecommunications technologies, and the increased demands of businesses for the transmission of information have all presented new opportunities to owners, developers, property managers, and tenants of commercial real estate. These opportunities include the provision of telecommunications and other related services to tenants.

Until the breakup of AT&T, owners and developers, in practical terms, needed only to interact with the local telephone company, which would dictate the needs and requirements for building design and engineering, with which the owner/developer would then comply. The telephone company would install switching equipment, install and own wires and cables through the building, install equipment and telephones for tenants, handle all service and maintenance requests, handle all billing of tenants and collection, and ultimately assume almost all liability and responsibility if telephone service was not provided.

Most telephone service and equipment was provided under tariffs filed with regulatory commissions. Accordingly, few real estate owners and developers or their counsel faced the legal issues involved in telecommunication agreements. In addition, new legal issues have been introduced as a result of the impact of certain aspects of landlord-tenant law.

This chapter will explore some of the legal issues present in telecommunications real estate ventures and, in particular, shared tenant services agreements. Not only owners and developers, but also tenants and the telecommunications companies, need to be aware of these issues. Because of the variety of proposed and existing business and legal relationships and the variances in the sophistication, financial stability, technological experience, motivation, and independence of the parties entering into the agreements, it is impossible to propound exactly how the parties should resolve the issues discussed herein.

Although novel to real estate developers and owners, many of the issues involved in telecommunications agreements have evolved over a period of time in other related legal and business specialties. For example, lengthy and comprehensive agreements between users of PBX systems and manufacturers of the equipment are common, particularly if the user is a major corporation experienced in purchasing PBXs and telecommunications services. There is a surprising similarity between these agreements and computer services and equipment agreements.

Real estate owners, developers, and tenants are in a position similar to the position of new computer users 10 years ago. Users were unsophisticated as to the business, technical, and legal issues, and their lack of sophistication has in some part led to the amount of computer-related litigation in the courts today. Agreements that promise little in the level of service, maintenance, or reliability and then attempt to limit all liability or responsibility on the part of the vendor or service provider may provide psychological comfort to the vendor when the agreement is executed, but may be of limited value when tested in court or in practice.

Many options are available to owners and developers when considering the provision and use of telecommunication services. These are some of the options available.

1. Continue to leave the selection and use of the telecommunications provider to the option of the tenant, and invite the local telephone company to be the primary provider of, or intermediary for, service.
2. Provide shared tenant communication services to tenants through the shared use of switching equipment by either of the following:
   a. Purchasing or leasing the equipment and providing the services directly to the tenants on either a profit or nonprofit basis.
   b. Entering into a management agreement with a telecommunications services company to purchase, lease, install, and maintain the equipment and provide the services to the tenants on behalf of the owner.
3. Enter into a joint venture partnership with an experienced telecommunications company, or the local telephone company, either directly or through a subsidiary of the developer.
4. Form a subsidiary of the developer to independently provide these services in buildings owned by the developer, as well as in buildings not owned by the developer. As a variant, a telecommunications company can be a co-owner of the subsidiary or a joint venturer with the subsidiary.
5. Obtain an equity position in a joint venture with a telecommunications partner, leaving all management to the telecommunications partner. The joint venture would have an exclusive franchise to provide shared tenant and related services in the developer's building or buildings.
6. Assign to a telecommunications company the exclusive franchise to provide services to tenants in a building, with the owner receiving a percentage of either gross or net revenues, under a percentage net lease or a separate agreement.
7. Create a building telecommunications utility network involving numerous special telecommunications rooms, rooftop satellite and microwave platforms, and conduit and cable systems; lease or license the use of these facilities to telecommunications companies and/or tenants.

As can be seen, the variety of relationships is endless. However, there are certain issues which arise in all of these situations.

WILL THE TELECOMMUNICATIONS VENTURE BE A REGULATED ACTIVITY?

A threshold issue is whether the telecommunications venture is or may become subject to direct regulation by the FCC or state regulatory agencies. These issues are considered elsewhere in this book in more detail. However, the developer who expects to provide shared tenant services to a tenant should carefully review the present and proposed regulations with respect to the resale of local and long-distance telecommunications services, especially if the developer expects to earn a profit on the resale of these services, or if property lines or public ways are crossed. There is considerable activity at the state regulatory level today. Although one may be tempted to dismiss some of these activities as attempts by local telephone companies to thwart competition, the issues are not so simple. Regulators are concerned with assuring the continuity of quality service at reasonable costs to consumers. There also are concerns as to cross-subsidization by the telecommunications companies.

Finally, there is a concern to protect business tenants from overcharging and inadequate service. This last issue is important: If providers of shared tenant services engage in overcharging or provide unreliable service, it is conceivable that areas currently deregulated could become reregulated in the future. Accordingly, developers should carefully examine their financial exposure and expectations to ensure that unexpected regulation will not cause unexpected financial exposure. Furthermore, the developer, if in a joint venture, should assign regulatory responsibilities to the telecommunications partner and obtain an indemnification should the telecommunications partner not perform its regulatory obligations.

SUBSTITUTION OF WRITTEN AGREEMENTS FOR TARIFFS

Prior to the breakup of AT&T and the deregulation of many telecommunications services, telephone company customers rarely entered into comprehensive written agreements for equipment or services. However, in most cases, the equipment and services were provided pursuant to tariffs filed with the FCC or appropriate state regulatory agencies, and the obligation of the telephone company was to provide services and equipment in accordance with those tariffs. Not only did the tariffs establish the rates at which the services and equipment would be provided, but they established certain standards of service for the telephone companies. The levels of service depended in part on whether the regulatory body or the major users forced the telephone companies to file tariffs that provided provisions protective of customers. In addition, many tariffs established limitations of the liability of the telephone companies. Accordingly, when a customer entered into a service agreement or placed an order with the telephone company, extensive tariff provisions were called into play in lieu of negotiated contract provisions.

If shared tenant services are provided to a tenant and are not regulated, then there are no tariffs to flesh out the obligations of the parties. Accordingly, owners and tenants should assume the nonapplicability of tariffs and should assure themselves that their agreements fully set forth the obligations of the telecommunications companies. This is especially true to the extent that tariffs can change over time. In addition, if tariffs are applicable, neither tenants nor developers need to assume that applicable tariffs are sacrosanct, nor that they are prevented from demanding a level of service better than that provided under the tariff or from asking the regulated entity to file a new tariff.

LEASES, INDEPENDENT COVENANTS, AND LIMITATIONS OF LIABILITY

One issue to which developers, owners, and lenders are particularly sensitive is the potential liability of the owner to the tenant in the event of poor telephone and other telecommunications service or the interruption of that service. Most owners and lenders have found it best not to provide shared tenant services under the real estate space lease, as discussed below. Both owners and telecommunications companies have utilized broad clauses limiting their liability.

Irrespective of whether an owner delivers the services directly, through a joint venture, or through a contract with an independent operator, certain legal issues relating to liability will have to be confronted and resolved. If the owner elects to provide the services under the space lease, of particular concern is whether the tenant's obligation to pay rent and the owner's obligation to furnish the services in accordance with the space lease are dependent or independent covenants.

Covenants are dependent where performance by one party under a covenant is conditioned on and subject to the other party's performance under its covenant. The party seeking performance by another in such a case must prove performance or a tender or readiness to perform on its part. When actual performance under a covenant of one party, however, is not dependent on the other party's performance, the covenants are deemed to be independent. Until a party shows performance of a dependent covenant, it may not hold the other party liable for failure to perform its covenant. It is no excuse for a party that failed to perform an independent covenant to allege as a defense that the other party failed to perform its covenant. The courts have taken the position that dependence or independence turns on the intentions of the parties when they negotiated their agreement. Acccordingly, suppose an owner provided shared tenant services under the space lease, or the obligation in a separate agreement was construed to be a dependent covenant of the lease obligations. In both cases there is a risk that if the telecommunication services are not provided properly, then the tenant may stop paying rent, claiming that its obligation to pay rent is dependent on the obligation of the owner to provide telecommunications services.

If a space lease is properly drafted, courts have tended generally to favor landlords in these disputes—partly influenced by the needs of mortgage lenders, who cannot risk the interruption of rent for reasons other than the continued availability of the real estate.

Accordingly, most owners and telecommunication companies have elected to expressly exclude telecommunication services from the space lease and to provide the services under a separate agreement, complete with limitations of liability. Owners have attempted to isolate themselves from the risk of nonperformance and liability by having the services provided through a separate legal subsidiary or through one of the joint venture structures described earlier.

However, having taken these formalistic steps, owners have then proceeded to market their real estate emphasizing the availability of state-of-the-art telecommunications. They have even directly marketed the telecommunications services to tenants, accepting tenant orders and ultimately sharing in the profits of the telecommunications ventures. Accordingly, notwithstanding provisions in the space lease or in the telecommunications agreement executed by tenant, due to the above activities of the owner, the tenant may prevail in claiming that the services are part of the services required under the space lease, or that the obligation of the tenant to pay rent is dependent upon the owner's obligation to provide the telecommunications services.

Assuming the services are provided or construed to be provided under the space lease, then the tenant may attempt to withhold rent or terminate its lease, alleging constructive eviction. Presumably, owners would rely on an independent covenants clause and the very broad hold-harmless clause in the space lease as a defense. However, to the extent that the services are seen as essential to the conduct of the tenant's business, courts are willing to view interruptions of such services as a constructive eviction of the tenant from its space. Generally, if the owner disturbs the tenant's possession of its space so as to render the space, in whole or in substantial part, unsuitable for occupancy or unfit for the purposes for which it was leased, the tenant may elect to deem the owner's action a constructive eviction and surrender its possession of the space. However, courts normally require the tenant to demonstrate that its use and enjoyment of the space was so materially and substantially impaired that it was compelled to vacate.

For example, courts generally hold that the willful failure to furnish elevator service is a constructive eviction of a tenant who moves out, but that mere irregularities in such service do not constitute such an eviction.

Even though the service may not be construed as a service provided under the space lease or as a dependent covenant, the owner may still be liable for damages to the tenant. Assuming the provider of telecommunications services is sued by a tenant due to inadequate or interrupted service, the limitation of liability contained in the space lease (if the services are provided thereunder) may be more or less effective than the limitation of liability contained in a separate contract (assuming a separate contract structure is chosen). The choice depends on the state involved and enforceability of limitations of liability under state landlord/tenant law as compared with state contract law. The Uniform Commercial Code (UCC) may also apply if the equipment lease is viewed to be essentially a contract for the sale of the equipment (or the mixed sale of equipment and services, with equipment predominating), bringing into play the doctrines of impossibility of performance, commercial impracticability, and the like.

If the UCC applies, implied warranties of merchantability and fitness for a particular purpose under certain circumstances might be read into the telecommunications services contract unless conspicuously disclaimed. Other provisions of the UCC may also apply to fill in gaps in the contract (usually to the benefit of the buyer-tenant) or to override the contract terms (as where the court views them to be unconscionable). Also, in certain states, such as Mississippi, liability under implied warranties may not be able to be fully disclaimed if the UCC applies. Finally, the statutes of limitation on actions by tenants may be different depending on whether state landlord/tenant laws or contract/UCC laws apply.

Owners should determine that they have adequate rent and liability insurance to cover possible claims by tenants and that the telecommunications provider has such insurance and has named owners and any secured lenders as additional insureds. Assuming the equipment is supplied by various manufacturers, affixing blame for a business interruption may be quite difficult, and the manufacturers' warranties should be examined closely. An indemnification from each manufacturer is desirable, if obtainable.

SECURED LENDER APPROVAL

An owner should not omit to secure appropriate prior approvals from secured lenders for the proposed telecommunication delivery structure. A secured lender will likely seek assurances that the actual provider of telecommunications services has appropriate regulatory approvals and that the services can continue to be provided to tenants, even in the event of casualty or the bankruptcy of the telecommunications provider. Indemnification from the telecommunications provider may also be required by such lender.

In any event, the owner should review its mortgage documents early in the negotiation process with the telecommunications company. Most mortage documents set forth certain requirements and mandatory clauses that must be included in all leases and long-term management agreements to which the owner is a party with respect to the mortgaged premises. The owner's counsel should review the telecommunications agreement to ascertain whether it incorporates a lease of space (such as a telecommunications room, conduit space, or a roof-type satellite antenna platform) or is a long-term facilities management agreement. Most mortgages will require that leases contain subordination and attornment clauses. The mortgage may require that the lender be given notice of, and the right to cure, defaults under leases and long-term management agreements. Further, the mortgage may require that the lender approve these agreements. In such case, the owner may wish to consult with the lender during the negotiations with the telecommunications company to ascertain whether the lender has any requirements not contained explicitly in the mortgage. If anything, advance notice to the lender may preclude the lender from subsequently vetoing the agreement after it has been negotiated by the owner and telecommunications company. Likewise, the telecommunications company may desire to include conditions that lender approval be obtained, so that if the lender forecloses on the building, the telecommunications company does not find that its contract is disavowed.

GENERAL LANDLORD/TENANT AND LEASE REQUIREMENTS

With the advent of shared tenant communication services and enhanced engineering and architectual features, owners should review standard form space leases to be certain that the following issues are addressed:

1. There is a clause that makes it clear that any telecommunication service provided by the owner or a company with which the owner has a contract is an independent covenant.
2. There is a clause that makes it clear that the tenant was not required to agree to any shared tenant services as a condition to accepting the lease (assuming this is the case).
3. There is a clause waiving any claim or rights against the owner on the grounds that the owner marketed the telecommunications services to the tenant (assuming the owner is not the provider of services).

In addition, the owner and the tenant alike should clarify certain issues, which should be included in the lease. The owner may seek to obtain additional income by separately charging for certain facilities, such as: conduit space and cables; telephone closets; basement or other telecommunications room; clean and uninterruptable electric power for PBXs, computer rooms, and desktop computers.

Accordingly, the owner and the tenant need to review those provisions of the space lease relating to utilities and air conditioning and, with the assistance of engineering advice on each side, ascertain that the power, telecommunication conduit, air conditioning, and other facility needs are met. For example, many tenants have in recent years executed space leases that imposed vague or insufficient electric energy obligations on their landlords; these tenants have suffered as office automation has spread throughout the modern office. It is incumbent that the tenant's engineer review with the tenant's counsel the obligations of the landlord as stated in the space lease.

An owner also needs to review the insurance requirements the space lease imposes upon a tenant. It is common for the standard form space lease to require that the tenant maintain casualty insurance covering the value of the tenant's property and installations. This is because the probability that the landlord will be sued by an injured tenant is minimized if the tenant has such insurance. (The probability of suit by the tenant's insurance company is reduced if a waiver of subrogation clause is required.) An owner who is providing telecommunications services to a tenant may consider requiring the tenant to carry business-interruption insurance to protect the tenant from loss in the event of lack of telecommunications services.

An owner probably will have to provide space for on-site maintenance, conduit and PBX facilities, and possibly rooftop space for a microwave dish. If an independent operator or third-party joint venture is involved, a lease for the space will be necessary. The lease should include all normal lease terms, including subordination clauses where required by any financing documents, and should require the provider of the services to properly shield the microwave dish, if any, and properly maintain its equipment. As part of this structure, the owner, at a minimum, will be responsible for providing special HVAC for the equipment, presumably at the expense of the provider of the services, and to properly maintain its wiring. The owner should also require the tenant, pursuant to the space lease, to maintain the proper ambient environment for the equipment in order to reduce downtime. The tenant should be prohibited from effecting its own repairs, alterations, and so on.

From a tenant's point of view, it probably would be most beneficial to have the equipment and services provided under a separate contract rather than under the space lease so that the UCC may apply. The tenant should attempt further to include the building brochures describing the telecommunications services as express representations and warranties in the contract and, if possible, to provide in the contract that the tenant's remedies are cumulative (thus allowing the tenant possibly to avoid limitations of liability in the contract). The tenant should seek the right of self-help if repairs are not promptly made.

Where a separate contract is utilized, assigning the space lease or subletting the space should be linked with the assignment of the tenant's rights under the separate contract. The tenant will have cause for concern when the term of the separate contract is shorter than that of its space lease.

OWNERSHIP OF CABLE PLANT

Even if the cabling is installed by the telecommunications company or the tenant, the building owner should maintain ownership in the cable and wiring "plant" so as to control the basic medium for the provision of telecommunications services. Also, the owner should require the telecommunications company and the tenants to label all cabling and to maintain up-to-date cabling plans to be filed with the building engineer. Some tenants of buildings have been induced to move to new facilities because their old buildings were choked with a spaghetti-like maze of unidentifiable wires and cables. Where the telecommunications company is using a shared PBX system for a number of buildings with different owners, the owners may also have to assure themselves of the availability of easements to use spare equipment in adjoining buildings.

ASSIGNMENT CONTRACT—SALE OF REAL ESTATE, BANKRUPTCY, OR FORECLOSURE

The telecommunications company and the tenant need to be assured that the telecommunications vendor will be permitted, or will continue, to perform its obligations if (1) the owner sells the building, (2) the owner becomes bankrupt, or (3) the secured lender forecloses on the building. These concerns are even greater if the telecommunications company is independent of the owner. The telecommunications company may need to record a memorandum of its contract with the owner in order to assure itself that a new owner of the building takes title thereto subject to the rights of the telecommunications company.

SECURITY INTERESTS

The owner should also obtain a security interest in the telecommunications equipment and have the right to purchase the equipment upon a foreclosure or default of the telecommunications provider, especially if the provider has leased the equipment. The owner in such an event should also have the right to have the contracts with tenants assigned to it and have the right to cure breaches of such contracts.

Depending on whether the equipment and services are supplied under the space lease or under a separate contract, financing statements may have to be filed in favor of any third-party lender on the basis of the equipment constituting real estate fixtures or personalty. The owner should be given the right to cure defaults under the loan documents. In addition, a separate equipment lease found to be a financing device will require financing statements to be filed to protect the interest of the seller/lessor. A real property mortgagee should make a fixture filing to protect its position if the equipment and services are supplied under the space lease. In any event, tenants should be prohibited from granting a security interest in their interests in equipment and services.

REAL ESTATE TAXES

If the telecommunications equipment and services are delivered pursuant to the space lease, the value of the equipment might be included in the value of the building for purposes of real estate *ad valorem* taxes. If the equipment is supplied through separate contracts, it should not increase the value of the building for real estate tax purposes, but may be subject to personal property *ad valorem* taxes.

INCOME TAXES

If the telecommunications equipment and services were delivered pursuant to the space lease, the equipment should also increase the owner's basis in the property and therefore would be depreciated over a longer period of time as fixtures than if viewed as personalty. Equipment supplied through separate contracts would be depreciated over a shorter period of time. In any event, most of this equipment may be subject to investment tax credit treatment depending on the particular circumstances. The use of an investment tax credit may be more readily transferable to a tenant if the equipment is leased under a separate contract rather than under the space lease. Tax counsel must be consulted before deals are struck and documents negotiated.

SALES TAXES

Depending on the length of any equipment lease and the presence of an option to buy for a negligible sum at the end of the lease, the lease may be viewed to be an installment sale contract with sales taxes being imposed.

ANTITRUST CONSIDERATIONS

In order to avoid a potential charge that a tying arrangement exists with respect to the leased space and the special equipment in violation of the federal and/or state antitrust laws, the special services and equipment should not be mandatory for every tenant but should be offered on a voluntary basis. This is a marketing risk that the owner must bear, but it can be reduced by careful testing of the market and interviewing of proposed tenants. Cross defaults between the space lease and any separate services contract with the tenant should probably be avoided for this reason.

ERGONOMIC LAWS

Several states are considering legislating ergonomic and related requirements for all workplaces that contain telecommunications equipment. There may even be requirements for indirect lighting wherever visual display terminals are in use. The owner of the building may become subject to these laws irrespective of how the services are provided.

CONFIDENTIALITY

Consideration should be given by the owner and provider of the telecommunications services as to providing an encryption service so as to maintain the confidentiality of tenant transmissions.

■ CONCLUSION ■

For the owner, drafting the documents for a telecommunications venture is not a simple task of negotiating an agreement with the telecommunications company. The owner needs to consult with real estate counsel to review the basic agreement together with the space leases, the mortgage documents, and any necessary easement agreements. A form of agreement needs to be prepared that will meet the legitimate needs of sophisticated and tough-minded corporate and professional tenants. The owner needs to obtain insurance, accounting, and engineering advisers, as well as counsel, with expertise in equipment, data processing, and telecommunications service arrangements. Counsel must also be asked to review the regulatory framework. Each of these advisers and counsel needs an appreciation of the other expertises involved.

The foregoing is by no means an exhaustive analysis. For example, we have addressed neither financial and accounting aspects nor provisions for establishing the level of service expected by owners and tenants. It is hoped that this chapter will provide a guide to some of the issues that need to be considered in new real estate telecommunications ventures.

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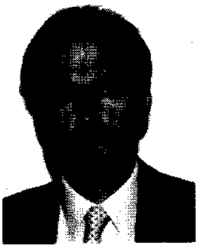

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Chapter 19

Negotiating a Shared Tenant Services Contract: The Developer's Perspective

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Outline

An oral contract, as Sam Goldwyn was wont to say, isn't worth the paper its printed on. In the shared tenant services (STS) market, few need worry about Goldwyn's warning. STS projects are seven-figure (or even eight-figure) deals. The contract entered into by a landlord/developer and a telecommunications company (the provider), under which the latter provides telecommunications services in the former's building(s), is not just written; it is usually overwritten.

This article is addressed to the developer of a first-class office/commercial building or office/industrial/research park who wishes to provide communications services to tenants but does not intend to do so entirely alone. It assumes some familiarity with the shared tenant services concept as it was being implemented in the United States in the second half of 1984. It does *not* assume a particular form of agreement. All of what will be said is applicable to "franchise" agreements, in which the provider contributes all of the capital and takes all the risk, and the developer receives a fee for giving the provider exclusive rights to serve a building. Most is also applicable to joint ventures, in which both the developer and the provider invest, and management contracts, in which the developer makes the investment and takes the risk but hires a provider to manage and operate the offering. All three arrangements can be found in the industry; although for reasons relating to the desire of real estate interests to conserve capital, franchise agreements are probably the most common.

The article also assumes that developers know what they want from shared tenant services, a leap of faith that is sometimes—but by no means always—justified. If you ask developers what they hope to get out of STS, the most common answers are (1) a more attractive building, which will lease up faster and yield higher rents in the long run, and (2) some immediate profit, usually with the least possible investment. It is only after beginning to investigate STS seriously that a developer discovers a need for some control over the offering, even if the developer is not making any investment and the arrangement is a "franchise."

The desire for control even absent investment is not surprising. Shared tenant services are in many ways unique in the real estate world, which is why shared tenant service agreements are themselves such strange animals. In one sense, entering into an STS agreement is like purchasing equipment. In another, it is like buying janitorial services. But it differs from both of these in the extent to which the developer (1) will be judged by tenants on the quality of the service delivered but (2) has relatively little short-term control over that service. You can throw out a janitor on two weeks' notice, and fix (or replace) defective equipment in a few more. But you cannot throw out a telecommunications company on short notice unless you are prepared for the possibility that your tenants' telephones will stop ringing.

An STS agreement is thus a little like a contract with an entertainer or a major architect—you are not buying a commodity; you are buying the reputation of a particular company or individual, and your success depends upon how well they live up to that reputation. That creates a desire for control that frequently complicates STS negotiations.

SOME KEY POINTS

The fundamental problem confronting a developer who is negotiating an STS agreement is that STS negotiation is a "battle of the forms," and the one who controls the drafting controls the deal. Developers are at a disadvantage because to them (with few exceptions) the drafting of STS agreements is a sometime thing, but to the providers it is their bread and butter. There is no prodeveloper boilerplate, but the providers all have forms, and they range from awful to horrendous in the protection they afford developers. The problem is aggravated because most of the affirmative obligations in an STS agreement are assumed by the provider; the developer does relatively little other than agree to cooperate, make facilities available, and (perhaps) contribute capital. In short, the contract consists mainly of promises by the provider. If the drafting is left to the provider, the promises will be minimal and largely unenforceable.

To compensate for their lack of forms, developers should make use of request for proposal (RFP) procedures when negotiating STS agreements. RFPs can be simple or elaborate, but they all boil down to descriptions and specifications of the services and equipment that the developer would like to offer and an invitation to all who are invited and who wish to participate to submit comprehensive proposals in a specified form.

RFPs have a number of advantages for developers in the STS industry. First, the very process of writing the RFP helps the developer to define exactly what is wanted in a system. Second, the RFP process forces providers to give information and proposals in a form that allows for comparison of what is being offered. Third, representations made in response to an RFP not only refine developer ideas, but are usually incorporated into the final contract by the terms of the RFP itself. When a developer has an attractive project, provider response to an RFP is likely to be drafted with an eye to the competition. RFPs therefore create a much better basis for negotiations than do provider forms.

Because of economies of scale, the success of an STS venture depends in large measure on how many square feet are wired and being served. That puts a premium on the size of the project (number of square feet) and penetration (the portion of available square feet that have been signed up). It suggests that several developers with adjacent or nearby buildings who can join together to negotiate with a communications provider will do much better than each of them would separately, because four buildings together are worth more than four times what each is worth alone. It also suggests that one way to make a building more attractive—thus maximizing what a provider will pay to serve it—is to be able to deliver the anchor tenant or several large tenants. The commitment of a tenant who is occupying 10, 15, or 20 percent of a building assures a provider's ability to cover much of the cost of installing and servicing a switch and risers, and makes a project that much more attractive to the provider.

The developer who wants to provide STS in a building obviously *wants* a good deal for himself, but also *needs* a good deal for the provider. There is an analogy to the experience of the cable television industry—one who is too tough (like many cities were with cable companies in the 1970s and early 1980s) can drive away the strong providers and end up with a large piece of nothing rather than a fair-size portion of something. Since a landlord can get badly burned by bad service in a building, the risks of being greedy go beyond the loss of profits that would be earned by a good system.

The risks and rewards of each of the various organizational options—franchise, joint venture, service contract—are obviously different. The point to remember is that potential return and (to some extent) system control follow investment. The developer who is contributing substantially to a project (whether in dollars, assumed liability, services, or space) can expect a larger potential return and more say in how service is provided.

Retrofit of existing buildings for STS presents some interesting questions. It is more difficult than new construction but cannot be ignored, since existing buildings represent 90 percent or more of the near-term market. Some of the special problems associated with retrofit—slower penetration, "partial" signups until leases expire or equipment is amortized, and so on—have little effect on contract negotiations. On the other hand, it may make sense in a retrofit situation to pay more attention to the need to prevent interference with existing tenants, and perhaps a different compensation structure will be warranted to take account of slower projected penetration. The basic agreement is the same, however, whether one is talking about retrofit or new construction.

Finally, developers need rules of thumb they can use to determine whether or not an STS agreement they have negotiated (or been offered) is a good one. Any guideline must necessarily be rough because buildings vary in attractiveness due to size, location, and tenant mix and because providers may be willing to offer premiums to get into major cities in which they do not have a presence. With that caveat, it seems fair to say that for buildings in the 500,000-square-foot range, an agreement that produces projected net revenue to the landlord of less than 10 cents per square foot per year is probably low. A contract that promises net revenues to the landlord of more than 25 cents per square foot per year is either generous, attached to an extremely desirable property, profligate, or all three.

THE TERMS OF A SHARED TENANT SERVICES CONTRACT

Every contract is unique, and the more complex the agreement, the more varied the opportunities for the insertion of individually tailored terms and conditions. The sections that follow outline the subjects that need to be addressed in most STS agreements, suggesting approaches that developers may wish to consider at each stage of negotiation.

The Grant of Exclusive Rights

Every STS contract includes a clause granting the provider exclusive rights to provide communications services in the developer's building or buildings. The word *exclusive* is a bit misleading; because of regulatory constraints and the need to maintain tenant good will, STS agreements routinely include a proviso to the grant of exclusive rights that allows provision of service in the building by the local telephone company and by any equipment companies or long-distance carriers with which an individual tenant wants to do business. (Later clauses, discussed below, address the need to ensure cooperation between the provider and other telecommunications venders serving the building.) Other common provisos to the grant of exclusive rights recite that the grant is not intended to convey any property rights in the building and that it is to be subordinate to any mortgages or deeds of trust on the building or the land on which it sits.

The biggest issue with respect to grants of exclusive rights is the scope of the services encompassed by the grants. Every shared tenant services contract includes (often as Exhibit A to the contract) a list of the services to be provided. Certain offerings—including the provision of equipment, access to local and discounted long-distance service, and such advanced PBX features as conference calling, call forwarding, and "camping"—can be found on every list. But providers often have a much longer reach. Some, such as United Technologies, are interested in selling "package deals" of building systems and will seek to include elevators and climate control systems in the deal. Others seek to migrate from telecommunications to "information services," which can range from shared data processing to electronic filing or publishing, copying services, and even temporary personnel.

It is not, as a rule, a good idea to grant too many exclusive rights to a provider. The provider will not initially offer all of the services on any list, and the grant of exclusive rights may make it difficult (or impossible) to obtain them elsewhere. The fact that there is little or no connection between some frequently listed services—such as temporary personnel—and telecommunications means that services are likely to be subcontracted out, reducing the landlord's comfort level with regard to the quality of the offering. On the other hand, expanding the scope of the grant of exclusive rights is one way of attracting good providers and may be necessary to interest qualified people in serving buildings that are marginal because of their size, location, or tenant mix.

The Provider's Obligations

The services that the provider has been granted the exclusive right to offer are usually of two kinds: required services that must be offered for the life of the agreement, and optional services that the provider is permitted to offer, usually after notice and an opportunity for the landlord to review plans for any building modifications required to provide the services. The goal of the developer is to keep the list of optional services relatively short, since they represent offerings that the provider is not compelled to make, but the landlord is not permitted to offer, himself/herself or through a third party. Several methods have been devised to reconcile the provider's interest in a long list of optional services and the landlord's interest in being able to ensure that tenants can get the services they want, regardless of whether the provider wishes to offer them. The contract can, for example, grant the developer the right to offer (or to allow a third party to offer) any optional service that the provider discontinues or refuses to offer after being invited to do so by the landlord.

Providers are presumably expert in telecommunications issues and are usually required to obtain all permits, approvals, and certifications necessary to provide the agreed upon services. Zoning variances (e.g., for roof towers or antennas) are an occasional exception, since they are viewed as within the landlord's area of expertise. The provider should be required to indemnify the landlord for any costs that the landlord incurs as a result of the regulatory process, including costs (such as fines and attorneys' fees) incurred to defend against challenges to regulatory authority or to comply with regulatory directives growing out of the STS offering.

Providers should be required to provide services to tenants pursuant to a standard contract, in a form subject to landlord review and approval. These contracts should be separate and apart from the tenants' leases, and the billing and collection of rent and of fees for tenant services should also be kept separate. It is usually a good idea to insist upon a clause that in the event of any conflict between the contract for communications services and a tenant's lease, the latter shall control.

Obvious, but important, is the fact that the provider is responsible for obtaining and installing necessary equipment and providing the services that are the subject of the agreement. The provider should do so in a manner that does not disrupt the operation of the building or the business of the tenants. The division of costs and the landlord's control over facilities varies with the form of the deal and the size of the landlord's investment. At a minimum, however, the landlord must have the right to review and approve any structural work.

Landlords, particularly those being advised by consultants whose background and expertise is in the selection of equipment, may be tempted to write into the STS agreement the specific switch or brand of station equipment to be used. That temptation should be avoided in favor of a performance specification, which can be general or very specific but should include as a minimum a blocking rate, signal quality, mean time between system failures, and so on. The performance specification should be accompanied by the right to have an independent expert audit the provider's performance to confirm that it meets specifications. Performance audits are useful not only as an incentive to quality service and a source of comfort (or fair warning) to the landlord, but also because they offer some assurance that should the provider disappear or go bankrupt, there would be at least one company or individual (i.e., the auditor) who is familiar with the system and can step in to run it on a temporary basis.

Finally, the provider should be charged with managing joint facilities (e.g., conduit) in a manner that does not interfere with the rights of others to use such facilities. Some landlords delegate to STS providers their entire responsibility for managing such building communications facilities as telephone closets and conduit space, but the landlord cannot avoid that responsibility and must remain alert lest a provider discriminate against the local telephone company or service providers brought it by individual tenants. For reasons discussed below, it probably makes sense to have the landlord own all conduit space, riser cables, and distribution frames—the components of a telecommunications system that are more like building fixtures than portable equipment. But ownership is not management, and the responsibility for the care and feeding of these facilities, to the extent they are used to provide STS, always rests with the provider.

The Landlord's Obligations

Beyond their essential contribution—access to tenants—landlords and developers typically bring less in the way of affirmative obligations to an STS relationship than do service providers.

Among the landlord's obligations is the provision of conduit access and space for a switch, offices and a display area, and environmental support for that space (modern telephone switches are large mainframe computers, and like others of that breed they tend to have special HVAC needs). Payment for the space provided by a landlord depends upon other financial terms, but the value of space provided should be taken into account when a deal is structured or interests are computed. One way to do this is to divorce the space lease on license from the rest of the deal and negotiate it as a separate transaction. Even if this approach is taken, however, it is important that the lease or license under which the provider gets space be coterminous with the STS agreement itself, ending if and when the STS agreement is terminated (for any reason).

Typically, landlords are asked to provide assurances of noninterference with the operations of the STS provider and access to the building at all times. Providers will often ask for rooftop rights so that they can erect microwave towers or satellite earth stations for the provision of long-distance service and broadband services like teleconferencing. Roof rights should be provided, but again the landlord must appreciate (and get credit for) the value of these rights. It can be high—permission to erect a single microwave transceiver can cost $1,000 per month near the top of the tallest building in a major urban center. For the same reason, any grant of roof rights should be nonexclusive, and the provider should undertake to cooperate with other licensees to minimize interference.

The landlord is also expected to cooperate in the marketing of shared tenant services. That cooperation can range from supplying the names of tenants and prospective tenants to sharing credit information and providing advance notice of plans to evict tenants. It is worth noting that marketing cooperation, although not difficult to negotiate, has proven to be a problem in the industry. Leasing agents are often loathe to introduce prospects to an STS provider until they have actually signed a lease. Many agents believe that talk of enhanced services will only complicate the deal or create an additional point on which a potential tenant can demand concessions. However they choose to address this problem, developers must bear in mind that they have the last word in the matter, and their influence may be the only way of securing the cooperation of leasing agents that is necessary if high penetration is to be achieved.

Finally, the landlord is obligated to respect the grant of exclusive rights that induces the provider to enter into an STS agreement. As discussed above, there are ways to limit and hedge that exclusivity, but it cannot be too stingy lest the economic viability of the venture be threatened.

Compensation

Everyone in the STS marketplace—like everyone in every other industry—thinks first of the bottom line. It is placed fourth in this article because that is about where it usually appears in an STS agreement.

The likely range of compensation in the nonexistent "typical" STS project has already been discussed. In a franchise setting, the landlord is compensated on a percentage basis, and the issue of how the compensation is to be computed resolves into whether the basis will be gross revenues or net revenues. From the developer's point of view, there is no real choice. Anyone who is tempted to accept a percentage of net revenues would do well to heed the lessons of Broadway, where hit shows have been known to run for years without returning a dime to those backers whose interests are limited to the "net." The solution to that problem—precise definitions of the net and how it is to be computed—is a drafting nightmare that invites abuse on the part of even the most well-meaning provider.

Gross revenue is not a perfect basis for computing payments. It tends, for example, to create diversions of interest between the provider and the developer—the provider seeks profits, and the developer seeks to maximize revenues. That tension is to some extent inescapable and needs to be taken into account as an agreement is implemented so that each party can appreciate the needs of the other. In the long run, the interests of the provider and the landlord merge because a project that is not profitable will not have high gross revenues (or any revenues, for that matter).

When the industry began, several of the larger providers sought to compensate on the basis of net, reasoning that it would reduce their expenses before operations became profitable and effectively spread the risk of the enterprise. Today, there remain a few reputable providers who will not talk about a percentage of the gross, but there are none who will not compensate on that basis if it makes the difference between closing and not closing a deal that they want. In short, gross is rapidly becoming the industry standard. That does not mean that there is not room for "play" at the joints, but variations take the form of exclusions from gross, rather than payment only of a percentage of the provider's net income. The variations can be crucial, and should not be negotiated by someone who lacks expertise in the field. Small and seemingly inconsequential wording changes can make a major difference in a developer's revenues.

One issue that occasionally arises, and should be raised by developers when it does not, is whether a landlord is entitled to a percentage of what tenants pay to receive services subcontracted by the provider or only to a percentage of what the provider receives from the subcontractor for permission to offer those services. The distinction is an important one.

Negotiation of the division of revenue and expenses in STS projects organized as joint ventures is so variable as to be unclassifiable. The basic rules are that the percentage of profits is likely to bear some relationship to the percentage of investment, although a developer can typically negotiate some premium for providing the monopoly resource (i.e., access to the building). The provider, on the other hand, is typically given a first claim on revenues to cover out-of-pocket costs. As in any joint venture, the road to financial harmony is paved with mutual trust and provisions ensuring that whoever does not keep the books has clear and well-defined rights to look over the shoulder of whoever does.

When the landlord "owns" the STS venture, division of revenues is not an obvious problem. Even here, however, there is typically a telecommunications company involved as project manager. As in property management, the companies providing this service seek "cost plus" contracts, and the landlords hiring them seek to pay a fixed price. As in all deals in which two parties must work together to maximize a value of an enterprise, a strong audit clause is a requirement and will not be resisted.

As discussed below, the termination of an STS agreement is trying at best, and the negotiation of the rights and duties of the parties in the event an agreement must be dissolved is typically sensitive and time-consuming. One way to reduce the agony in the event of termination is to have the landlord take title to those portions of the telecommunications system best described as fixtures, while the provider (or more commonly a leasing company) retains title to more portable equipment. If the parties decide to go this route, some way has to be found to arrange for the landlord to pay for the facilities that she/he will own. One possibility is recoupment out of the fees payable to the landlord. Such an arrangement is particularly advantageous in franchise agreements because it allows the landlord to obtain title to (and control over the disposition of) permanent installations without having to make any direct outlay, and minimizing direct outlays is usually a priority of landlords entering into such agreements.

Finally, note should be made of the possibility that the facilities or equipment installed to provide STS in one building can and will be used to provide service to adjacent or nearby buildings. If such "satellite" use occurs, the owner of the building in which the facilities are located deserves, and should demand, a share of the revenues obtained in the satellite buildings. Typically, the compensation in such instances is a fraction (one third to one half) of the percentage paid to the landlord from revenues received for the provision of service in the landlord's own building.

Term and Termination

STS agreements generally run 5 to 10 years, and those on the shorter end often include provider options for short-term renewal. That is fairly long as commercial agreements go, but the length is necessitated by the time required to penetrate a project and, more important, the time required to amortize a PBX. The STS agreement "term clause" should include a provision that no contract with any tenant will extend beyond the term of the agreement.

Termination prior to the end of term is one of the most difficult and sensitive issues facing a landlord contemplating an STS agreement. A good agreement includes not one termination clause, but three or four. Either party must be allowed to terminate the agreement in the event of a material breach or default by the other, though it is common to provide for notice of breach and an opportunity to cure. Beyond that, however, there must be provision for termination of the agreement in the event of destruction or condemnation of the building (with subclauses addressing entitlement to insurance proceeds and condemnation awards) and sale of the building (unless the landlord does not expect to suffer if the building must be sold subject to the STS agreement).

Securing the ability to terminate is straightforward; developing terms to implement it is not. The subject is too complex and situation specific for full discussion here, but among the problems that must be addressed are assurances of continued service while another provider is found, purchase of the provider's equipment and assumption of lease and tenant obligations, compensation of the provider if termination is due to causes within and beyond the provider's control, and liability to tenants for loss of service before (and after) the agreement is terminated.

Each of these issues can be difficult to resolve. Telecommunications equipment, for example, may decline in value more quickly than it is depreciated; a 4-year-old switch may well have a fair market value that is less than its value on the provider's books. If the switch is to be purchased by a landlord or third party as a part of the termination of an STS agreement, will the payment be fixed to provide some profit to the provider, to allow recovery of net book value, or to reflect the market value of the equipment? And if the first or third measure is chosen, who will decide the appropriate profit or market value?

There is a tendency to gloss over such issues as these when negotiating an agreement, partly because no one wants to seem pessimistic about a deal they are just about to sign, and partly because early termination is viewed as an unlikely prospect that can be "worked out" if and when the need arises. That tendency can be fatal and must be avoided.

To American businesses telephones are a necessity, and few can tolerate a lapse of more than a few hours in the availability of telephone service. The long-term prospects in the industry for both landlords and providers are ultimately dependent upon their ability to provide continuous service of a quality comparable to what businesses came to expect over the course of a century from the Bell system. Everyone knows that, but in the heat of a nasty dispute in which "divorce" looks increasingly likely, neither the provider nor the landlord is likely to keep it in the forefront of their respective minds. Uninterrupted service to tenants can become little more than a bargaining chip as accusations and counteraccusations fly. That is *not* the time to consider the steps that will be taken to assure continuity of service, nor to negotiate when and on what terms control over a switch and associated equipment will change hands. Provision for landlord ownership of risers and distribution frames, discussed above, can avoid one explosive possibility—the prospect of pulling cable and frames out of a building. Arrangements also need to be made, however, for the disposition of more portable facilities, such as the switch and station equipment and the assignment of tenant contracts.

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Allocation of Risk and Liability

The problems of assigning risks and liability are not unique to the STS market. They are at the heart of virtually every complex commercial and real estate contract, and little can be said about them beyond the obvious facts that they are important and must be addressed.

Most STS agreements include a requirement that the provider obtain specified insurance to cover specific incidents, and that the provider name the developer as an insured. Beyond that, the parties must negotiate the responsibility of a provider for system failure and its consequences: Is the provider to be an absolute insurer, liable only for his/her own negligence or that of employees, subcontractors, and other agents; or not liable at all beyond loss of franchise, interest in the joint venture, or management contract? Similar considerations apply with respect to the responsibility of the provider for damage to the building, tenants, or third parties that may flow from the provision of STS. Injuries can range from electrocution to holes in walls to business lost when a tenant who gets service from someone other than the STS provider loses the dial tone because someone cut the wrong cable.

The assignment of risks like these is a battle of the forms, and the forms developed by STS providers include little protection for developers. To the contrary, they often include no express warranties and a disclaimer of any warranty of merchantability or fitness for a particular purpose. Those provisions are always negotiable, however. How much they can be changed is a function of the landlord's bargining power and willingness to trade compensation for avoidance of risk.

Assignment

Typically, the landlord's revenues may be assigned to anyone, and one's entire contractual interest may be assigned to any party who acquires an equity interest in the building—purchaser, mortgagee, and so on—and to any of the landlord's affiliates.

Because an STS agreement is in many respects analogous to a personal services contract, and the unique qualities of a particular provider are often a major factor in the decision to close a deal, the provider's rights and obligations under STS agreements are usually not freely assignable. Often there is no provision for provider assignment without the express consent of the landlord, which consent may be granted or withheld at the landlord's discretion. Where the provider is a subsidiary or affiliate of a major corporation, assignment to a sister subsidiary, affiliate, or the parent is often permitted, but generally with the proviso that the parent will continue to be liable on the contract and/or that the assignee will have a net worth and financial position that is comparable to that of the assignor.

Some agreements include a provision for sale or assignment of the agreement by the provider to a third party, but these are invariably accompanied by lists of conditions or restrictions designed to ensure that the purchaser who wants to step into the provider's shoes will provide service and support comparable to (or better than) that provided by the predecessor.

Other

No American contract in the last quarter of the 20th century would be complete without boilerplate, and STS agreements are no exception. "The usuals"—clauses specifying the applicable law, where to send notices under the agreement, severability, and the fact that the written agreement incorporates and supercedes all prior agreements or understandings—are routinely found in STS contracts.

Among the less typical miscellaneous terms that can be found in STS agreements are clauses providing for the use of trademarks or trade names in advertising, the confidentiality of proprietary information exchanged by the parties, and a clause (which first appeared in SBS RealCom's form agreement) that assures landlords that the provider will defend and hold them harmless in suits alleging copyright or patent infringement if the landlord cooperates in the matter set forth in the clause.

Not surprisingly in this technical area, arbitration clauses are increasingly common. There are advantages and disadvantages to arbitration that are well known to corporate lawyers and go beyond the scope of this article. Nothing about the STS industry (except perhaps the technical complexity of the subject matter) argues particularly in favor of or against arbitration. It does make sense, if an arbitration clause is inserted, to specify that the arbitrator(s) be familiar with the STS market, or at least with the telecommunications industry.

■ CONCLUSION ■

The preceeding general guide is not (and could not be) comprehensive: It does not address the specifics of a very situation specific field. It is, in short, no substitute for good advice and wise counsel. The goal was to help developers appreciate where their interests lie when negotiating an STS agreement and to see to it that the final agreement serves those interests fairly.

A good contract can not save a bad deal any more than a good dam can prevent a river from flooding every five years. But a good contract *can* cushion the risk of loss and improve the likelihood of gain, and it can provide tools to minimize the havoc that a bad STS deal can wreak on the developer's bottom line and on relations with valued tenants.

There are, after all, two kinds of STS providers—those who have never done a project and promise never to make the mistakes that others have made and those who *have* done a project and promise not to repeat their own mistakes. There are two kinds of developers, too—those who will pick the gold up off of the street on their first STS deal and those who are sure that they have finally figured out how to squeeze a profit out of their next STS deal. All stand to benefit from a clear, fairly apportioned list of rights and responsibilities.

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Chapter 20

Legal Considerations Relating to Telecommunication Rights-of-Way and Easements

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Outline

A high tech building requires unobstructed access to satellite signals and to sunlight when solar energy is utilized. In addition, the more traditional cable rights-of-way may of course have to be secured. There are two principal legal devices for securing rights of this sort over the property of others: One is through the use of easements; the other is through covenants.

There has been considerable academic discussion concerning the differences that exist between easements and covenants. The consensus among academic writers has been that the distinctions between the two legal devices make up something of a historical anachronism and that the law should be reformed so as to bring them more closely together.[1] Although there is a great deal to recommend these proposals for reform, the practitioner cannot afford to overlook the traditional distinctions since, where real property is involved, old traditions die hard.

The purpose of this chapter is to provide some practical suggestions on how these different types of property concepts can be used. To do so, however, it is important to review the distinct characteristics of these interests.

THE PRINCIPAL DISTINCTIONS BETWEEN COVENANTS AND EASEMENTS

An Easement Is a Conveyance of an Interest in Land, Whereas a Convenant Is More Akin to a Contract

The Statute of Frauds applies to the creation of both easements and covenants: they must be created in a document in writing signed by the party who is sought to be obligated, or by his agent who must be authorized in writing to do so. Easements require a document couched in terms of a conveyance of an interest in land, whereas covenants are written in the form of an agreement.

Easements. A document of conveyance (also known as a deed) must at the minimum contain (1) words of conveyance, (2) words designating the duration of the interest created ("words of limitation"), and (3) a sufficient description of the property conveyed.[2] Of course a deed of conveyance must be signed by the grantor, and acknowledged if it is to be recorded.

By statute or custom the necessity for words of conveyance is satisfied by using the word *grant* or the word *convey,* although in some jurisdictions both words are required by statute.[3]

An easement can be created for any period for which any other interest in real estate can be created. Therefore, the words of limitation required in a conveyance of an easement can be words of perpetuity (e.g., "to XYZ Inc., its successors and assigns"); or they can create an easement for a term of years ("to XYZ Inc. for a period of 10 years from the date hereof"); or they can create a determinable easement or an easement subject to a condition subsequent (e.g., "to XYZ Inc. so long as its present building is in existence; and if it should ever cease to exist, then this easement shall cease and determine and shall revert to the grantor herein, its successors and assigns" or "to XYZ Inc. on condition that its present building remains in existence and if said building shall ever cease to exist the grantor may reenter and repossess itself of its former estate").

Finally, to grant an easement one must provide a sufficient description of the easement. Unlike grants of interests in fee, an easement can be validly granted even though its precise location is not determined in the document, provided that the outside boundaries of the area within which the easement must be located are specified. For example, an easement stated to be 30 feet wide across parcel 1 and which describes parcel 1 with specificity but does not describe the location of the 30-foot right-of-way, is a valid easement. The easement can provide that one of the parties may locate the easements at a future time. Such an easement is often called a "floater." If no provision is made for its precise location, the courts will allow the parties to locate the right-of-way by later agreement, or if the parties cannot agree, the courts will select the most reasonable location.[4]

Covenants. Although we have spoken broadly of covenants as distinguished from easements, there are in fact two bodies of law concerning covenants. Covenants that impose restrictions on the use of land have been given recognition in equity and are referred to as "equitable servitudes." Such covenants generally run with and bind all successors to the property who take title with actual or constructive notice of the covenant.[5] On the other hand, covenants that require the owner to undertake some affirmative action (such as erecting a building or maintaining an improvement), though sometimes recognized as equitable servitudes, have generally been subjected to much stricter requirements applicable to old common law real covenants. Affirmative covenants of this sort will not normally be allowed to bind successors in interest of the burdened land unless there is "privity of estate" and unless it is shown that the covenant "touches and concerns the land."[6]

These quaint old concepts have been much discussed in the writings.[7] In general, the Courts have held that affirmative obligations of an owner of real property will bind his/her successors in title if they are given in a lease of the property or associated with an easement in the property. The owner's affirmative obligations to provide environmental protection for communications conduits and cables, or other areas in which communications equipment is located, e.g., to provide appropriate security, air conditioning, or insulation from fire, can, therefore, be made to bind successors in interest to the owner provided that the right to the conduit, cable or area in which the equipment is located is itself couched in the form of a lease or an easement. Whether affirmative covenants which are not associated with an easement or a lease of the property can be made to bind successors in interest continues to remain in doubt. Access to sunlight and communication signals would normally involve negative restrictions (i.e., not to build so as to abstruct a particularly described access angle) rather than affirmative obligations, and would be an equitable servitude that runs with the land.

An Easement Is a More Solid Property Interest than a Covenant

Covenants partake sufficiently of a property interest so that courts have generally been willing to protect covenants by injunctive relief against breach by the other party or against interference by others. However, easements have been given even more protection in this regard. For example, courts have refused to grant protection to covenants where the conditions have changed since the date when the covenant was agreed to.[8] Yet, they have never thought it appropriate to terminate an easement because of changes in circumstances.[9]

Furthermore, in the case of an easement destroyed by condemnation of the property over which it existed, the owner of the easement must be compensated for that loss.[10] However, when government condemnation destroys a restriction imposed by covenant, a substantial number of jurisdictions hold that the person who has lost the covenant is not entitled to any compensation.[11]

Easements on Leasehold Interests and Sub-Easements

Historically, easements have been associated with a particular limited use of another person's land, such as a right-of-way across parcel A. The property burdened by such a use, parcel A, would be known as the servient tenement or "burdened property." If a parcel is benefited by the easement, it is known as the "dominant property." Since the idea of the servient tenement has invariably been associated with property owned in fee, there is little authority on the question of whether or not persons who have a lesser interest in land can create easements in such interests. For example, can long-time tenants or mere easement holders create easements? Although there are statements in the books to the effect that easements can only be created by fee owners, this view seems unsound.[12] In most cases the view is merely a reflection of the truism that a person who has a limited interest in land cannot create an interest in another that is greater than the interest the person has.

Thus, a tenant cannot create an easement in portions of the building or the land that he/she does not lease. Nor can a tenant create an easement in the leased portions of the building or land that would survive beyond the date on which the lease terminates.[13]

Although there are surprisingly few cases on this subject, the better view is that a tenant has the power to grant an easement provided that the easement does not exceed the scope or the term of the leasehold interest or violate any specific provisions of the lease.[14] Similarly, it should be clear that a person who has an easement may grant further easements. So far as we know, however, that issue has never been addressed directly. Rather, the cases on this subject are mainly concerned with whether or not the new easement is within the scope of the old. Thus there are numerous cases debating whether a railroad that has a right-of-way for railroad purposes may grant easements for telegraph and telephone poles and wires and whether a public authority that has a street right-of-way may grant easements in the subsurface.[15] Many of the cases in this field are dated, and they exhibit remarkable hostility to the idea that an owner of a right-of-way may grant additional rights to others. If we could hazard a guess, the courts probably do not like the idea that an easement owner, who may not have paid the owner of the underlying land for the privilege, should profit from, for example, fiber optic rights-of-way. After all, that is the central question: Who gets the money?

It should be noted, however, that some of the more recent cases involving cable television seem to be more receptive to the idea that an existing telegraph or telephone easement holder may piggyback a cable on it.[16] In general, however, the right of an easement owner to piggyback additional easements is far from clearly established. The courts do not seem to doubt that an easement owner has the power to grant further easements as an abstract proposition, but they doubt whether in the given case before them the easement is broad enough to encompass such a power.

From the above discussion, therefore, several conclusions should be drawn. First, whenever possible the necessary cable or air space access easements should be obtained from the fee owners. Of course, if there are tenants already in place when the easement is negotiated and the easement must pass through their leased space, their consent must also be obtained. Second, when negotiating with the fee owner and tenants, one should secure an easement that expressly allows one to grant additional easements or other rights in the same location. In the case of cables or pipelines, it is desirable to define the easement location in three-dimensional terms or as a cross-sectional area so as to permit the laying of additional cables and pipelines within the described space. Here the notion of a "floating easement"[17] is extremely useful. Third, if the easement cannot be obtained from the fee owners so that it must be obtained from other easement owners or tenants, one should secure adequate indemnity against any potential liability to or disruption by the fee owner.

Finally, negative rights may be involved, such as unobstructed access to sunlight or to satellite communications signals; the rights may be sought from tenants or other easement owners. In such cases it is desirable to couch the rights not only in the form of grant of an easement, but also in the form of a covenant, since there is no doubt at all that restrictive covenants may be obtained from persons who hold lesser interests in property, such as tenants and other easement owners.

The Need for a Dominant Property

Traditionally, easements not associated with the use of some nearby property (i.e., easements in gross) have been treated with disrespect under the law. Such easements are considered to be personal to the original parties between whom they have been created. As personal easements, they are automatically dissolved by the death of either party or by any attempted transfer of the servient property.[18] An exception has been made for commercial easements, such as utility lines and gas lines.[19] Presumably, the courts would be willing to extend the exception to communication cable easements, communication signal access rights, and solar easements held by telecommunications companies, otherwise their rights might be cut off when the building they service is sold.

With regards to covenants, there is authority for the proposition that a covenant will not bind successors in interest unless it is initially given to a person who has a property interest in the land benefited by the covenant.[20] However, it is believed that the courts would make the same exception in favor of commercial interests as they have made in the case of easements.

Succession to the Burden and Benefit of Easements and Covenants

Probably because easements have traditionally involved simple situations, such as owner of parcel 1 having an easement for a right-of-way across parcel 2, there has never been much debate about what circumstances allow succession of the benefits and burdens of an easement. Simply put: Provided an easement is not cut off by failure to record and because it is not visible, it will bind any successor to the servient tenement, even persons who acquire lesser interests in the servient property than the interest of the person who originally created the easement. Thus an easement for a right-of-way across lot 2, if recorded or visible so as to be discoverable by reasonable inspection, will be good against a subsequent owner of parcel 2. It will also be good against any lesser interest holder who takes possession of parcel 2, such as a tenant. Similarly, the benefit of the easement will normally run in favor of the person who becomes owner of parcel 1 and also in favor of persons who acquire lesser interests from the owner, such as tenants, if the easement is one that would be useful to the lesser interest holder or conveyed to the lesser interest holder.[21]

As long as covenants impose only restrictions on the use of land (i.e., they are true "equitable servitudes"), they will behave in the same way as do easements. Provided that they are recorded so as to put others on notice, they will bind successors in interest of the restricted land, including persons who succeed to lesser interests. Such covenants will also run in favor of any person who succeeds to the land that is benefited by the covenant, including persons who acquire lesser interests in the land where their interests are such that they would benefit by the enforcement of the restriction. As already noted, easements and covenants held by companies that have acquired these rights in order to provide services to the servient property will bind successors to the servient property even though the holder has no land nearby that is benefited by the easement or covenant.

Summary of the Distinctions

Easements normally involve a limited right to invade another's land, such as by a cable, pipeline, or right-of-way. Such rights must be created by grant and cannot normally be created by covenants. However, when the right sought in another's property is to prevent that person from developing or using it in a certain way, covenants can do the same job as easements. In some respects they can do a better job. Like easements, they will follow the property and bind not only subsequent owners but also any lesser interests who are on actual or constructive notice of them. Moreover, covenants can initially be created by holders of lesser interests in land, such as tenants. It is not as clear that easements can be created between lesser interests. There as some authority for the proposition that easements can be created only by fee owners or owners who have interests equivalent to the fee, such as long-term ground lessees.

Both covenants and easements require that they be given to someone who has an interest in nearby real property that is benefited. However, an exception has been made in favor of commercial easement holders such as pipeline companies and it is believed that the same exception will apply to companies providing communications services. Although covenants can do the work of easements in certain cases and may be more versatile, especially as to the parties by whom they may be created, they occupy a lesser status in the property hierarchy. This status is reflected in the power the courts have exercised to terminate covenants when they decide there has been a change in the circumstances since the original agreement. It is also shown in the doubt that continues to exist as to whether or not the termination of a covenant by the condemnation of the restricted land is a "taking" of a property right, and thus compensable, or merely a destruction of the subject matter of a contract, and therefore not compensable.

USE OF NEGATIVE EASEMENT

We have seen that whenever rights are sought to locate a physical object, such as a cable, an easement is the proper device to use. When a negative obligation is sought to be imposed, covenants should be considered, but easements are the more solid and permanent device—especially for securing access to communication signals from space and to sunlight. There is still one difficulty to explore regarding use of easements for this latter purpose.

As already noted, historically easements have involved a specific limited use of another's land, such as a right of way. Either because the constant repetition of the most commonly used form of easement was slowly elevated to the status of law, or for some other reason, the view developed at common law that restrictions imposed on the use of property that do not involve any right on the part of the dominant owner to invade the servient property in some physical way, cannot be treated as true easements. There were some clearly recognized exceptions: rights of access to light and air have been recognized as easements since time immemorial.[22] Similarly the right to prevent an owner from interfering with the natural flow of water from the servient to the dominant property and to prevent the servient owner from denying support to buildings on the dominant property were also recognized as easements.

Based on these exceptions, it is generally recognized that solar access rights are valid easements because of their kinship to the easement for light and air. The common law right to light and air could be acquired by prescription (long use, usually 20 years); this was known in England as the doctrine of "ancient lights." When the question of right to light and air came before our courts in the late 19th and early 20th century, they generally declined to adopt the English doctrine of "ancient lights," judging it to be inconsistent with the development needs of the New World. However, all of the courts agreed that such easements could be created by express grant, even though they could not be implied through long use.[23] As our society has developed, there are signs of a change. A recent decision of the Wisconsin Supreme Court has held that an owner of a solar-heated residence can prevent a neighbor from unreasonably obstructing the owner's sunlight by treating it as a nuisance.[24] The court points out that the early American cases that refused to accept the English doctrine of ancient lights reflect factual circumstances and social priorities that are now obsolete.

Thus, although there is as yet no direct authority on the subject, it would seem that easements designed to give access to communication signals—even though negative in nature—will be recognized as true easements by the courts.

DRAFTING THE EASEMENT DOCUMENT

If an easement is to be used, the document should conform to the minimum requirements of a deed for the jurisdiction in question. This normally includes words of grant, words of limitations, a sufficient description of the property, and a signature by the grantor at the end of the operative words of the document. In addition, of course, an acknowledgment is required to entitle the document to be recorded.

Although we have been speaking of a separate document of grant, an easement can be created by the deed of conveyance used when property is sold. In the case of the dominant property being conveyed, the deed of conveyance will include the grant of an easement across the servient property held by the grantor. In the case of the conveyance of the servient property, the easement will be created in the deed granting the servient property by reservation in favor of the dominant property held by the grantor. A reservation is accomplished by using the words in the deed granting the servient property as follows: "Reserving therein in favor of the grantor, his/her heirs, executors, successors and the assigns an easement [description]." Note that a reservation of an easement should always describe the duration of the reserved easement (i.e., must contain words of limitation describing the duration of the estate). This is mentioned only because of the many cases in which conveyancers have forgotten to do so.

In the case of an easement created in the deed of grant conveying the dominant property, the conveyancer should remember that, inasmuch as the easement is mentioned in the deed to the dominant property only, the recordation of that deed may not be sufficient record notice of the easement so far as successors in title of the servient property are concerned.[25] An appropriate notice of the easement should be recorded against the servient property.

Consider the case of a larger project involving multiple buildings and wherein the developer wishes to impose reciprocal restrictions and easements on the various properties within the project before they are conveyed out. In such circumstances it is frequently more economical to draft and record a declaration of easements and covenants against the whole project and then convey each property subject to the declaration. This method of creating easements is well recognized and widely used in residential settings and it can be used to advantage in the larger commercial setting.[26]

If instead of utilizing easements, it is decided to employ covenants, a declaration is again a useful device for creating reciprocal rights of enforcement within the larger project. Although it has been said earlier that covenants are in the nature of an agreement, a covenant should always expressly provide that it is intended to bind successors and assigns. It is also important that the covenant identify with particularity the property to be restricted as well as the property to have the benefit of the covenant.

Although the courts may be prepared to intervene to terminate or modify a covenant that has become obsolete, the conveyancer should remember that modification of an easement without the consent of both parties is not available. Therefore, careful consideration should be given to providing for the circumstances in which an easement may be allowed to be modified. Indeed, even when covenants are used, one should not rely on the courts to provide future flexibility. Rather one should attempt to provide a mechanism for effecting change in the convenants themselves, where appropriate.

When describing an easement for a communications cable, the conveyancer should remember that the client may wish to place additional cables in the same location and may wish to subgrant easements to others. These rights should be specifically spelled out. Furthermore, the easements should be described in three dimensional terms or as a cross-sectional area creating a larger path within which additional communication facilities can be placed in the future.

If an easement can be secured only from another easement owner or from a tenant, one should seek a strong indemnification clause from these parties against any liability to or disruption by the fee owner. Then there is the question of unusual easements, such as negative easements or easements secured from other easement owners or from tenants. It is desirable to draft such easements in the form of a traditional grant and also in the form of a covenant or, where appropriate, a lease or license to use. So doing provides alternative ground for upholding the interest in the courts.

■ NOTES ■

1. French, *Toward a Modern Law of Servitudes: Reweaving the Ancient Strands*, 55 So. Cal. L. Rev. 1261 (1982); Reichman, *Toward a Uniform Concept of Servitudes*, 55 So. Cal. L. Rev. 1177 (1982); Berger, *A Policy Analysis of Promises Respecting the Use of Land*, 55 Minn. L. Rev. 167 (1970).

2. The legal requirements for a deed may differ in different jurisdictions.

3. *See, e.g.*, Pa. Stat. Ann. Tit. 21 §2, which provides that either the word *grant* or the word *convey* will suffice. *Compare* 25 Del. Code §121, which requires the use of both words.

4. Wood v. Wilson, 260 Mass. 412, 157 N.E. 592 (1927); Cooke v. Wake Elec. Membership Corp., 245 N.C. 453, 96 S.E.2d 351 (1957).

5. The original case was Tulk v. Maxhay, 2 Ph. 774, 41 Eng. Rep. 1143 (Ch. 1948); Berger, *A Policy Analysis of Promises Respecting the Use of Land*, 55 Minn. L. Rev. 167 (1970); Newman & Losey, *Covenants—Running with the Land, and Equitable Servitudes: Two Concepts or One*, 21 Hastings L. J. 1319 (1970).

6. *See* French, *Toward a Modern Law*, pp. 1269–76, 1289–1300.

7. See articles cited in notes 1 and 5 above.

8. Downs v. Kroeger, 200 Cal. 743, 747, 254 P. 1101, 1102 (1927); Acopian v. Haley, 387 So.2d 999, 1001 (Fla. 1980); Rolfe v. Robinson, 99 Mich. App. 404, 298 N.W.2d 609 (1980).

9. Waldrop v. Town of Brevard, 233 N.C. 26, 31; 62 S.E.2d 512, 515 (1950).

10. Nichols on Eminent Domain §5.14 (3d ed. 1983).

11. *Ibid.*, §5.15.

12. Nemm Furniture Co. v. Select Furniture Co., 25 Mis. 895, 208 N.Y.S.2d 51, 57 (1960); Hollabuagh v. Kolbet, 604 P.2d 1359 (Wyo. 1980); Aebischer v. Zobist, 56 Ill. App.3d 151; 371 N.E.2d 1003 (1977).

13. Reimer v. Stuber, 20 Pa. 458, 463 (1853).

14. Newhoff v. Mayo, 48 N.J.Eq. 619, 23 A. 265 (1891), Reiner v. Stuber 20 Pa. 458, 463 (1853). *Obiter dictum; contra* Nemmer Furniture Co. v. Select Furniture Co., 25 Misc. 895: 208 N.Y.S.2d 51, 57 (1960), *and see* cable cases collected at note 16.

15. Annotation 3 ALR3d 1256, 1278 (1965).

16. *See* Crowley v. New York Telephone Co., 80 Misc.2d 570, 363 N.Y.S.2d 292 (1975); Consolidated Cable Utilities Inc. v. City of Aurora, 108 Ill. App.3d 1035 (1982); Jolliff v. Hardin Cable Television Co., 260 Ohio St. 2d 103; 269 N.E.2d 588 (1971).

17. See note 4 above.

18. Maw v. Weber Basin Water Conservancy Dist., 20 Utah 2d 195; 436 P.2d 230 (1968); *see* "Annotation," 130 *ALR* 1254.

19. Johnson v. Michigan Consol. Gas Co., 337 Mich. 572, 60 N.W.2d 464 (1953).

20. Minch v. Symon, 96 N.J. Super. 464, 233 A.2d 385 (1967).

21. 3 R. Powell, *The Law of Real Property,* ¶418; 2 *American Law of Property,* §8.71 (A. Casus ed. 1952).

22. *Gale on Easements,* 13th ed. (M. Bowles, 1959), p. 21.

23. The development of American Law on this subject is traced in Prah v. Maretti, 108 Wis. 2d 223, 321 N.W.2d 182 (1982), *see* Pfeiffer, "Ancient Lights; Legal Protection of Access to Solar Energy, 68 *ABAJ* 288 (1982).

24. Prah v. Maretti, note 23 above.

25. In some jurisdictions, however, the title searcher is required to search the deeds to adjacent properties conveyed out of a common grantor. *See, e.g.,* Finley v. Glenn, 303 Pa. 132, 154 A. 299 (1931); "Annotation," 4 *ALR* 2d 1364.

26. Krasnowiecki, "Townhouses with Home Associations: A New Perspective, 123 *U. Pa. L. Rev.* 711, 716 (1975).

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Chapter 21

Regulatory Aspects of High Tech Buildings

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Outline

The integration of advanced telecommunications and data processing capacity into many facets of the national economy and lifestyle has been predicted and debated in public policy forums for the past 20 years. Its application to commercial and multi-tenant residential buildings and the offering of shared tenant services are recent manifestations of these predicted technological opportunities. Commencing in the late 1950s, it became increasingly evident to federal and state regulators that advances in telecommunications, computer, and satellite technology would rapidly transform the nature of communications services. It also became increasingly evident that regulatory policies had to be revised in order to accommodate this transformation and to ensure that it ultimately benefited the general public by providing a wider choice of services at reasonable prices. The revision effort has been difficult and controversial, and like the technological transformation itself, it is not yet complete. Although the regulatory environment is generally favorable to the development of high tech buildings, several potential pitfalls, coupled with the present level of uncertainty, make the regulatory aspects of any venture worthy of review and analysis.

HISTORICAL PERSPECTIVE

The past few decades have seen a substantial shift in regulatory policies from a traditional, regulated environment to an innovative, competitive, and increasingly deregulatory scheme. The process is still ongoing, and in many respects regulatory policy continues to be influenced by the same conflicting forces that have been at work throughout this period. Understanding these forces and how they have been reconciled is essential to any discussion of present regulation and future trends.

From the late 19th-century, telephone service evolved as a relatively standardized commodity with limited capability. Service was provided to the public by regulated carriers that held de facto monopolies within their service territories. By the time the Kingsbury Commitment of 1913 had ended significant head-to-head competition between carriers, AT&T dominated the industry, controlling most of the profitable service areas, and it also emerged as the preponderant provider of long-distance service.[1] Legislative and regulatory policy essentially reflected this industry structure, and it created a regulatory framework to deal with the market reality. The Communications Act of 1934 created the Federal Communications Commission and transferred telephone regulation to the Commission from the Interstate Commerce Commission. The 1934 act set the regulatory goal of "universal service" to be achieved through the creation of a nationwide telephone system available to the widest number of users at reasonable rates. Given the nature of the industry and the service it was providing, the Commission pursued its universal service goal through the regulation of telephone transmission wires used for, and the rates charged for, interstate long-distance service. The states, in turn, exercised responsibility for regulation of intrastate service pursuant to state utility law. Until the mid-1960s the domestic industry continued to be "properly characterized . . . as one where monopolists provided a limited number of homogeneous communications services."[2]

Although the regulators were concerned that carriers' services were universally available while their construction plans and service charges were reasonable, the carriers controlled all aspects of telephone service, and any telephone service or equipment had to be obtained from the local telephone company. Their control was so pervasive that some companies insisted that ancillary equipment, such as telephone directory covers, must be provided only by the telephone company. The nature of telephone service was also easily distinguishable from broadcasting, newspapers, and other forms of information generation, processing, and distribution.

Regulators, both federal and state, were quite successful in pursuing the goal of universal service, and by the 1960s that goal had essentially been achieved. However, the decisions and trade-offs made during this era shaped many of the conflicts and public policy debates with which the industry still must deal. For example, low local telephone service rates were viewed as directly related to a customer's use of telephone service, and hence to the achievement of universal service. As long-distance costs declined and as local business service and equipment use rose, most experts contend that costs for local residential service were shifted to these other service categories. So long as the entire industry was regulated, service was provided on virtually a monopoly basis, and little substitution or interchangeability between services was possible, such cross-subsidies were feasible. However, as technology and federal policy created options and new entrants, it became inevitable that charges for each category of service, particularly artificially high charges, would be forced toward their real costs. As these higher charges were reduced, there would be insufficient resources to defray underpriced services, forcing these charges to rise. Hence, questions relating to the introduction of competitive vendors and deregulated pricing have been accompanied by concerns regarding the impact of such policies upon local residential rates. These concerns are very much a part of current debates. For instance, Congress forced the Commission to delay its decision to collect interstate nontraffic sensitive (NTS) costs directly from local customers through an access charge. Such NTS costs have been included in interstate long-distance rates, and their transfer to access charges collected directly from local customers was viewed as essentially raising local rates. While a reduced charge has now been approved, it is quite likely Congress will not let the access charge issue drop in the months ahead.

Nor would the controversy end with any resolution of this access charge question. The dominance of AT&T and of the Bell Operating Companies

(BOCs) in transmission services and market penetration has presented special problems to a regulatory philosophy based upon fair competition. Dealing with these problems and measuring the extent of these carriers' dominance continue to plague policymakers. In addition, while state regulators' traditional sphere of influence has been reduced as the federal policymakers have preempted state authority in such areas as customer equipment, the tension between conflicting federal and state policies remains. In state regulation areas, such as intrastate long-distance and local exchange service, state authorities remain less inclined to favor competition, and they often permit rate structures that favor certain services to the disadvantage of others or prohibit on an intrastate basis services which are permitted on an interstate basis, such as resale. The pressures caused by the continuing differences between federal and state policies will continue, until inevitably either accommodations will be reached or choices will be made.

TECHNOLOGICAL CHANGE AND DEREGULATORY POLICIES

Federal Common Carrier Regulation

As the dimension of telephone equipment and service diversity increased during the 1960s and 1970s, the Commission embarked upon an increasingly aggressive policy of open-entry, competition, and deregulation. Advances in computer technology particularly impacted upon the diversity of communications services and equipment available to the public. Satellite and related microwave technological improvements revolutionized the transmission field, creating the opportunity for wider diversity of services, carriers, and other transmission providers.

In less than 15 years and most notably in the past 5 years, the Commission has completely altered regulatory treatment of both telecommunications equipment and services. The backbone of the Commission's procompetition and deregulation policy is encompassed in the *Computer II*[3] and *Competitive Carrier*[4] decisions. The *Computer II* decisions preempted state regulation of, and deregulated the provision of, customer premises equipment (CPE)[5] and enhanced services.[6] The rationale behind Computer II is this: Competition should replace regulation wherever the marketplace can support fair competition; and a transition is needed to move from a regulated to a competitive environment, particularly with respect to traditional carriers that dominate the market. Two basic safeguards were devised in *Computer II* to permit these dominant carriers to participate in deregulated markets without traditional tariff and facility authorization requirements: the basic/enhanced service dichotomy and the competitive subsidiary.

As advances in computer technology were incorporated into communication services, it had become increasingly difficult to distinguish between computer or information processing activities that were unregulated and communications activities that could be, and often were, regulated. For example, if a piece of equipment could process information and communicate that information over telephone wires, the Commission would have to ask whether the equipment was a telephone, subject to regulation, or a computer, the use of which was unregulated. Recognizing the ultimate impossibility of such a query, *Computer II* abandoned its earlier test. First, *Computer II* recognized the functional difference between basic service (the transmission of information)[7] and enhanced service (the application of data processing features to the information being transmitted or customer interaction with stored data, such as occurs with teletext services). Rather than attempting to determine what data processing applications might constitute communications, the Commission used this "basic/enhanced dichotomy" to confine its regulatory boundaries to the provision of basic service, while deregulating CPE and enhanced services offerings. For many activities, such as the integration of communications services into high rise buildings by developers and other businesses, *Computer II* removed the risk that such integration would subject the business to federal common carrier regulation. Other decisions removed this risk for interstate shared use and resale activities.

Computer II acknowledged that traditional telephone companies retained considerable power because of their long history of virtually monopoly domination, and that this market power could be used discriminatorily against their competitors if their activities were left completely unregulated. Among the requirements imposed on telephone carriers to protect competitors and rate payers, the second major safeguard of *Computer II* requires AT&T and the recently divested Bell Operating Companies (BOCs) to offer enhanced services and CPE through structurally separate subsidiaries, essentially arm's-length operating subsidiaries. AT&T and the BOCs were deemed to require this separate subsidiary safeguard because they are so overwhelmingly dominant in their respective control of long-distance and local exchange facilities and service. The separate subsidiary requirement permits these companies to participate in unregulated markets without commingling their unregulated activities and the costs thereof with their extensive regulated operations. Accordingly, both the regulated carrier and its competitive subsidiary may be involved in a proposed venture, the former bidding on the basic service features, including Centrex, and the latter proposing deregulated CPE and enhanced services as well as potentially acting as an agent for basic service procurement, or as a reseller in the case of AT&T-IS.

Interstate basic services. The *Competitive Carrier* decisions have substantially reduced the level of regulation applied to nondominant and resale carriers offering interstate basic service. AT&T, the BOCs, and other local exchange carriers remain subject to federal regulation, notably tariffs for interstate basic service including access to the local exchange. The Commission determined that AT&T overwhelmingly dominated the interstate long-distance markets and that local exchange carriers controlled the access to their exchanges, which is essential to all interstate services. Hence, continued regulation of the terms and conditions for interstate service, including exchange access, was found to be necessary. These decisions affect the carrier's ability to price and alter service, but they do not prevent the offering of basic interstate services by any entity, including AT&T. In addition, and notwithstanding these findings, several pending proceedings may liberalize the level of remaining interstate service regulation and the nature of tariff regulation, such as cost support and rate of return requirements.[8]

Customer wiring. Also unsettled is the regulatory environment for complex intrasystem or premises wiring, defined by the Commission as the wiring needed to interconnect the customer premises equipment (CPE) with the transmission network. The Commission has required the detariffing of premises wiring and said that replacement or new wiring may be provided by nontelephone company entities, including a building developer or tenant. The local carrier also may continue to install inside wiring, though on an untariffed basis. Intrasystem wiring was defined to include the wiring on the customer's side of the demarcation point—the point separating premises wiring from network wiring, which usually is where the telephone company's protector or equivalent is located. The efficacy of this definition of the demarcation point is being challenged; users and others contend it is too limiting.[9] The Commission is also being asked to find that users have the right (1) to access telephone company wiring, especially house and riser cable, including the right to move the demarcation point or make other changes as they may require; and (2) to obtain the system diagrams for embedded wiring as well as notice and other price-related protection concerning the rates for this embedded complex inside wiring. Further, the extent to which the Commission's rulings preempted state regulation is unclear with some evidence suggesting that states can impose carrier restrictions or prohibit projects when the wiring crosses a public way, as can well be the case when a PBX is shared by multiple buildings or by a campus which stretches across city streets. Resolution of these questions can particularly affect the management of a multi-tenant communications system, including the degree of access to telephone company network wiring located within the building or complex, the extent to which a customer or multiple tenants may provide wiring, and the regulatory status of building-supplied wiring, ranging from state prohibition to operating conditions such as obligations of a building system regarding tenant access to the building wiring.

As a result of Commission decisions to date, federal regulatory exposure for high tech building projects is minimal, with its exact dimension dependent upon the nature of services being offered and the type of provider. The major regulatory constraints to the purchase or sale of CPE and enhanced services are that the BOCs and AT&T must act through their separate subsidiaries and that the BOCs must comply with the AT&T divestiture agreement, which prohibits their offering of inter-LATA and information services. Several of the BOCs have requested waivers of the separate subsidiary requirement to permit the integration with basic service of certain enhancements, such as code and protocol conversions, and certain CPE, such as network channel terminating equipment. AT&T also has requested waiver of the *Computer II* separations requirements. These waivers are likely to be taken up by the Commission early in 1985. Further, there are negligible regulatory implications involved in the purchase or resale of interstate basic services. Noncarriers may participate in such interstate service activities without the fear that carrier status may attach and impose burdensome regulations. AT&T's separate subsidiary may offer basic interstate service on a resale basis,[10] and other entities also may operate as resellers. Service may be obtained directly either from AT&T-Communications, on a tariffed basis, or from numerous competing carriers, such as MCI, SBS, and GTE. The BOCs cannot offer interstate or intrastate, inter-LATA services because of restrictions imposed upon them by the AT&T divestiture agreement (discussed later herein). Non-AT&T carriers and others are increasingly able to offer intrastate services, depending largely upon the state regulatory situation (discussed later herein).

Federal Spectrum Allocation Regulation

In addition to its regulatory authority over common carrier activities, the FCC is charged with managing the electromagnetic spectrum. It must determine how to allocate this spectrum among geographic areas and among a variety of uses, such as television and radio broadcasting, satellite and terrestrial microwave, and mobile and private radio. Notably for high tech buildings, whether private systems or shared tenant services are involved, there are an increasing array of high-speed, nonwire transmission services used either locally or as the local component for long-distance service. Because federal allocation decisions determine the amount of spectrum capacity available, they have a significant effect upon the availability and the cost of services.

Within the parameters of its allocations decisions, the Commission must license the use of the spectrum. Applicants may be exposed to financial, technical, and legal qualifications and other obligations, which vary according to the type of license involved. Hence a private earth station applicant must meet only minimal requirements, while a television broadcast applicant would be subject to a much greater degree of scrutiny. This situation could change for high tech building applicants if spectrum for a particular service is scarce. Assignment decisions critical to business plans or to competition and hence service pricing could then take on a more closely scrutinized and contested flavor. In fact the question of spectrum availability may become a substantial factor in high tech building projects, since most development can be expected to occur in urban areas where demand for spectrum is greatest. If the project developers or tenants wish to provide their own services, such as a transmit and receive earth station, in the past these frequencies generally have been readily available to operators. As crowding occurs, if these services require spectrum that turns out not to be available, the project must either turn to an entity that does hold a license, find alternate services, or petition the Commission for a reallocation of spectrum. If spectrum is available but limited, the Commission may be required to select licensees from among competing "mutually exclusive" applications for the same assignments, a process involving a substantive comparison of the applications, negotiations among the parties, or a lottery. Since either alternative services or Commission selection processes can be time-consuming and costly, it is best to determine frequency availability early in the project planning phase.

How the Commission will handle allocation questions as well as the extent to which it will tolerate inconsistent local regulation of spectrum use services are not settled questions. The manner in which the Commission proceeded with regard to Digital Electronic Message Service (DEMS) and Digital Termination Systems (DTS) may be illustrative of the way it will handle other activities affecting high tech buildings. While state regulation has no role in the allocation and assignment of spectrum, some states have imposed entry and tariff regulation upon such licensees as mobile radio carriers which operate within the state. DEMS/DTS is a two-way cellular microwave system that will be used for local digital distribution of voice, data, and videoconferencing[11] and will be provided by both telephone companies and other carriers on a licensed basis.[12] In its Report & Order, the Commission noted that it envisions DTS facilities as being used primarily in connection with interstate nonvoice service, although it did not rule out the possibility that they will be used for local voice distribution. Nevertheless, basing its regulatory authority on the projected interstate character of DTS, the Commission concluded that it had the regulatory authority to "preempt inconsistent state regulation of technical standards, market entry standards, and rates and tariff regulations of all carriers using DTS facilities."[13] The fundamental policy reason cited for preemption was that state regulation might impede the development of a new and innovative telecommunications service that is essential to the maintenance of a modern, efficient communications system in the United States.

Telecommunications service associated with high tech buildings, whatever the transmission technology, can arguably be described as similarly interstate in nature, innovative, and essential to the maintenance of a modern, efficient communications system. It is not yet clear how far the Commission must go, or can go, but it is likely that if the conflict between state and federal policies persists, the DTS decision suggests a possible remedy.

State Utility Regulation

The *Computer II* decisions preempted and deregulated CPE and enhanced services, and interstate basic service regulation has been substantially liberalized. However, the states retain material regulatory authority over intrastate basic service, which generally includes terrestrial transmission services that originate and terminate within the boundaries of one state. Recognizing that regulation varies among the states, but has generally adhered to a more traditional approach, state utility regulation is likely to present the most common source of regulatory impediments to high tech building projects and shared tenant services. Hence, any project which proposes to offer intrastate services must review the state regulatory situation where the project is located.

In the past, most states required that all providers of common carrier services under their jurisdiction be authorized by state regulators, and often such authorization was not granted to newcomers without a showing that existing carriers did not offer the services involved and would not be harmed by the competition. Since the states are subject to the same technological pressures that have caused federal policy changes, and since the pressures are increased by the very fact of federal action, some regulatory changes have been evidenced. For example, states have been gradually dropping their entry barriers for intrastate long-distance service, permitting competitive carriers, such as MCI and SBS, to provide service, albeit usually on a regulated basis. Frequently, resale activities have been viewed in the same manner as direct provision of service, and while it is possible to define resale to exclude shared tenant activities, they appear to be viewed as synonymous. To date, 11 jurisdictions have permitted resale and sharing of intrastate services among multiple tenants. Only one state, Florida, has prohibited shared tenant service pursuant to a state statute which prohibits local resale. However, 14 of the 23 states presently considering the question of multi-tenant services have statutes which prohibit resale, making the definitional issue potentially more troublesome in the future. Where multi-tenant services are authorized, conditions may attach, such as a prohibition on earning a profit, or alternate access to the local carrier for all tenants, as several states now require. (See *Shared Tenant Services Regulatory Review* by Telestrategies Publishing, 1984.)

Although *Computer II* imposed separate subsidiary requirements upon AT&T and the BOCs, it left to the states the decision whether other telephone carriers should be required to offer competitive services and CPE through separate subsidiaries. While not apt to be widely adopted, several states, including Florida and California, are considering whether to impose some form of subsidiary requirements upon the larger of the independent telephone companies, such as GTE, to facilitate their regulatory oversight and to minimize the opportunities for cross-subsidization.

States are concerned about the impact of federal actions and increased competition upon the price and quality of local telephone service. Further, many states are increasingly concerned that high tech buildings and large corporate users are most likely to find ways to bypass the local exchange, that is to reduce their reliance upon the local telephone carrier's services. Regulators believe the loss of these users will force other users, primarily residential users, to pay a larger share of fixed telephone plant costs, causing residential phone rates to rise dramatically and service quality to decline. Because regulators wish to avoid such rate increases, there is increasing evidence of state actions to head off local bypass, even though there is little substantive evidence that massive bypass will occur or that it will have the adverse consequences being predicted. Such state actions can take the form of broad definitions of regulated activity and refusals to authorize new carriers or services. For example, in one recent case a state regulatory authority insisted that a cable system must file as a carrier when it offered a data transmission service,[14] which would potentially compete with and offer the option to bypass the local exchange carrier. Also, at least one state contends that joint use of a PBX, especially if such use crosses a public right-of-way, constitutes local common carriage. Of course a shared PBX within any large complex or campus environment would involve the crossing of such public ways. If such a position were to prevail and shared PBX[15] services were defined to be a common carrier activity as is local telephone service, shared tenant services could be significantly curtailed. Providers of such shared services would need to obtain authorization, and in light of state concerns with local service protection, such authorization can be difficult to obtain. Even if authority were granted, the providers would likely be subject to the cost-of-service pricing scheme of traditional tariff regulation, affecting rate of return and other business planning assumptions.

In addition to entry constraints, state regulatory concern for local service viability is also credited with a seemingly protectionist approach to Centrex services. Centrex service involves the use of the telephone company central office switching facilities for intercom switching and other services that can be performed by a PBX. Since they can perform many similar functions, Centrex service and PBXs are considered competitive alternatives, even though Centrex is a local, regulated service, and PBXs are defined as CPE. PBX vendors contend that Centrex service in many states has been underpriced and is not recovering all of its true costs. Until recently, Centrex was viewed as an inefficient service that was being rendered obsolete by advances in PBX technology. Prior to divestiture, AT&T was increasingly deemphasizing Centrex and migrating its Centrex customers to its PBX equipment. Further, in resolving interstate access pricing issues, the Commission imposed a per-line charge on business access lines. Since Centrex services must use one line for each connected telephone on the customer's premises, but PBXs have a much more efficient line use, these access charges substantially increase Centrex costs compared with those for PBXs. However, contrary to these trends, many of the now-divested BOCs more recently appear to be reemphasizing Centrex, and states seem inclined to perpetuate favorable tariff treatment of Centrex. For example, several state commissions have permitted Centrex tariff reductions apparently to offset the federal access charges. In other cases states are permitting carriers to negotiate rates, rather than adhering to a tariffed rate. Carriers in turn have announced plans to upgrade Centrex service as with conversion to digital service and target multitenant building projects. Such actions could reduce demand for landlord-provided shared PBX service and lower revenue projections from PBX and transmission resale accordingly.

Complaints are pending at the Commission, as well as before state commissions, regarding Centrex pricing and regarding the extent to which Centrex may be "enhanced" by the BOCs without compliance with the separate subsidiary requirement. Considerable further activity is likely before these issues are resolved. In the interim both the ultimate rate levels for, and the nature of, Centrex service are uncertain.

To illustrate the various forces at work within the states as well as how some of the issues are being resolved, four states have been sampled, namely California, Illinois, New York, and Texas. These examples are not intended to be complete or totally representative. However, these states contain major population centers, and since they have major state questions under active consideration, their actions could well suggest some general directions for state regulation.

The Public Utilities Commission of California recently released a lengthy Interim Order concerning intrastate competition in telecommunications.[16] With several shared service projects already in operation under a joint user tariff, the Interim Order consolidated many different matters, including a complaint by Pacific Telephone and Telegraph Company[17] and the applications of more than 40 different entities for authority to provide intrastate long-distance (inter-LATA) services.[18] Noting that inter-LATA competition had been authorized since January 4, 1984, the Interim Order declared that inter-LATA authorizations did not include the ability to provide local or intra-LATA service.

On the intra-LATA competition issue, the state commission attempted to compare the benefits of competition with possible adverse consequences, and it sought to define the "regulatory climate that would prevail for years to come." The California commission concluded that its goals were perhaps too ambitious for the time being and that the industry was too transitory for a final ruling. Accordingly, the order prohibited competitive entry into the intra-LATA market until such time as a record could be established regarding the effect of competition on universal service, and stated, "If we err, we should err on the side of universal service." California then launched a further study including the question of bypass.

The Illinois state legislature, through its Sunset Committee on Telecommunications, is apparently considering a rewrite of its public utility laws, and the committee chair has indicated that the legislative debate will likely involve whether service or companies should be regulated.[19] The state regulatory commission, the Illinois Commerce Commission, has not addressed the intra-LATA competition issue, apparently preferring to wait for any statutory revisions. Inter-LATA competition, however, has been authorized, and carriers are subject to what is described as streamlined regulation. Restrictions against local resale and sharing have also been removed and may be undertaken on an unregulated basis in connection with measured local service. On the question of Centrex pricing, the Illinois commission recently approved a rate reduction apparently in an attempt to offset the access line charges.

The New York Public Service Commission addressed the issue of how to regulate intrastate resale of telephone service in 1982. Rejecting a decertification scheme similar to the scheme used by the FCC, the New York commission required a reseller to obtain a certificate of public convenience and necessity from the state commission before providing service.[20] In order to obtain such a certificate, an applicant must, in addition to providing basic business information, show that it will provide an entirely new service and that it will enhance competition. A hearing on the application will be held unless otherwise ordered. In addition, the certified resellers must file all relevant pleadings with the state commission that are filed with the FCC or other state and local commissions. Claiming jurisdiction over any entity that seeks to provide a service that New York Telephone Company can offer, the New York commission has also indicated its concern with "bypass", which it will take up in 1985. This inquiry is clearly intended to encompass high tech buildings and in particular shared tenant services and to revisit its regulatory treatment of resale, notably its prohibition on local resale.

With inter-LATA entry authorized, the Texas Public Utility Commission was brought into the issue of intra-LATA competition by a Southwestern Bell petition for rule making, which sought to limit the provision of local exchange intra-LATA service to the existing telephone companies.[21] The decision of the Texas commission took on added importance because it appeared that there were currently 16 buildings in Dallas representing 10.2 million square feet of office space offering or planning to offer shared telecommunications.[22] Also, Texas seems to be a testing ground for the intra-LATA competition issue, as Southwestern Bell and various other BOCs are actively seeking sweeping pronouncements that will foreclose future local competition and could jeopardize current and planned shared service buildings. The Texas commission rejected Southwestern Bell's petition and refused to exclude non-carrier resale, including local resale services, although Southwestern Bell is expected to seek restrictions in 1985 on the offering of such services.

Local Zoning Regulation

As with any construction project, a high tech building developer must focus on local zoning codes. These zoning codes can cover telecommunications facilities, notably antennas that may be affixed to the roof of the building. In other cases, zoning codes have not kept up with advances in communications, or they have not been written to specifically address telecommunication facilities. In these cases it may not be clear how codes will impact upon antennas and other facilities. Zoning regulations (in addition to FAA regulation) may limit antenna heights or locations, and since both height and location will affect propagation and reception characteristics, the local rules can impact operability.[23] Also, either zoning or building code restrictions may govern the method by which antennas must be fastened to the building in order to ensure that the antennas can withstand the wind speed generated at the location height. These codes are likely to require inspection of the facility. In rare cases antennas may be specifically prohibited, usually because of a historic district or for other aesthetic reasons.

In all cases it will be important to determine and comply with local regulations. In one instance involving Chicago's north side, the city of Chicago is reported to have revoked permits for satellite dish antennas on numerous high rise apartment buildings. It has been alleged that this action occurred because these dish antennas are able to receive signals directly from satellite carriers, and hence the local cable television system recently franchised by the city could be "bypassed." City authorities cite the dish antenna owners' failure to obtain a needed city council variance as the reason for the revocations. Whatever the reason, this situation does point out that potential problems can occur if local regulations are not identified and followed.

It is apparent that vast differences in the nature and timing of state regulation exist. Any predictions are especially difficult given the large number of variables, but it is clear that any high tech building venture must explore the state regulatory factors, and it must pay close attention to any potential changes to state rules. Such changes could come from the state commission or legislature, the FCC, the courts, or Congress.

AT&T DIVESTITURE

In addition to the myriad of changes brought about by deregulatory decisions and technological innovations, AT&T set in motion a third major source of change when it agreed in 1982 to divest itself of its wholly owned operating companies in order to settle a major antitrust suit that had been brought by the federal government. The AT&T divestiture was implemented on January 1, 1984, but the repercussions and the unresolved issues surrounding divestiture will continue for many years. The divestiture resulted in a streamlined AT&T and seven new entities, the Regional Bell Operating Companies. The reconstituted AT&T is vigorously pursuing new ventures, including the offering of multi-tenant services. The BOCs are adjusting to a new "independence," and regional spheres of influence. While their primary business remains intra-LATA basic service, each regional company is actively pursuing a variety of new ventures, many of which relate to high tech projects and shared services.

AT&T and the BOCs contend that the divestiture substantially reduced their market power, which had been the basis for numerous rules regarding their activities, particularly the *Computer II* and *Computer Carrier* decisions. Hence these entities have sought further reductions in the level of their regulation, notably the *Computer II* separate subsidiary requirement and tariff and facility regulation. Competitors and some users have objected to the carriers' claims, contending that the carriers retain considerable facility control and must continue to be subject to regulatory scrutiny. The issue is far from being resolved, and the recent Commission decision permitting AT&T's subsidiary to resell basic service may indicate some willingness to find a new ground of accommodation.

The divestiture agreement also mandated equal access to the local exchange for all competing carriers, and the BOCs are in the process of developing and implementing this requirement. The pace and dimension of this equal access requirement will unfold over time, but it is bound to improve the technical and operational quality of service for the non-AT&T carriers and more ready access to these carriers' services. In addition, equal access may mean higher rates for competing services as the tariffs for access are adjusted to reflect a new level of market access.

The agreement, referred to as the Modified Final Judgment (MFJ),[24] released AT&T from virtually all earlier restrictions concerning the types of services it may offer. For example, a 1956 consent decree, which had precluded AT&T from offering noncommunications services, such as data processing services, was removed. In negotiating this divestiture agreement, the Justice Department's Antitrust Division believed that AT&T's market power was largely due to its control of local transmission facilities. By relinquishing ownership of the Bell Operating Companies (BOCs), it was believed this control would be removed, which in turn would diminish AT&T's power sufficiently to permit entry into lines of business previously foreclosed to AT&T. Since divestiture, AT&T has directed considerable attention to the high tech building market, and except for electronic publishing activities, the MFJ should not restrict AT&T's involvement in high tech building projects.

Since the BOCs retained control of the local exchange facilities that were deemed to be so significant a market power factor, the MFJ restricts the lines of business the BOCs may enter. These line-of-business restrictions limit the extent of BOC participation in high tech buildings. For example, the

BOCs may not offer any inter-LATA service, either directly or by resale, or manage a system that offers such services. Further, the Justice Department interprets this restriction to include such services as "least cost routing." In addition, the BOCs may sell but not manufacture CPE, and they may not offer information services, which are defined by the MFJ to mean:

> The offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information which may be conveyed via telecommunications, except that such service does not include any use of any such capability for the management, control, or operation of a telecommunications system or the management of a telecommunications service.

Where the nature of new services is not yet clearly defined, the BOCs must pay careful attention to how these restrictions could affect certain service features. For example, many aspects of the general category of service referred to as "local area networks" (LANs) would seem to be permitted, but LANs can include distributed data processing features, which could be foreclosed to the BOCs as a prohibited information service offering. If so, a BOC could not manage a system that incorporated such features absent a waiver from the Court. The extent to which line-of-business waivers in general may be granted was recently addressed by the district court that had approved the MFJ.[25] Court action upon numerous individual waiver petitions further clarify some of the circumstances under which, and the extent to which, waivers may be approved.[26]

On July 26, 1984, Judge Harold H. Greene issued his opinion dealing generally with petitions for waiver of the line-of-business restrictions. This order laid out a definitive interpretation of markets virtually beyond waiver, the factors that would be considered in waiving the restrictions and safeguards, and the conditions that would facilitate consideration of certain waivers. On the question of interexchange service, the opinion was very clear in stating that it would not consider any waiver involving the provisions of interexchange services, at least until the BOCs no longer controlled local bottleneck facilities. Likewise, the opinion indicated that no waivers involving the provision of information services[27] or equipment manufacturing would be considered absent significant technological or structural changes.

Concerning waivers for services not clearly discouraged by the court, the opinion contains four conditions that, if incorporated into the waiver requests, would put the companies in a "better position to make the requisite showing and to receive the requisite approval."[28] The conditions include the following: (1) Competitive activities for which waiver is sought must be offered through a separate subsidiary; (2) these subsidiaries must obtain their own debt financing on their own credit and may not use the financial resources or credit of the BOC; (3) the bulk of the investment of the BOC must remain in basic telephone activities (10 percent of total revenues is a maximum rule of thumb); and (4) the decree's monitoring and visitatorial provisions must apply to the competitive activities to enable the Department of Justice to monitor compliance. Subsequent to the court's opinion, the Justice Department has recommended approval of numerous line of business waiver requests which have been tailored to meet the four conditions. These requests include proposals by several regional companies to enter the real estate business as contractor, broker, and building manager, and Justice has conditioned its approval upon restrictions which prohibit the carrier from providing communications services to property which it owns or controls. The court is likely to accept the Justice recommendations. At the end of 1984, Justice and the carriers had not reached agreement in other multi-tenant areas, such as least cost routing, which Justice continues to insist is a prohibited inter-LATA service.

In the case of high tech building projects, therefore, the MFJ permits the BOCs, through their Commission-required separate subsidiaries, to provide whatever lines of CPE it may have available to it; and several BOCs offer data processing and other office equipment as well. They may offer local transmission service, including Centrex service, directly through their operating companies; and the FCC has authorized the subsidiaries and unaffiliated entities to act as sales agents of the regulated carrier in marketing local services. The BOCs cannot offer, manage a system that offers, or (it would seem) even arrange for the provision of, inter-LATA services and information services without a waiver. Instead these services must be provided by other vendors or by the owners or tenants.

BASIC SERVICE PRICING

Having acted to replace the traditional scheme of carrier regulation, it was inevitable that the earlier methods for calculating and recovering costs also would be overhauled. The process of that overhaul has been as complex as it has been controversial, generating an avalanche of paper filings with the Commission. From the viewpoint of a building developer or a shared tenant venturer, however, the significant question is how this activity will affect the pricing of services.

In the case of local service pricing, it is likely that local carrier rates will continue to climb. First, increased competition removes the ability of some services to subsidize others, and since it is generally contended that local rates have been the beneficiary of such subsidies, these rates will rise as the subsidies are removed. Competition also increases the pressure for more accelerated depreciation schedules, which translates into higher costs and hence higher rates. The notable exception to this upward trend seems to be Centrex service, for which telephone companies and some state commissions appear inclined to decrease rates, especially in urban areas. These actions are occurring without regard for alleged long-term consequences, such as artificially inflated usage patterns leading to excessive plant investment. This Centrex pricing strategy is increasingly coupled with expanded Centrex features, and it is likely to continue for the foreseeable future.

The second factor serving to raise local rates is the access charge decision, which sought to recover federal nontraffic-sensitive costs directly from subscribers through a customer access charge for each line that is used to access the network, rather than from long-distance rates. For Centrex lines already in service, these charges are being phased in while new Centrex lines and other business charges now pay the full per-line business charge. Since Centrex service uses many more lines than a PBX system, the access charge costs must be included in any cost comparison of these alternatives.

The access charge policy decision coupled with divestiture also precipitated the filing of new tariffs for all interstate services, including separate tariffs for local exchange access.[29] Tariffed rates for message toll service (MTS) and switched access generally have been approved. Tariffs for private line and "special access" should come by the spring of 1985. Access tariffs must be reviewed carefully for their cost impact. WATS access charges, for example, may be many times higher than a dedicated access line. Such cost differences can affect both project planning and tenant demand assumptions.

In the case of interstate, switched long-distance service, rates should continue to decline as the access charge decision, particularly the residential customer access charge, is implemented. Competing interstate carriers may experience increased costs and hence increased rates as they achieve local exchange access that is more equal to that of AT&T. Further, although the Commission has a published decision regarding end-user access charges, the residential portion is by far the largest cost and revenue component, and it has not yet been implemented. The Commission agreed to a moratorium on imposing these charges, bowing to congressional concerns, and when the moratorium ends a $1.00 line charge is proposed, rising to and frozen at $2.00 in June 1986. Even then, only time will tell whether Congress will tolerate transfer of the full federal NTS costs to the direct line charge. In the interim, long distance rates will continue to reflect the balance of these costs. Further, as the Commission continues to inquire into the "bypass threat," proposals are being advanced as access alternatives.[30]

As a result of the present uncertainty, the question of tariffed service pricing is quite unclear at this time. Tenants are likely to have the option of obtaining the package of services provided by the building venture or of dealing directly with other vendors. Hence, those involved in a building venture must pay close attention to the impact of potential and actual rate changes upon their own cost and rate-of-return calculations. Underlying carrier rate changes or approvals by the Commission may affect the profit margins of a venture's resale activities and tenant demand for alternative services. If a competing carrier's service is to be used, the impact of equal access must be considered. If the venture contemplates the provision or resale of intrastate services and such activities are authorized services, state tariffs for the planned capacity and its alternatives must be investigated and their effect incorporated into the venture's plans as well. If the venture contemplates shared PBX services, then the nature and pricing of Centrex service must be considered. Likewise, if a long-term rate commitment to Centrex service is contemplated, the likely state trend for these rates as well as the prospect of federal involvement must be reviewed.

■ CONCLUSION ■

Shared tenant services and high tech buildings are evidence that the process of deregulation and competition correctly foresaw the evolution of technology. Plans for these business ventures cannot be developed, however, without careful attention to regulatory constraints and consequences. At the federal level in particular, these consequences are not great and generally relate to the manner in which some entities must deal with the venture (e.g., BOC and AT&T separate subsidiaries), the nature of services that can be provided (e.g., BOC prohibited by the MFJ from offering inter-LATA or information services), and the relative rates for alternate services.

The degree of regulation at the state level is less susceptible to generalizations because of the wide variations. However, state regulation is likely to focus upon intrastate transmission activities, particularly local service, and there is typically some form of carrier regulation of intrastate service. With the increased concern over the perceived threat of local exchange "bypass," competitive alternatives to the local telephone company could be restricted in the name of regulation and local service viability, and restrictions could involve expansive definitions of local service alternatives to include local shared tenant services. Should the degree of state regulation become extensive, local reaction from developers and business users can be expected to be influential. If state actions come into strong conflict with established federal policies, federal action would seem likely.

As policymakers had predicted, technology is driving public policy to a substantial degree. The innovations now being introduced into commercial and multi-tenant residential buildings demonstrate that the hoped-for public benefits are becoming reality. Regardless of the temporary uncertainties or problems raised by regulation, in the long run the services and applications are bound only by the entrepreneurs' imaginations and the marketplace demands.

■ NOTES ■

1. Federal Communications Commission, *Report on Domestic Telecommunications Policies.* September 27, 1976, Tab C, p. 9.

2. Ibid, p. 14.

3. *See* Amendment of Section 64.702 of the Commission's Rules and Regulations (Second Computer Inquiry), 77 FCC 2d 384 (1980) (Final Decision), *on reconsideration*, 84 FCC 2d 50 (1980) (Reconsideration), *on further reconsideration*, 88 FCC 2d 512 (1981) (Further Reconsideration), *aff'd sub nom.* Computer and Communications Industry Assn. v. FCC, 693 F.2d 198 (D.C. Cir. 1982), *cert. denied sub nom. Louisiana Public Service Commission* v. *FCC*, 103 S. Ct. 2109 (1983) *(Computer II); see also* Furnishing of Customer Premises Equipment, Enhanced Services and Cellular Communications Services by the Bell Operating Companies, CC Docket 83–115, FCC 83–552 (released December 30, 1983), *reconsideration denied*, FCC 84–252 (released June 1, 1984), *aff'd sub nom.* Illinois Bell Telephone Company v. FCC, No. 84–1145 (7th Cir. June 29, 1984) *appeal of reconsideration pending sub nom.* U.S. West v. FCC, No. 84–2853 (7th Cir.) and North American Telecommunications Ass'n v. FCC, No. 84–2216 (7th Cir.) (BOC Structural Separations Order requiring the BOCs to provide CPE and enhanced services via a separate subsidiary); *see also* In the Matter of American Information Technologies Corp., BellSouth, NYNEX Petition for Waiver of Section 64.702 of the Commission's Rules to Allow Marketing of Network Services by Separate Subsidiary, ENF File No. 84–18, FCC 84–290 (released July 11, 1984) (Sales Agency Order), *appeal pending sub nom.* North American Telecommunications Association v. FCC, No. 84–1430 (D.C. Cir. filed August 20, 1984); *see also* the Commission's order developing criteria for removal of embedded CPE from regulated service: In the Matter of Procedures for Implementing the Detariffing of Customer Premises Equipment and Enhanced Services (Second Computer Inquiry), CC Docket 81–893, FCC 83–551 (released December 15, 1983) (Embedded CPE Order), *reconsideration petitions pending*, Public Notice No. 1445, 49 Fed. Reg. 5672 (released February 6, 1984).

4. In the Matter of Policy and Rules Concerning Rates for Competitive Common Carrier Services and Facilities Authorizations Therefor, CC Docket 79–252, 85 FCC 2d 1 (1980) (First Report and Order) (classified carriers as dominant or nondominant and applied streamlined regulations to the latter), 91 FCC 2d 59 (1982) (Second Report and Order) (applied forbearance to resellers of terrestrial common carrier services), *aff'd* 93 FCC 54 (1983) (*Reconsideration Order*), 95 FCC 2d 554 (1983) (Fourth Report and Order) (extended forbearance to all other resellers and specialized common carriers, and extended streamlined regulation to domestic satellite carriers, miscellaneous common carriers, and facilities-owning interexchange carriers affiliated with exchange telephone companies), 49 Fed. Reg. 34824 (September 4, 1984) (Fifth Report and Order) (removed unnecessary tariff and facilities authorization filing requirements for domsat, miscellaneous common carrier, and digital electronic message service carriers) FCC No. 84–566 (adopted November 21, 1984) (Sixth Report and Order) (eliminated the filing of tariffs for non-dominant carriers) (Competitive Carrier Rulemaking).

5. *Computer II* defined *customer premises equipment* or *CPE* as: "terminal equipment located at a subscriber's premises which is connected with the termination of a carrier's communication channel(s) at the network interface at that subscriber's premises. . . . Excluded from CPE is overvoltage protection equipment, inside wiring, coin operated or pay telephones, and multiplexing equipment to deliver multiple channels to the customer." 77 FCC 2d at 398, n. 10 and 447, n. 57. The Commission retained Part 68 of its Rules, which concerns the equipment registration program, a technically oriented, competitively neutral program designed only to examine equipment design in order to prevent harm to users or to the network.

6. *Computer II* defined *enhanced services* as: "services, offered over common carrier transmission facilities used in interstate communications, which employ computer processing applications that act on the format, content, code, protocol or similar aspects of the subscriber's transmitted information; provide the subscriber additional, different or restructured information; or involve subscriber interaction with stored information." 77 FCC 2d at 498.

7. *Computer II* defined *basic service* as: "the common carrier offering of transmission capacity for the movement of information. . . . In offering a basic transmission service, therefore, a carrier essentially offers a pure transmission capability over a communications path that is virtually transparent in terms of its interaction with customer supplied information." 77 FCC 2d at 419, 420.

8. *See, e.g.*, Long Run Regulation of AT&T's Basic Domestic Interstate Services, CC Docket 83–1147, 95 FCC 2d 510 (1983) (inquiry into the level of necessary AT&T regulation); In the

Matter of AT&T Petition for Relief from *Computer II* Structural Separation Requirements, ENF 84–17 (filed April 30, 1984) (petition for waiver of Computer II rules for AT&T); In the Matter of Authorized Rates of Return for Interstate Services of AT&T and Exchange Telephone Carriers, Notice of Proposed Rulemaking, CC Docket 84–800 (adopted August 8, 1984); In the Matter of Investigation of Access and Divestiture Related Tariffs, Memorandum Opinion and Order, CC Docket 83–1145, Phase I (released October 19, 1983), Memorandum Opinion and Order, CC Docket 83–1145, Phase I (released March 27, 1984), Memorandum Opinion and Order, CC Docket 83–1145, Phase I (released June 8, 1984), Memorandum Opinion and Order, CC Docket 83–1145, Phase I (adopted November 8, 1984).

9. Pending proceedings involving complex premises wiring questions include: In the Matter of Petitions Seeking Amendment of Part 68 of the Commission's Rules Concerning Connection of Telephone Equipment, Systems and Protective Apparatus to the Telephone Network and Notice of Inquiry into Standards for Inclusion of One- and Two-Line Business and Residential Premises Wiring and Party Line Service in Part 68 of the Commission's Rules, CC Docket 81–216, FCC 84–182 (released May 18, 1984), *partial reconsideration petition pending,* Public Notice No. 1467, 49 Fed. Reg. 28618 (released July 13, 1984); International Communications Association Petition for Declaratory Ruling Regarding the Right of Users to Access Embedded Complex Intrasystem Wiring (filed August 16, 1984). Embedded intrasystem wiring refers to the wiring in place prior to May 2, 1984, in accordance with the Commission's order detariffing intrasystem wiring. In the matter of Modifications to the Uniform System of Accounts for Class A and Class B Telephone Companies Required by Detariffing of Customer Premises Equipment and Proposed Detariffing of Customer Provided Cable/Wiring Installed as Part of an Intrasystem of PBXs and Key Systems, CC Docket 82–681, FCC 83–457 (released November 2, 1983).

10. *See:* In the Matter of American Telephone and Telegraph Co. Provision of Basic Services via Resale by Separate Subsidiary, CC Docket 83–1375, FCC 24–289 (released July 11, 1984) (AT&T Resale Decision); *see also* In the Matter of Regulatory Policies Concerning Resale and Shared Use of Common Carrier Services and Facilities, 60 FCC 2d 261 (1976), *amended,* 62 FCC 2d 588 (1977), *aff'd sub nom. AT&T* v. FCC, 572 F. 2d 17 (2d Cir.), *cert. denied,* 439 U.S. 875 (1978) (Resale and Shared Use Decision).

11. The technology behind DEMS/DTS was developed by Xerox Corporation and brought to the Commission's attention in a Petition for Rulemaking filed by Xerox. *DEMS* refers to the service, and *DTS* refers to the facilities that will provide DEMS.

12. Some of the major applicants are: ISACOMM, Tymnet, SBS, Contemporary Communications Corporation, RCA Network Services, Graphic Scanning Corporation, MCI Telecommunications Corporation, Federal Express Corporation, and the Bell Operating Companies.

13. In the Matter of Amendment of Parts 2, 21, 87 and 90 of the Commission's Rules to Allocate Spectrum for, and to Establish Other Rules and Policies Pertaining to, the Use of Radio in Digital Termination Systems for the Provision of Digital Communications Services, Docket 79–188, 86 FCC 2d 360, 390 (1981).

14. It is reported, for example, that Pacific Northwest Bell (PNB) has challenged the data transmission services of Cablesystems Pacific. PNB contends that these services are utility offerings that only a telephone company may offer or, in the alternative, PNB should be permitted to offer these services also on a deregulated basis.

15. PBX equipment is located on-premises and facilitates transmission from the customer to telephone company central offices. In addition to handling internal transmissions on-premises, i.e. intercom, its function is partially that of a concentrator. PBXs are efficient means for customers to obtain such features as call waiting, call forwarding, conferencing and "mailbox," and to upgrade features and equipment. PBXs permit customers to internally perform numerous changes and other services that had been provided by the telephone carrier at substantial charges, such as the relocation of telephone extension numbers as employees were moved within the customer's premises. Shared PBX services refer to multiple tenants acquiring one PBX the capacity and capabilities of which are then shared by these tenants, with the tenant phone systems' wiring routed through the "centrally located" PBX.

16. Order Instituting Investigation to Determine Whether Competition Should Be Allowed in the Provision of Telecommunications Transmission Services within the State, Case No. 83–05–05 (released June 13, 1984) (Interim Order). In all cases, much of the information was obtained through interviews with regulatory staff.

17. The complaint (Case No. 83–05–05), filed May 12, 1983, "alleges that MCI, Sprint and Western Union Telegraph Company have unlawfully furnished intrastate telecommunications services." *See* Interim Order at 4.

18. Local Access and Transport Area or LATA encompasses the BOCs' spheres of operation. LATAs were created as part of the AT&T divestiture to distinguish between AT&T functions and retained assets, which involve inter-LATA activities, and BOC functions and retained assets, which are limited to intra-LATA service. In many cases, a LATA includes a larger geographic area than the traditional local exchange, and hence intra-LATA services will include both *(a)* local and *(b)* short-haul, long-distance toll services. In lesser populated areas, a LATA may cover a large geographic area or even an entire state.

19. *Communications Daily,* July 25, 1984, p. 5.

20. New York Public Service Law 21 (McKinney 1982).

21. Similar pleadings were filed with the commissions of Arkansas, Kansas, Missouri, and Oklahoma, the other states where Southwestern Bell provides service.

22. *Shared Tenant Services News,* June 1984, p. 9.

23. The Federal Aviation Administration (FAA) exerts regulatory control over any objects that may affect navigable airspace, including buildings and antennas. *See* 14 CFR § 77.1–§ 77.5 (1983). Generally the contractor or owner need only notify the FAA of any proposed construction and await acknowledgement of the receipt of notice. The acknowledgement will either approve the construction or indicate that a hazard is present and set forth the remedial steps that must be taken.

24. United States v. American Telephone and Telegraph Co., 552 F. Supp. 131 (D.D.C. 1982), *aff'd,* 103 S. Ct. 1240 (1983) (Modified Final Judgment).

25. United States v. Western Electric Co. and American Telephone and Telegraph Co., No. 82–0192 (D.D.C. July 26, 1984) (BOC Line of Business Decision).

26. The regional companies are continually testing the line-of-business restrictions and they can be expected to continue to do so. The critical future tests appear to involve the interpretation of whether information services include least cost routing, voice storage, and other typical shared tenant services. The carriers appear reluctant to request a waiver for such features perhaps because of the court's separate subsidiary requirement. In other proceedings, the court must decide whether the sale of a PBX to a resale carrier to be used as a switch is a prohibited sale of telecommunications equipment or permitted as a CPE sale. (Department of Justice Motion to Compel Compliance with the Decree, October 19, 1984). In another proceeding involving computer sales, Justice has stated that any equipment capable of connecting to the network is CPE obviating the need for a waiver. Some carriers appear to be proceding in reliance on this interpretation while others are seeking waivers for a full range of office equipment sales from computers to desks. (*See, e.g.,* Further Response of the United States to Motion of NYNEX Corp. to Provide Office Equipment and Related Services, November 16, 1984; Petition to Permit Southwestern Bell Corp. to Provide Office Equipment.)

27. The functional definitions in *Computer II* and in the MFJ are not exactly parallel. For example, pursuant to the MFJ, the BOCs may offer "telecommunications service," but they may not offer "information service." Although these terms are roughly equivalent to *Computer II's basic service* and *enhanced service* definitions, respectively, there may be some activities that would constitute "enhancements" for *Computer II* separate subsidiary and other purposes, and they would come within the "telecommunications services" definition in the MFJ, instead of the prohibited "information services" category permitting the BOCs to offer them. Neither the Court nor the Commission has yet determined what these "enhanced telecommunications services" may be, but it may be an important matter for the BOCs. The questions involving enhanced Centrex, such as the petition now pending at the Commission (ENF 84–2), may be the occasion for such determinations.

28. BOC Line of Business Decision, *supra*, note 25 at 52, n. 101.

29. In the Matter of Investigation of Access and Divestiture Related Tariffs, Memorandum Opinion and Order, CC Docket 83–1145, Phase I (released October 19, 1983); Memorandum Opinion and Order, CC Docket 83–1145, Phase I (released March 27, 1984); Memorandum Opinion and Order, CC Docket 83–1145, Phase I (released June 8, 1984) Memorandum Opinion and Order, CC Docket 83–1145, Phase I (adopted November 8, 1984).

30. *See, e.g.*, the recent proposal by NARUC, referred to as the St. Louis Resolution, adopted May 8, 1984, on which the Commission has requested and received public comments (Commission Seeks Comments on National Association of Regulatory Utility Commissioners (NARUC) Response to Common Carrier Bureau Questions on the St. Louis Resolution [MTS and WATS Market Structure Inquiry, CC Docket 78–72; Amendment of Part 67 of the Commission's Rules, CC Docket 80–286), 49 Fed. Reg. 37434 (September 24, 1984)]).

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Chapter 22

The Regulatory Foundation for High Tech Buildings: The *Computer II Inquiry*

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Outline

It is virtually beyond dispute that the most significant regulatory development affecting the growth of high tech buildings is the FCC's *Computer Inquiry* proceedings, which have been underway since 1966. The effects of the series of decisions issued in this proceeding permeate every corner of the high tech building, including customer premises equipment (CPE), switching equipment, local area networks, enhanced transmission services, computers inside wire, and local transmission service.

Many observers believe that the deregulatory advances implemented by the Commission in this seminal proceeding have actually made possible the development of high tech real estate. Certainly the deregulation of computers, customer premises equipment, and enhanced transmission services has sparked the application of these products and services in numerous real estate settings.

The *Computer Inquiry* decisions further establish the rules of conduct between telephone companies and outside equipment and service suppliers. The decisions also identify the guidelines under which AT&T, the Bell Operating Companies, and other telephone companies can provide unregulated services and participate as vendors in all or various parts of the high tech real estate market.

Although the FCC presently is reconsidering the desirability of many of these rules, *Computer Inquiry* is must reading for any party wishing to understand the regulatory consequences of providing telecommunications-enhanced real estate. The intent of this article is to trace the regulatory development of the *Computer Inquiry* proceeding and the resulting regulatory treatment of the various components of high tech buildings.

THE FIRST *COMPUTER INQUIRY*

The first *Computer Inquiry (Computer I)* was initiated November 10, 1966, as a broad-ranging investigation of the increasingly complex interrelationship of the computer/data processing and communications industries.[1] As initially framed by the Notice of Inquiry, the proceeding covered a broad range of issues, including the need for new common carrier service offerings, restructuring rates to accommodate new computer services, and these questions:

> whether, and under what circumstances the rendition of data processing and other computer services involving the use of communications facilities should be free from, or subject to, government regulation; whether, and under what conditions, the entry into the provision of such computer services by common carriers and others requires regulatory control. [28 FCC 2d at 291]

The Commission ultimately chose to focus on these last two issues.

Distinguishing "Data Processing" and "Communications"

It is noteworthy that in this first *Computer Inquiry,* the Commission gave very little consideration to the question of how to divide regulated communications services from unregulated computer and data processing services. In a half page the opinion sets forth, without discussion, the definitions on which the commission was to rely in distinguishing the two sectors of the industry. *Computer I* defines *data processing*, in effect, as the use of the computer for any processing application except circuit or message switching. *Remote access data processing* was defined as data processing that used communications facilities to link a central computer to remote customer terminals. *Message-switching,* a communications function, was the computer-controlled transmission of a message via communications facilities without alteration of the message's content. The Commission also defined a *hybrid service* category, made up of services that combine remote access data processing and message switching in a single integrated service.

Extent of Regulation

The Commission next considered whether or not data processing and other computer-related services should be regulated. The Communications Act of 1934 confers comprehensive powers upon the Commission to regulate "the rendition for hire of interstate and foreign communications services." This authority has been interpreted to include "jurisdiction over communications facilities and services not in existence or even anticipated" at the time of the 1934 Act. Thus the Commission concluded that regulation of data processing services which were integrated with communications services was within its authority.

The fact that such jurisdiction is available under the 1934 act does not mean that the Commission was required to assert it. The Commission announced it would determine the advisability of exercising jurisdiction with reference to "the basic purpose of regulatory activity in the context of our general national policy." This policy dictated:

> Government intervention and regulation are limited to those areas where there is a natural monopoly, where economies of scale are of such magnitude as to dictate the need for a regulated monopoly, or where such other factors are present to require governmental intervention to protect the public interest because a potential for unfair practices exists [28 FCC 2d at 297].

Using this standard, the Commission determined not to regulate data processing services.

The problems created by this decision to remove computer/data processing services from regulation are apparent from the Commission's handling of its *hybrid services* category. By definition, a *hybrid service* combined communications and data processing elements. The Commission was particularly concerned with whether such a service should be regulated like a communications service or left free from regulation as are other data processing services. It was ultimately decided to make this determination according to whether the communications or data processing element dominated in the hybrid service.

Under this formulation, a hybrid service would be subject to regulation if it were shown to be basically a substitute for communications common carrier service or if the message-switching component of the service was essentially independent of its data processing element. The Commission declined to enumerate examples of hybrid services, finding that these services could be better identified on a case-by-case basis.

Carrier Participation in Data Processing

The Commission also considered whether entities providing regulated communications services should be allowed to enter unregulated information services market, and if so, under what conditions. Here, the Commission took the middle ground to allow entry subject to regulatory safeguards. Entry by local telephone companies in these new markets without such precautions was believed too risky, since such carriers could subsidize unregulated enterprises with revenues derived from their regulated monopoly services. The FCC was also concerned that these carriers would be able to discriminate against competitors in providing the communications component of data processing services. To the extent that carriers focused on data processing services, their provision of communications services could suffer. The Bell System companies were believed to be foreclosed from providing these services under a 1956 consent decree.

The Maximum Separation Policy

The Commission maintained that the regulatory safeguards imposed should seek to assure:

> *(A)* That such services will not adversely affect the provision of efficient and economic common carrier services;
> *(B)* That the costs related to the furnishing of such services will not be passed on, directly or indirectly, to the users of common carrier services;
> *(C)* That revenues derived from common carrier services will not be used to subsidize any data processing services; and
> *(D)* That the furnishing of such services will not inhibit free and fair competition [28 FCC 2d at 302].

To achieve these objectives, the Commission adopted a "maximum separation" policy requiring local telephone companies to furnish data processing services only through separate corporate entities. The separation rule required that a common carrier's data processing affiliate use separate officers and personnel, equipment and facilities, maintain their own books of account, and file separate annual reports. The Commission further required that the carrier notify it of all intercorporate agreements between itself and its affiliate and that affiliated data processing entities obtain communications facilities from their parent only pursuant to generally applicable tariff terms and conditions. On appeal, the U.S. Court of Appeals for the Second Circuit struck down this later requirement prohibiting carriers from obtaining data processing services from their affiliates.

THE SECOND *COMPUTER INQUIRY*

The *Computer I* distinctions between communications and data processing were obsolete soon after they were finalized. Technological development in the information industry resulted in a new "distributed processing" environment in which central computer facilities were replaced with "intelligent" networks and customer premises terminal equipment. In this environment, the *Computer I* definitional framework broke down.

The *Computer I* definitions had distinguished between communications and data processing services on the basis of the functions involved in rendering the service. In an integrated environment in which communications and data processing functions were used to supplement one another, it made no sense to attempt to distinguish among services based on whether the communications or data processing component was integrated with or incidental to the service. Further, distributed processing service was determined not by the transmission facilities under carrier control but rather by the equipment attached by customers to transmission channels. More important, the increasingly artificial *Computer I* definitions prevented efficient use of computer facilities since, under maximum separation, computer resources could not be used for both communications and data processing applications.

Computer II focused on the emerging role of computer applications in the communications industry. Specifically, the Commission sought to determine: (1) what computer applications a common carrier would be allowed to use in providing communications services; (2) under what regulatory structure enhanced computer services could be provided by common carriers or others; and (3) by what criteria should the Commission use to distinguish between basic transmission services, enhanced communication services, and enhanced data processing services.

DISTINGUISHING DATA PROCESSING AND COMMUNICATIONS

Computer I distinguished between communications and data processing on an assumed difference between the functions involved in providing the two services. In place of this distinction, *Computer II* initially proposed a two-tiered scheme: (1) a distinction was made between basic transmission services and all other, enhanced, services; (2) a distinction was proposed between enhanced communications services and enhanced data processing services.

Basic and Enhanced Services

Under these initial proposals, *Computer II* defined basic voice service as "the electronic transmission of the human voice such that one human being *can orally* converse with another human being." Basic nonvoice service was defined as "the transmission of subscriber-inputted information or data where the carrier: *(a)* electronically converts originating message to signals that are compatible with a transmission medium; *(b)* routes these signals through the network to the appropriate destination; *(c)* maintains signal integrity in the presence of noise and other impairments to transmission; *(d)* corrects transmission errors; and *(e)* converts the electrical signals to usable form at the destination." 72 FCC 2d at 394.

The Commission defined enhanced nonvoice service as "any nonvoice service that is more than the "basic" service, where computer processing applications are used to act on the form, content, code, protocol, etc., of the inputted information." 72 FCC 2d at 394.

In creating the enhanced services category, the Commission sought to address a problem created by application of the maximum separation rules to the *Computer I* hybrid services category. Since it was often difficult to articulate whether a hybrid service was a communications or a data processing service, it was difficult for providers to know whether or not the maximum separation requirement applied to the provision of a particular service. This, it was feared, inhibited innovation in manufacturing and designing equipment and services. Worse still, the maximum separation rules prohibited the provision of both hybrid data processing and hybrid communications services through the use of a single computer facility. The rule thus resulted in inefficient use of computer resources and forced users and providers to make inefficient use of these resources.

In its Final Decision, the Commission discarded this three-way—basic voice/basic nonvoice/enhanced nonvoice—classification in favor of a definition that simply divided communications offerings between "basic transmission service" and "enhanced services." Into the basic transmission services category were placed both the voice and basic nonvoice classes of the previous definition.

The voice/nonvoice distinction relied upon by the Commission in its tentative decision had been roundly criticized by commentors who argued that the distinction was artificial and "[would] eventually fall of its own weight as technology evolves." 77 FCC 2d at 417. This artificiality was pointed up by the fact that both voice and nonvoice services were present on either side of the structural separation line as defined in the tentative decision. The new definition replaced this distinction with the basic/enhanced dichotomy, which was expected to focus on more fundamental differences in the types of service provided by the industry.

In defining basic transmission service, the Commission no longer could rely on distinctions based on the purpose to which users put the service. Thus, in defining basic transmission service, the Commission focused on the characteristics of transmission itself.

> A basic transmission service is one that is limited to the common carrier offering of transmission capacity for the movement of information. . . . [A] basic transmission service should be limited to the offering of transmission capacity between two or more points suitable for a user's transmission needs and subject only to the technical parameters of fidelity or distortion criteria, or other conditioning. . . . Thus, in a basic service, once information is given to the communication facility, its progress towards the destination is subject to only those delays caused by congestion within the network or transmission priorities given the originator. [77 FCC 2d at 119–20]

The Commission clung to the method of classification by mutual exclusion in defining enhanced services solely in terms of basic transmission services. "An enhanced service [constitutes] any offering over the telecommunications network which is more than a basic transmission service." Enhanced services are those in which the subscriber uses computer applications provided by the communications carrier to "act on" subscriber-provided information.

In *Computer II,* the Commission decided against regulating enhanced services. Although asserting that enhanced services fell within the FCC's jurisdiction, the Commission declined to regulate these services. As the Commission noted, "not all services involving the electronic transmission of information are communications services subject to regulation under Title II," and "all those who provide some form of transmission services are not necessarily common carriers." 77 FCC 2d at 431.

At the boundary, the distinction between basic and enhanced services blurs. Certain ancillary services directly related to the provision of plain old telephone service (POTS) may be provided directly by carriers in conjunction with basic transmission service. These services include: call forwarding, speed calling, directory assistance, itemized billing, traffic management studies, and voice encryption. In distinguishing between (1) services that may be provided in conjunction with basic transmission service and (2) services that are classified as enhanced and are therefore subject to structural separation requirements—the Commission will apply the rule that "any option that changes the nature of such telephone service is subject to the basic/enhanced dichotomy and their respective regulatory schemes." 77 FCC 2d at 421.

In the *Computer II* Final Decision, the Commission concluded that an attempt to distinguish between enhanced data processing and enhanced communications services "would be ultimately futile, inconsistent with our statutory mandate, and contrary to the public interest." 77 FCC 2d at 425. The Commission did not generally believe that the distinction was workable in the environment of the information industry with its rapid technical evolution. Any communication/data processing distinction was necessarily based on a current configuration of services. This configuration would change rapidly along with the technical evolution of the industry. Regulatory distinction thus would either impede new developments or, to the extent the rule was administered to keep pace with these developments, would burden the Commission with a multitude of ad hoc decisions. The Commission also found that the proposed distinction "would most likely result in the direct or indirect expansion of regulation over currently unregulated vendors of computer services." 77 FCC 2d at 425.

CUSTOMER PREMISES EQUIPMENT

In *Computer II* the Commission also addressed the regulation of carrier-provided CPE—another important component of the high tech building. Integration of communications and data processing systems was occurring rapidly, not only in provision of network services, but with CPE as well. Thus the Commission was concerned whether or not the provision of CPE by carriers should be subject to the same data processing/communications definitional structure and resale requirements as were network services. In an earlier set of decisions, the FCC permitted noncarrier vendors to attach their customer premises equipment to the network, provided that it meets certain technical requirements as set forth in Part 68 of the FCC's rules.

In deciding that it would require carriers to deregulate CPE and unbundle it from regulated transmission offerings, the Commission noted that, contrary to network services, CPE is characterized by rapid evolution. In this environment, regulation would be rapidly outmoded and would serve to deter desirable technical innovation. Because CPE can be put to various uses, attempts to classify CPE as either data processing or communications would be largely arbitrary and would force providers to make uneconomic design choices.

Final Decision: CPE Deregulation

The Commission found it necessary to "unbundle" and detariff carrier-provided CPE for several reasons. First, continued regulation could distort the Commission's new basic/enhanced dichotomy, since it would allow carriers to provide directly to end users CPE that was capable of providing enhanced services. Second, allowing carriers directly to offer CPE allowed them to bundle terminal equipment and transmission service charges. This could result in rate distortions in either area. It could also restrict freedom of consumer choice of the goods to be purchased as well as inhibit competition if carriers chose to set predatory prices for the CPE they offered in order to discourage noncarrier vendors.

In support of its decision, the Commission found that the act did not require that all CPE be offered as part of a communications service; nor did the act require that all CPE be offered on a tariffed basis, subject to regulation. While affirming its jurisdiction over CPE, the Commission cited persuasive precedent for the proposition that mere provision of CPE did not constitute a common carrier service.

THE STRUCTURAL SEPARATION REQUIREMENT

Computer II retains the maximum separation policy initiated in *Computer I,* although in a different form. *Computer I* required separation between regulated communication services and unregulated data processing services. *Computer II* drew the line instead between basic communications services (whether or not they used data processing applications) and enhanced services CPE.

While admitting that the separate subsidiary requirement would not "guarantee a competitive marketplace because it does not significantly change the incentives of a firm upon which it is imposed," the Commission nevertheless believed that separation "reduces the ability of dominant firms to engage in [predatory pricing] or to do so without detection." 77 FCC 2d at 462. The chief benefit of separation was allegedly "protection for the regulated market rate payer against costs transferred from the competitive market by the parent corporation, and protection for the general public against such anticompetitive activities as denial of access and predatory pricing." 77 FCC 2d at 463. The Commission further believed that separate subsidiaries would stimulate a healthy market for enhanced services and would thereby lower the unit costs of transmission. The major cost alleged to result from the separation requirement was a diminished rate of innovation said to result from the prohibition on vertical integration.

The Commission determined that it would apply the separation requirement only to dominant carriers, "those telephone companies having sufficient market power to engage in effective anticompetitive activity on a national scale and which possess sufficient resources to enter the competitive market through a separate subsidiary." 77 FCC 2d at 469. The Commission measured "market power," especially in terms of the control of local facilities. On the basis of these standards, it ultimately decided to apply the separation requirement only to the Bell System companies. Other telephone carriers, including GTE, need not establish separate subsidiaries to promise CPE or enhanced transmission services. However, to the extent that these nondominant carriers use their own transmission services in providing enhanced services, they must acquire those facilities pursuant to the terms, prices, and conditions reflected in their tariffs.

In defining the extent of the separation requirements, the Commission announced its intent "to impose only the minimum [requirements] necessary to address those regulatory concerns where sole reliance on accounting is an inappropriate safeguard." 77 FCC 2d at 476. Carriers subject to the separation requirement must maintain separate books of account from their unregulated subsidiaries. At the time of its decision, the commission prohibited the joint marketing of enhanced services by a dominant carrier and its separate subsidiary. Moreover, a dominant carrier was precluded from sharing physical or computer facilities as well as software develpment with its separate subsidiary.

As to the sharing of technical information, the Commission required dominant carriers to release network design and technical standards to competitors of its separate subsidiary at the same time it disclosed them to the subsidiary. Research and development results could be shared on a fully compensated basis (with the exception of software). Moreover, customer proprietary information must be disclosed to other competitive vendors at the same time it was disclosed to the subsidiary. A dominant carrier was not required to find independent financing for its subsidiaries but rather was required to submit a subsidiary capitalization plan for prior FCC approval.

APPLICATION OF *COMPUTER II* REQUIREMENTS TO THE BOCs

When *Computer II* was implemented in 1980, the Bell System was a consolidated entity consisting of 22 wholly owned BOCs, AT&T Long Lines, and Western Electric. One of the major effects of the divestiture agreement between AT&T and the U.S. Department of Justice was the divestiture of the BOCs, which were eventually reconfigured into seven separate regional telephone holding companies.

Following release of the divestiture order, the question arose whether the post-divestiture BOCs should continue to be treated as dominant carriers and be required to provide CPE and enhanced transportation service offerings only through separate subsidiaries. In December 1983, the Commission stated in its *BOC Separation Order* that it would continue applying the *Computer II* structural separation requirements to the BOCs but modified that decision, as it applied to the BOCs, in the manner described below. The extent to which the BOCs may provide CPE and enhanced services defines its ability to compete in the high tech building market.

Alternative corporate structures. The *Computer II* rules generally require a dominant carrier's competitive activities to be segregated from its regulated activities by means of a separate corporation. In its *BOC Separation Order,* however, the Commission recognized that other separation arrangements, such as use of unincorporated divisions, might be advantageous to the BOCs. Accordingly, the Commission indicated that it would permit the BOCs to establish structural alternatives to separate incorporation if they achieved the degree of separation required in *Computer II.*

Joint billing. The *BOC Separation Order* allows the BOCs to provide billing for both their regulated services and CPE offerings for a period of four years following divestiture. *Computer II* prohibited joint billing on grounds that (1) it would be virtually impossible to allocate properly the costs of billing services between regualted and unregulated operations, giving rise to cross subsidy opportunities; (2) joint billing might provide subsidiary employees access to sensitive customer proprietary information; and (3) such billing functions as bill dispute resolution are central to promoting customer relations. The Commission believed that unregulated subsidiaries might exploit access to this relationship to the disadvantage of competitors.

In spite of these concerns, the Commission found that joint billing by the BOCs was necessary to prevent "consumer confusion," which might result if the BOCs were allowed to bill for embedded CPE (which, under divestiture, had been transferred from the BOCs to AT&T Information Services, AT&T's separate subsidiary) but were required to submit separate bills for new CPE sold by the BOCs' unregulated subsidiaries.[2]

Several commenters objected that permitting joint billing would actually serve to create, rather than alleviate, customer confusion caused by divestiture. Joint billing could be seen by customers as an implied threat that local service might be terminated for failure to pay CPE charges. The Commission, however, was not swayed by these assertions, finding that its guidelines for joint billing procedures were sufficient safeguards against these alleged difficulties.

Dialtone referrals. The Commission now allows a BOC to refer customers to its unregulated affiliate provided that it informs the customer that CPE and enhanced services also can be obtained from other vendors. The Commission refused to permit BOCs to engage in general marketing of their separate affiliates' products and services on these grounds: (1) Simple accounting controls would not effectively allocate marketing costs between the competitive and regulated entities, thus raising the risk that rate payers would be forced to subsidize competitive activities; (2) combined marketing of regulated and unregulated products would recreate the potential for abuses the *Computer II* rules had sought to prevent, in that the BOCs might exploit and transfer their monopoly-derived positions into unregulated markets.

Despite objections from certain parties that the FCC would be unable to monitor BOC referral practices effectively, short of actually specifying permissible language or procedures, the Commission chose to except dialtone referrals from the general prohibition on joint marketing. The Commission reasoned that (1) the BOCs will reenter the extremely competitive CPE markets with a zero market share; (2) allowing BOC personnel to explain that both BOC affiliates and other vendors supply CPE will reduce postdivestiture customer confusion; and (3) referrals do not present a high risk of cross-subsidization.[3]

Joint installation and maintenance. The *BOC Separation Order* further permits the BOCs to provide installation and maintenance support in the provision of residential and single-line business telephones by their unregulated subsidiaries. The Commission refused, however, to allow BOCs to provide maintenance support for complex business CPE marketed by their unregulated affiliates. Since installation and maintenance of complex business CPE requires specialized personnel, the Commission concluded that it should not be provided by BOC network maintenance personnel. According to the FCC, any attempt to share maintenance costs would involve cumbersome regulatory oversight of cost allocation.

Shared administrative services. Finally, certain parties argued that the Commission should have specified the types of services that the BOCs will be permitted to share with their separate subsidiaries. However, the FCC concluded that its requirement that the BOCs file a shared administrative service plan would be sufficient to ensure that there is no unjustified sharing of services.

Relevance of* Computer II *guidelines. Several BOCs contended that the FCC erred in imposing a structural separation requirement on the BOCs without strictly following the Commission's dominant carrier guidelines.[4] The Commission dismissed this contention, stating that its guidelines for defining dominant carriers must be weighed along with other considerations in a cost-benefit analysis. Using this standard, the Commission determined that BOC control over bottleneck facilities was sufficient to give them the ability and opportunity to engage in anticompetitive conduct or to attempt to subsidize competitive products and services with revenues derived from regulated offerings. In the FCC's view, the benefits of a modified structural separation requirement in controlling these tendencies outweighs the costs or inefficiencies that might result from separating competitive and regulated activities.

Perceived Need for Structural Separation to Prevent Anticompetitive Conduct

Certain BOCs contended that prevailing regulatory safeguards applicable to all telephone companies are sufficient to prevent anticompetitive activities in unregulated CPE markets, without the further restriction of structural separation. Among the regulations the BOCs mentioned in this regard are:

1. The FCC's Part 68 equipment registration program.
2. The *Computer II* network information disclosure rules, which require all carriers to disclose to third parties network information affecting interconnection.
3. The announced intent of several of the BOCs to continue using centralized operations groups (COGs) to ensure equal interconnection of competing vendors' CPE.

The FCC found that although these regulations might at some point provide sufficient safeguards to protect the public interest, structural separation would reduce the common transactions between BOCs and their affiliates and would highlight transactions in which the risks of anticompetitive conduct were high.

Perceived Need for Structural Separation to Prevent Cross-Subsidization

In its order on reconsideration, the Commission also found that, absent structural separation, a substantial risk existed that the BOCs could use their monopoly bottleneck positions to engage in cross-subsidization of unregulated products by regulated activities. The Commission also noted that state regulation cannot alone prevent cross-subsidization, since the multistate nature of the regional companies places aspects of their activities beyond the reach of state regulators. The FCC further noted that it would scrutinize the BOCs' access charge tariffs closely to ensure that no improper expenses are included in the rate base. According to the Commission, this objective will be furthered by structural separation, which will reduce the amount of accounting review the Commission must undertake. Finally, the Commission reasoned that the structural separation requirement helps ensure that the BOC subsidiaries will not burden the basic regulated network. Under the Commission's reasoning, financially independent subsidiaries will not compete for additional funds that would otherwise be used to improve the basic network.

The Commission also rejected the contentions of certain BOCs that they would be unable to support the expense of structural separation. Moreover, the Commission rejected the argument that it is unfair to require separation of the BOCs and not require separation for the GTE operating companies. Although admitting certain similarities between GTE and the BOCs, the FCC nonetheless found an important distinction between the two in that BOCs often dominate urban population centers, whereas CPE marketing efforts—as well as multi-tenant buildings—are likely to be most intense. In contrast, the FCC noted that even in geographic areas where GTE is a formidable presence, geographically adjacent BOCs are frequently larger carriers.

The *BOC Separation Order* was appealed to the U.S. Court of Appeals for the Seventh Circuit (Illinois Bell Telephone Co. v. FCC, Docket Nos. 84–1145, 84–1382, 84–1475, June 29, 1984), which upheld the FCC order. In that proceeding appellent BOCs objected that, in requiring them to establish separate subsidiaries for the provision of CPE and enhanced services, the Commission had "changed regulatory directions without explanation" Opinion at 6. *Computer II* had established criteria for application of the separation requirement. Most important of these criteria was nationwide control of bottleneck facilities. The companies argued that after divestiture they lacked this nationwide control and thus could not, under the *Computer II* standards, be required to establish separate subsidiaries.

The Seventh Circuit agreed that the FCC order modified the *Computer II* rule by applying separation requirements to companies that did not have nationwide control. The court found, however, that this modification was not so inconsistent with the *Computer II* standards as to require the commission to have justified its "changed policy" or, failing such justification, to require the court to reverse the order. Although the new ruling was inconsistent in terms with the *Computer II* standards, the fact that the BOCs had monopoly power in local exchange areas that could be used to cross-subsidize competitive offerings made the BOC separation order consistent with the policies underlying *Computer II.*

The court was not persuaded by the suggestion that the costs of separation were particularly high; it noted that none of BOCs had offered evidence of the expense of the separation to the Commission on their petitions for reconsideration in this matter. Although the court found the Commission's attempt to distinguish between the BOCs and the independent companies not fully persuasive, it was not swayed by the argument that the Commission's order created an irrational distinction between the BOCs and independent telephone companies, such as GTE, Cincinnati Bell, and SNETCO, not subject to the separate subsidiary requirement.

AT&T PETITION FOR RELIEF FROM SEPARATION REQUIREMENTS

On April 30, 1984, AT&T filed a petition with the FCC requesting that it be relieved from the *Computer II* structural separation requirements. This petition was still pending at the time this chapter was drafted. In essence, AT&T argued that the benefits the Commission had sought to achieve by imposition of the *Computer II* separation rules had been achieved by divestiture. If continued in force by the Commission, *Computer II* would allegedly impose burdensome costs on AT&T and hinder the development of the information services market. AT&T noted that the Commission consistently had recognized that its structural separation requirements were "provisional," therefore to be reevaluated upon change of circumstances. AT&T suggested that divestiture and "explosive competition" now seen in the communications industry constituted just such changed circumstances.

AT&T argued that continued imposition of the *Computer II* restrictions was inappropriate under the criteria set forth in *Computer II* itself. First, postdivestiture AT&T controlled no bottleneck local loop facilities and thus had no opportunity to cross-subsidize competitive enterprises from monopoly rates. (Local exchange facilities had been transferred to the BOCs by divestiture.) AT&T asserted that the inter-LATA facilities it retained were not bottleneck facilities because competition in these service areas was healthy and growing. According to AT&T, were it "to deny enhanced services venders use of its intercity network in these markets or raise its rates in an attempt to cross-subsidize its competitive offering in markets for CPE and enhanced services, the effect would be to drive subscribers to the services of AT&T's competitors" (Petition at 18). Although AT&T did retain some "monopoly power" over certain routes, these routes were reportedly low-density rural routes, which would not yield super competitive profits, and thus could not be used to cross-subsidize competitive enterprises.

Second, AT&T asserted that it had no ability to use revenues from basic services to engage in cross-subsidization to the detriment of the communications ratepayer. Divestiture deprived AT&T of the "pool" of monopoly revenues from which to cross-subsidize competitive enterprises. Competition in the markets in which postdivestiture AT&T operates would also prevent any AT&T attempts to misallocate joint and common costs.

Third, joint research and development by AT&T and its affiliates could not be used to transfer costs from unregulated to monopoly services. The Commission had required structural separation to reduce the risk that excessive prices would be paid for equipment used in monopoly services and to inhibit the use of monopoly revenues to fund R&D for competitive CPE sales and enhanced services offering. Again, divestiture had eliminated these concerns by eliminating the connection between the BOCs and AT&T—the BOCs had no incentive to pay excessive prices for AT&T equipment. The market for provision of these services was competitive. R&D activities would not be a vehicle for transfer of unregulated costs to regulated industry rate payers, since AT&T's equipment sales to BOCs and independent telephone companies provide a market test of the prices that AT&T Communications paid for AT&T equipment from its affiliated manufacturing arm.

AT&T did have the resources to establish a separate subsidiary, the fourth *Computer II* criterion, as demonstrated by its formation of AT&T Information Systems (AT&T–IS). AT&T argued, however, that the issue now was whether maintenance of the separation requirements would produce benefits to competition that outweighed their costs.

Further, AT&T asserted that the separation requirements would prevent it from providing single system service to customers: Business customers "increasingly demand that a single company offer 'system' solutions for their communications needs" Petition at 43. AT&T noted in particular that it was hampered in the "full-service communications and building management package area, especially in multiple-tenant buildings and among multiple-premised locations, including the new "teleport" concept, . . . [N]ot only is this one of the fastest growing areas of business, but it is one of the most creative, allowing communications companies the opportunity to tailor their offerings to the needs of particular customers and sites. . . . Yet AT&T's ability to compete has been effectively hampered by the separation rules" (Petition at 44–45).

The FCC is presently considering AT&T's request to shed itself of the *Computer II* separate subsidiary requirements, which is a proposal strongly opposed by interexchange carriers, equipment manufacturers and suppliers. At the present time, the *Computer II* separation rules, in conjunction with the MFJ, still apply to AT&T and the BOCs. As a result, these rules directly affect the ability of these companies to serve the high tech buildings in the most efficient manner, and, in the case of the BOCs, the ability to offer high tech buildings the wide array of services offered by nonregulated entities.

■ NOTES ■

1. In the Matter of Regulatory and Policy Problems Presented by the Interdependence of Computer and Communications Services and Facilities, 28 FCC 2d at 291 (rel. April 3, 1970) *(Tentative Decision).*

2. BOC joint billing arrangements, however, are subject to the following limitations:
   a. BOCs may not provide bill dispute resolution or collection services for CPE charges.
   b. Partial payments of bills must first be applied against charges for regulated transmission services.
   c. BOCs may not terminate regulated transmission service due to a customer's failure to make payments to the BOC's CPE affiliate.

3. BOCs will be allowed to refer customers to their unregulated affiliates subject to the requirements that (1) all costs of providing such referrals be charged to the affiliate pursuant to a commission-approved marketing plan and (2) BOCs wishing to engage in such referrals file an accounting plan with the FCC 60 days after the release of the December 30 order.

4. The guidelines focus upon (1) a carrier's ability to engage in anticompetitive activity through its control over local transmission bottleneck facilities, (2) the carrier's ability to engage in cross-subsidization detrimental to rate payers, (3) the carrier's vertical integration with entities supported by basic communications services-derived revenues, and (4) the carrier's possession of resources sufficient to enable it to enter competitive markets through a separate subsidiary.

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Chapter 23

Financial and Tax Aspects of High Tech Real Estate

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Outline

In 1983 only a handful of buildings offered multi-tenant telecommunications services. Today, such systems are under construction in numerous projects, with many more still in the discussion stage. These systems enhance the real estate and enable developers to truly differentiate their property. This differentiation adds to the attractiveness of the development, which should lead to a faster lease-up and a continued high-occupancy rate in the future. The developer therefore has an opportunity to reduce the risks associated with building speculative office space in this highly competitive marketplace. Because of this opportunity, most developers are contemplating offering shared services in their buildings. The purpose of this chapter is to provide insight on the concepts to be considered in making a decision to offer shared tenant services, and to review the impact that the Internal Revenue Code has not only on these services, but on all of the components of a high tech building.

SHARED TENANT SERVICES

The excitement generated by the substantial growth of the shared tenant service market has resulted in every telecommunication entity attempting to enter the area. Numerous entities have entered the market without either the technical or financial wherewithal to survive in this ever-changing industry. Therefore, it is inevitable that a shakeout of the participants will occur with those who fully evaluate the market prospering, while the others fall by the wayside. This is an important fact to be noted by all interested parties.

The business strategy to take must be carefully determined both to maximize the entity's profit potential and to fit in with its overall company business plan. The alternative forms for providing shared services are as follows:

- Having the developer purchase and operate the system.
- Permitting a third party to provide the services directly to the tenants.
- Forming a joint venture with a third party to provide the system and service to the tenants.

An evaluation of the costs of being a provider is the final element for consideration. In determining the financial feasibility of an approach, the most important element is to ensure that the risks and related rewards are balanced, so as to maximize profit potential. This can only be achieved by thoroughly analyzing all of the financial considerations of a shared service system.

STRATEGIC ALTERNATIVES—SHARED TENANT SERVICES

The following section discusses in detail the alternatives for providing shared telecommunication services. Analyzing these alternatives is an important step in determining how to offer these services.

Purchase

Under the purchase scenario, a developer has direct responsibility over purchasing, installing, managing, operating, and maintaining the telecommunication system. Although some of these functions may be subcontracted to vendors or telecommunication management companies, the ultimate control over the system rests with the developer.

The purchase approach has two primary advantages. First, the developer maintains total control over the system and decisions involving features (i.e., voice mail, electronic mail, data processing, etc.) that will be offered to office tenants in the future. Second, since they have taken all the financial risk in the system, all potential profits will go directly to the developer.

The major disadvantage of the purchase approach is the high degree of financial risk to the developer. Due to large capital outlay and fixed costs involved in purchasing and operating a system, the developer must be able to obtain a certain level of tenant participation in order to break even. Since the decision to purchase a system is often made before a building is completely leased, a degree of uncertainty exists relating to future tenant participation. Furthermore, the lack of developer telecommunications experience could lead to some inefficiencies in managing and operating the system.

Third Party

The second alternative available to the developer is having a third party (i.e., telecommunication managing company or vendor) provide the system and service directly to the tenants with little or no developer involvement. Under this scenario, a third party would have virtually exclusive control over the acquisition, installation, management, and maintenance of the system. All future decisions regarding the acquisition and installation of additional system features rest solely with the third party. Depending on the agreement with the third party, the developer could receive a small percentage of net income or gross revenue from system operation.

The primary advantage with the third-party approach is that the developer is able to provide a telecommunications system to its tenants with absolutely no financial risk or capital outlay. Since the developer has no financial or operational responsibility with the system, he/she would have no liability in the event of a system breakdown.

The major disadvantage in the third-party service scenario is the lack of management input on the developer's part relating to the operations of the system. As mentioned above, the developer has no involvement in the decisions regarding future acquisitions of additional system features. Another disadvantage relates to the third party's ability to complicate the developer plans to network telecommunication systems at various locations. Finally, under the third-party scenario, the developer has little or no share in current and future profits generated by the telecommunications system.

Joint Venture

The third alternative available to the developer is to jointly provide a system to tenants with a third party. Depending on the arrangement with the third party, the developer can play a number of roles in various levels of financial and operational responsibility.

Joint venture relationships allow the developer to actively participate in management while potentially limiting financial involvement. This approach also enables the developer to gain tenant service expertise through a relationship with an experienced telecommunications management company. Although any potential profits generated from a tenant service operation will be split up, sharing financial responsibility with a third party mitigates many of the risks connected with the unstable and changing telecommunications marketplace.

Ownership Form

As part of the determination of the structure to be used, consideration should be given to the form of ownership, especially for the purchase or joint venture alternatives. The form of the business (corporation, S corporation, or partnership) should be determined in light of the participants and the entity's short and long-term needs. Because there are significant tax and legal differences between the forms, all parties' needs must be carefully considered to ensure that the business form meets the requirements. See Table 23–1 for a comparison of key factors.

TABLE 23–1

Factor	*Corporation*	*S Corporation*	*Partnership*
Life	Normally unlimited unless limited by state or terms of its charter.	Same as regular corporation.	Generally, set up for specific, agreed-upon term. Usually will be terminated by death, insolvency, or legal disability of a partner.

TABLE 23–1 (*concluded*)

Factor	*Corporation*	*S Corporation*	*Partnership*
Liability of owners	Stockholders are generally sheltered from the liabilities of the corporation.	Same as regular corporation.	General partners are fully liable for all debts. A limited partner's liability is usually limited to the amount of his/her capital contribution.
Taxpayer	The corporation is taxed on its taxable income, whether or not it is distributed.	The shareholders are taxed on the taxable income of the corporation, whether or not it is distributed.	The partners taxed on the taxable income of the partnership, whether or not it is distributed.
Special allocation of net income or types of income and deduction among owners by agreement.	Not applicable.	Not possible. All income, gain, loss, deduction, or credit is apportioned to shareholders on per share, per day basis.	Can be done, as long as there is substantial economic substance to the agreement.
Distribution of earnings.	Taxable to shareholders as ordinary dividends.	Generally, no tax effect to shareholders unless the distribution exceeds the shareholder's basis. The excess is taxed as a capital gain.	No tax effect to partners, unless distribution exceeds partner's basis. The excess is taxed as a capital gain.
Net operating loss.	Deductible by corporation only within prescribed carryback and carryover period.	Deductible by shareholders subject to adequate basis to cover losses. Any excess is carried over indefinitely until shareholder has basis.	Deductible by partners, subject to adequate basis to cover losses. Any excess is carried over indefinitely until partner has basis.
Liquidation.	Amounts received in excess of basis in stock is taxable as a capital gain.	Same as regular corporation.	Amounts received in excess of basis in partnership is taxed as a capital gain.
Type of investor.	No limitation.	Limited to 35 individuals, estates or certain trusts.	No limitations.

FEASIBILITY STUDY—SHARED TENANT SERVICES

After giving consideration to the structure and the most advantageous form of ownership, the financial realities of shared services must be examined. To determine the financial implications of a tenant services strategy, a feasibility study should be performed. This study should incorporate all of the relevant financial considerations, including revenues and expenses, associated with offering telecommunications capabilities is a shared service environment. Among the questions the developer should consider are the following:

What communication services are being offered by competitors?

Is the size of the building sufficient to provide the necessary economies of scale?

What is the nature of the tenant's business? Is it data or computer intensive?

With whom does the prospective tenant communicate? What is their long distance usage?

What kinds of communication services does the prospective tenant currently use?

- Data lines for computer transmission.
- Electronic mail.
- Facsimile machines.
- Telex.
- Voice mail.

What types of communication features could the company use if they were available?

What is the financial strength of the tenant? Could they utilize tax benefits (e.g., ITC) on their own capital additions?

Does the prospect have the managerial resources to operate their own equipment?

Is it possible that a telecommunications company could service this prospect better than the shared system? Have they been approached by equipment vendors?

What are the various regulatory considerations?

The developer must clearly understand the primary advantages of using a single building system over individual tenant systems to evaluate the feasibility of a system. These advantages are as follows:

The ability of the telephone switch to provide least-cost routing of long-distance calls.

The realization of economies of scale by purchasing a large system, obtaining high-volume discounts, minimizing excess capacity and reducing the administration functions performed by each tenant.

The convenience for the tenant of dealing with one entity for all equipment and services.

The approach for performing a telecommunications feasibility study should be a table of key assumptions. The study should be designed to show the average costs and revenues per line for a proposed system within certain size parameters. All usage assumptions should account for above/below average usage patterns experienced in particular industries.

Sensitivity analysis should be performed on the most significant variables; those that have the greatest impact on the results of the model are those that are most closely related to the overall business issue. Deviating from the expected results by using a reasonable "best" and "worst" outcome provides a valuable tool for evaluating a business strategy. For the shared services model, sensitivity should be performed on the following assumptions:

Occupancy rate.

Penetration rate.

Number of net square feet per person.

Percentage markup on long-distance services.

The following describes each major category of assumptions and discusses the key factors to consider.

Economic. Economic assumptions are related to the general business environment in which the firm operates. Factors such as the inflation rate, corporate tax rate, investment tax credit, and financing term for capital assets are important considerations for an income and cash flow projection. Other economic assumptions relate to the telecommunications environment, such as insurance costs, rates for telephone and related equipment, taxes and surcharges on telecommunications costs, and expected growth in calling volume.

Real estate. Real estate assumptions represent the factors that customize the study to a specific property being considered for shared services. By specifying the gross square footage and the usable percentage, a net square footage estimate can be generated. The maximum capacity needed can be determined by dividing net square footage by an accepted industry square-foot-per-person standard. From this, key assumptions are used to determine the maximum number of stations lines, telephone sets, and direct inward dial lines that the telephone system could contain. The occupancy and penetration rates for each year of the projection should be used to determine the capacity requirements for the telephone system. Occupancy rate refers to the percentage of available space rented by tenants. Penetration rate refers to the percentage of those tenants occupying space who have elected to subscribe to a tenant servicing arrangement. This penetration rate is the single most significant factor in defining the actual requirements for telephone sets, trunks, lines, and PBX equipment in the proposed configuration.

PBX equipment. Cost assumptions about PBX equipment should be used to determine the estimated cost per line, within configuration size parameters, for the proposed configuration. Equipment costs can be broken into common equipment and station equipment categories. Common equipment is composed of the basic PBX switching, memory and processing hardware, as well as the associated cabling/wiring and installation costs. Station equipment can fall into three basic types of telephone instruments: standard sets, electronic sets, and terminal phones or console devices.

Personnel. There are assumptions related to the cost of personnel resources that typically would be allocated to support a shared service telecommunications system. These costs should be adjusted to reflect administrative personnel serving multiple buildings or systems. Personnel costs can be broken into three primary categories: managerial, technical, and clerical.

Calling pattern. The average volume and cost of local and long-distance calling made by the average business is represented by calling pattern assumptions. The volume estimates should be based on the average length of the call and average number of calls placed on each line per month. The cost assumptions reflect the average cost per minute, taking into consideration the variety of carrier alternatives available in a least-cost routing environment.

Trunking and access. Assumptions about trunking and access are used to determine the requirements necessary for serving a given system with a certain size of line with local, long-distance, and direct inward dial capabilities. Industry ratios of trunks to total station lines should be used to specify the trunking needs as system size expands. The trunking requirements, along with the costs for monthly service, access, and installation, enable estimates to be calculated regarding the total cost of providing dial tone service.

Revenue assumptions. To mark up various services and equipment for resale to the tenants, revenue assumptions are used. Revenue-producing opportunities can divided into the following categories:

Usage revenues, obtained from local and long-distance calling usage.

Equipment revenues, generated from the sale and/or lease of station equipment.

Network revenues, produced by charging a fee for access to long-distance and local dial tone services, as well as for direct inward dial capabilities.

Service revenues, available by providing services and labor, such as management reports, moves and changes, and installations.

Enhanced services revenues, available by offering such features as voice mail and word processing.

TENANT LEASE CONSIDERATIONS

Once the determination to offer shared services is made, attention must be focused on convincing prospective tenants to subscribe to the system. Shared communication services can be linked to the negotiation of an overall lease package with a tenant; however, it is generally more advantageous to provide for these services under a separate contract, since these services differ significantly from the arrangement of providing space.

The cost of providing the basic space is less susceptible to change and more controllable than the cost of telecommunication services. Financing costs, maintenance services, real estate taxes, and heat and electricity are fixed or can be estimated within a reasonable range. Regulatory, competitive, and tenant demands for shared telecommunication services are less likely to be accurately predicted.

Additionally, competitive factors will change, along with the cost of providing the shared tenant communication service. The tenant mix, including type, size, and number of tenants are also factors in the cost and pricing dynamics of a shared system.

Accordingly, the building owner providing the communication service should normally contract this service with the tenant outside of the lease for space and the basic amenities. This way, the owner can easily pass through changes in costs of providing communication services to the tenant.

There may be exceptions to this principle. If the building owner is attempting to lease space to a potential major tenant that has the capacity or need to install its own PBX, Local Area Network, or ancillary equipment, then it may be necessary to include some elements of the shared tenant communication service in the basic lease. Unless this is done, the tenant may not rent the space, or sufficient economies may not be generated to make it feasible to provide services to the remainder of the tenants. In making this decision, the owner must carefully evaluate the fixed and variable cost components of the shared system.

However, no feasibility study is complete unless the developer considers the tax aspects of the proposed project. In addition, whether or not the developer chooses to provide shared tenant services, there are important decisions to be made at the design stage for the building that could provide tax savings. These are discussed in the next section of this chapter.

TAX ATTRIBUTES OF HIGH TECH REAL ESTATE PROPERTY

The purpose of this section is to address the tax ramifications and potential tax benefits available in a developed telecommunication network system—more specifically, the investment tax credit and the depreciation rules as they relate to high tech property. However, before undertaking this analysis, the reader should have a general understanding of the investment tax credit and depreciation rules.

DEPRECIATION AND COST RECOVERY

Depreciation is "the systematic recovery of the cost or other basis of tangible assets, other than natural resources, due to the exhaustion, wear, tear, and obsolescence of such assets over their useful lives in the taxpayer's hands."[1] Essentially, the concept of depreciation is premised upon the fact that property utilized by a taxpayer will eventually wear out and become useless.

Section 167 of the Internal Revenue Code (IRC) permits a depreciation deduction in the form of a reasonable allowance for the exhaustion, wear and tear, and obsolescence of business property and property held for the production of income.[2] The Regulations provide that property is depreciable only to the extent that the property is subject to wear and tear, to decay or decline from natural causes, to exhaustion, and to obsolescence.[3] Moreover, the depreciation allowance does not apply to inventories or stock in trade, nor to land apart from improvements or physical development added to it.[4]

Depreciation is not permitted unless the property has a definite and limited useful life.[5] Moreover, for property either placed in service before 1981 or certain property placed in service after 1980, the rate of depreciation depends upon the estimated useful life of the property.

Pre-1981 Assets

Before 1981 a taxpayer had a choice of any reasonable method of computing depreciation on assets placed in service before 1981, so long as the method was used consistently with respect to the specific asset. Essentially, a taxpayer had a variety of methods to select from in computing yearly depreciation deductions. The most common were: straight-line, declining-balance, and sum of the year's digits.

However, the taxpayer was not limited to the above choices, but could utilize any other consistent method so long as it did not result in greater total depreciation being claimed during the first two thirds of the useful life than would be allowable under the double-declining method (e.g., machine hours or unit of production method).

Post-1980 Assets

The depreciation rules were completely overhauled by the Economic Recovery Tax Act of 1981 (ERTA). ERTA replaced the general depreciation rules with an Accelerated Cost Recovery System (ACRS), which covers most property placed in service after 1980. Under ACRS, recovery of capital costs for most tangible, depreciable property is achieved through use of accelerated methods of cost recovery over statutory recovery periods. The rates utilized in computing the depreciation under the statutory percentage method are prescribed in IRC Section 168, which was added by ERTA. The rates are based on the 150 percent declining-balance method, with a switch to straight-line to maximize acceleration, using the half-year convention and an assumption of zero salvage value.[6]

Eligible property under ACRS generally includes "new" or "used" tangible assets placed in service after 1980, and used in a trade or business or for the production of income.[7] However, Section 168(e) specifically excludes the following categories of property from the definition of "recovery property":

1. Property not depreciated in terms of years (e.g., units-of-production method).
2. Property that is amortized (as in the case of leasehold improvements and certain rehabilitation expenditures).
3. Public utility property for which the normalization method of accounting is not used.

After determining that a particular asset qualifies as "recovery property," the ACRS deduction must be computed. Under ACRS, taxpayers have a choice of either a straight-line method using the regular or optional recovery period or the prescribed accelerated method using the tabular recovery percentages.

Straight-Line Method

In lieu of the specified cost recovery allowances provided under Section 168, a taxpayer may elect to use the optional straight-line method over either the assigned ACRS class life or an extended class life,[8] as set forth below:

3-year property	3, 5, or 12 years
5-year property	5, 12, or 25 years
10-year property	10, 25, or 35 years
15-year public utility property	15, 35, or 45 years
18-year property or low-income housing	18, 35, or 45 years

Generally, an election made under this provision applies to all property in a class acquired during the year. Moreover, under this election, salvage value is not taken into account, and a half-year convention must be used.[9]

Statutory Percentage Method

Under the statutory percentage method, the allowable recovery deduction is determined by multiplying the basis of the property by the applicable percentage.[10] The applicable percentage rate depends upon the classification of the property as set forth in IRC Section 168. Essentially, Section 168 classifies all recovery property in one of five categories; 3-year, 5-year, 10-year, 15-year public utility, and 18-year real property. After determining the correct classification, the taxpayer computes the ACRS deduction by simply multiplying the basis of the recovery property by the percentage rate. With the exception of real property, the full statutory percentage is to be used for the year the property is placed in service, no matter when the property is placed in service during the year.[11]

For the purposes of this article, a discussion of 3-year property, 5-year property, and 18-year real property is necessary:

> ***Three-year property.*** IRC Section 168(c) defines three-year property as Section 1245 class property (1) with a present class life of four years or less or (2) used in connection with research and experimentation. Essentially, this definition covers automobiles, light-duty trucks, research and development equipment, and personalty with a present class life of four years or less.
>
> ***Five-year property.*** The code defines 5-year property as Section 1245 property that is not 3-year, 10-year or 15-year property. Basically, this includes most personal property with an ADR class life of five years or more. This includes most business assets and most equipment (e.g., office furniture and fixtures) other than long-lived public utility equipment.
>
> ***Eighteen-year real property.*** The term "18-year real property" means Section 1250 class property, except low-income housing, with a present class life of more than 12.5 years placed in service after March 15, 1984. The Tax Reform Act of 1984 classifies such property in the 18-year real property class for purposes of computing ACRS deductions either under the regular accelerated method or the optional straight-line method.
>
> Taxpayers should also be cognizant of the antichurning rules.[12] Essentially, these rules prevent taxpayers or a "related person"[13] from bringing pre-1981 property within ACRS through a post-1980 transfer of such property, other than by reason of death. These rules should be reviewed to determine whether or not they apply in a particular situation.

The above discussion constitutes a broad overview of depreciation and the variety of methods available to taxpayers. With this background, a general discussion of the investment tax credit rules is warranted, followed by an analysis of the rules as they relate to high tech property.

INVESTMENT TAX CREDIT

Background and Overview

The investment tax credit is an incentive device designed to stimulate investment in certain assets. Similar to other tax credits, the investment tax credit is utilized by the government to achieve specific social and economic objectives. Promulgated by Congress in 1962, this credit was expected to encourage the modernization and expanded use of capital equipment, improve the competitive position of U.S. companies abroad and help alleviate the country's balance of payments problem.[14] Generally speaking, this objective is to be achieved by allowing taxpayers a credit against their income tax liability based upon a percentage of the amount the taxpayer has spent for qualified assets.[15]

Property that qualifies for the credit is referred to as Section 38 property, despite the fact that it is defined in code Section 48 and the regulations thereunder. Basically, to qualify under this section, the property must be depreciable and must have an ACRS recovery period or a useful life of at least three years.[16] Additionally, the property must be of a type of property defined in Section 48.[17]

The applicable code sections, regulations, revenue rulings, and case law comprise a complicated and technical explanation of the investment tax credit rules. An understanding of these rules is absolutely essential in order for the taxpayer to achieve the significant tax benefits allowable. With the above overview at hand, a general discussion involving the mechanics of the investment tax credit rules is necessary, followed by a detailed analysis of its availability to those assets peculiar to high-tech real estate.

Calculating the Credit

The investment tax credit is computed by multiplying the basis of the qualifying property by the applicable percentage.[18] As set forth in Section 1.46–3(c)(1), the basis of new Section 38 property is its cost as determined under Section 1012, which would include all items properly included in the depreciable basis of the property, such as installation and freight costs. The applicable credit percentage rate, on the other hand, depends upon whether the property qualifies as ACRS recovery property or whether it is classified as nonrecovery property.[19]

The Economic Recovery Tax Act of 1981 significantly altered the investment credit provisions for property placed in service after December 31,

1980. Congress introduced these changes in order to conform to the new ACRS rules.

The applicable percentage rates for Section 38 property placed in service after 1980 are as follows:[20]

Recovery Period	*Applicable Percentage*[21]
Three years	6
Other than three-year property	10

Thus, if the taxpayer acquired and placed in service in 1982 an automobile ($10,000) and certain business machinery ($20,000), the tentative investment tax credit would be as follows:

Asset	*Recovery Period*	*Cost*	*Qualified Percentage*	*ITC*
Auto	3	$10,000	6	600
Business machinery	5	20,000	10	2,000
Tentative credit*				$2,600

* This is classified as a tentative credit, since the code places certain limitations on the availability and use of the credit.

For 1982, Congress again made significant changes in the investment tax credit area. The Tax Equity and Fiscal Responsibility Act of 1982 mandated taxpayers to reduce the basis for cost recovery by 50 percent of the amount of credit taken. However, as an alternative to the basis reduction required under IRC Section 48(q), a taxpayer could elect to reduce its otherwise allowable investment credit by 2 percent.[22] Thus, the investment tax credit would be 8 percent (rather than 10 percent) for recovery property other than three-year property and 4 percent (instead of 6 percent for three-year property).

Limitations on the Use of Investment Credit

Aware that credits have an overall effect of reducing government revenue, Congress enacted legislation limiting the amount of investment credit that could actually be utilized. IRC Section 38(c) provides that the credit allowed for any taxable year shall not exceed the sum of:

(A) so much of the taxpayer's net tax liability for the taxable year as does not exceed $25,000 plus

(B) 85 percent of so much of the taxpayer's net tax liability for the taxable year as exceeds $25,000.[23]

Thus if a company's tax liability in 1984 was $100,000, the investment credit allowable in that year would have been $88,750 (100 percent of $25,000 plus 85 percent of $75,000).

The amount of credits not usable due to this limitation are subject to the carryback and carryforward rules under IRC Section 39(a). Basically, this section provides that unused credits can be initially carried back 3 years (to the earliest year) and subsequently carried forward 15 years until the credit amount is exhausted. The carryover, however, cannot exceed the limitation imposed by IRC Section 38(c) for the taxable year.[24]

A further limitation upon the amount of investment credit available is imposed by the "at risk" rules under Section 46.[25] Essentially, this section limits the amount of credit allowable by reducing the "credit base" for the investment tax credit by the amount of nonqualifying nonrecourse financing.[26] A full understanding of the "at risk" rules is beyond the scope of this manuscript.

Section 38 Property

In order to qualify for the investment tax credit, property must be depreciable and must have an ACRS recovery period or useful life of at least three years.[27] Furthermore, the property must qualify under one of the seven categories enumerated in Section 48.[28] With respect to this article, the following categories are pertinent:

(A) tangible personal property (other than an air conditioning or heating unit), or

(B) other tangible property (not including a building and its structural components) but only if such property:

(i) is used as an integral part of manufacturing, production, or extraction or of furnishing transportation, communications, electrical energy, gas, water, or sewage disposal services.

The investment tax credit must be claimed in the year during which the property is actually "placed in service." Regulation 1.46–3(d)(1) provides that "property shall be considered placed in service in the earlier of the following taxable years:

(i) the taxable year in which, under the taxpayer's depreciation practice, the period for depreciation with respect to such property begins; or

(ii) the taxable year in which the property is placed in a condition or state of readiness and availability for a specifically assigned function, whether in a trade or business, in the production of income, in a tax-exempt activity, or in a personal activity.

If qualified property is prematurely disposed of or ceases to be qualified investment credit property prior to the end of the recovery period, the taxpayer must recapture part or all of the credit originally taken.[29] The amount of investment credit recaptured is added to the taxpayer's tax liability in the year of disposition.

For ACRS property, the amount recaptured is a specified percentage of the credit that was taken by the taxpayer. This percentage is based on the period the property was held by the taxpayer, as shown below:

	The Recapture Percentage Is:	
If the Property Is Disposed of:	*For Three-Year Property:*	*For Other than Three-Year Property:*
Within 1 year	100	100
After 1 year	66	80
After 2 years	33	60
After 3 years	0	40
After 4 years	0	20
After 5 years	0	0

Code Section 47 and the corresponding regulations delineates those events that trigger recapture.[30]

APPLICABILITY TO HIGH TECH PROPERTY

The equipment utilized by high tech real estate industries and the overall telecommunications process is highly technical in nature. To fully appreciate the tax treatment of high tech property and the corresponding tax benefits, a composite sketch of a communication system is warranted.

A basic system in a high tech building involves a variety of technical equipment. Such a system may consist of the following:

Private branch exchange (PBX). Essentially, a PBX system is a network-switching device that connects internal telephones with each other and with external telephone company lines. With the advance of technology, PBXs have developed into sophisticated computer systems that have the ability to connect voice and data paths in network communications as well as provide a host of other features to meet various communications requirements. For instance, by adding certain hardware and/or software to an existing PBX unit, the user may add such features as voice mail, an energy management system, and an internal security system.

Air conditioning units. The temperature of the area in which the PBX unit is located must be controlled. Thus, in some situations, an air conditioning unit may have to be installed to maintain certain temperature requirements.

Wiring. There are basically two types of wiring involved in the construction of a PBX telecommunication system. "Backbone," or "riser," wiring travels from the PBX system to the particular areas where the station equipment is located. This wiring is usually enclosed within the walls of the building. "Vertical" wiring connects the backbone wiring with the station equipment. Vertical wiring may or may not be enclosed.

Station equipment. Station equipment is the actual equipment serviced by the PBX system. This equipment could range from telephones to personal computers.

Tangible Personal Property

Depreciable high tech property with a recovery period or useful life of three years or more that falls within a Section 48 category will qualify for an investment tax credit. More than likely the property would have to qualify under the "tangible personal property" category as set forth in IRC Section 48(a)(1)(A). The second category, which is referred to as "other tangible property," would normally not apply to a communication system as described above.[31] As pertinent to our facts, this category is limited to tangible property "used as an integral part of manufacturing, production, or extraction, or as an integral part of furnishing . . . communications . . . by a person engaged in a trade or business of furnishing . . . such services."[32] The regulations further provide that "examples of communications businesses include telephone or telegraph companies and radio or television broadcasting companies."[33] Thus, in order to qualify, the taxpayer must be engaged in the trade or business of furnishing communication services.

Local law not determinative. The determination of whether certain property is tangible or intangible, real or personal, is not controlled by local law. Regulation Section 1.48–1(c) provides that "local law shall not be controlling for purposes of determining whether property is or is not "tangible" or "personal." Thus the category of a property under local law—whether it is held to be personal property or tangible property—shall not be controlling. Conversely, property may be personal property for purposes of the investment credit even though under local law the property is considered to be a fixture and therefore real property."[34]

Tax code definition. The definition of "tangible personal property" is provided in the regulations and supplemented and explained by revenue rulings, case law, and legislative history. The regulations provide in pertinent part as follows:

> [T]he term *tangible personal property* means any tangible property except land and improvements thereto, such as buildings or other inherently permanent structures (including items which are structural components of such buildings or structures). Thus, buildings, swimming pools, paved parking areas, wharves and docks, bridges and fences are not tangible personal property. Tangible personal property includes all property (other than structural components) which is contained in or attached to a building. Thus, such property as production machinery, printing presses, transportation and office equipment, refrigerators, grocery counters, testing equipment, display racks and shelves, and neon and other signs, which is contained in or attached to a building, constitutes tangible personal property for purposes of the credit allowed by Section 38.[35]

The legislative history of Section 38 clarifies the legislative intent behind this code section. Normally, legislative history precedes the implementation of a statute; however, with respect to certain aspects of Section 38, the Senate Finance Committee supplemented their legislative intent as follows:

> In addition, the committee wishes to clarify present law by stating that tangible personal property already eligible for the investment tax credit includes special lighting (including lighting to illuminate the exterior of a building or store, but not lighting to illuminate parking areas), false balconies and other exterior ornamentation that have no more than an incidental relationship to the operation or maintenance of a building, and identity symbols that identify or relate to a particular retail establishment or restaurant, such as special materials attached to the exterior or interior of a building or store and signs (other than billboards). Similarly, floor coverings which are not an integral part of the floor itself, such as floor tile generally installed in a manner to be readily removed (that is it is not cemented, mudded, or otherwise permanently affixed to the building floor but, instead, has adhesives applied which are designed to ease its removal), carpeting, wall panel inserts, such as those designed to contain condiments or to serve as a framing for pictures of the products of a retail establishment, beverage bars, ornamental fixtures (such as coats-of-arms), artifacts (if depreciable), booths for seating, movable and removable partitions and large and small pictures of scenery, persons, and the like which are attached to walls or suspended from the ceiling, are considered tangible personal property and not structural components. Consequently, under existing law, this property is already eligible for the investment tax credit.[36]

It should be noted, however, that the IRS does not consider itself bound by committee reports and thus may take a contrary position.

Is the Property Personal Tangible Property?

An analysis of whether certain property qualifies for the investment credit depends upon the facts and circumstances of each case. The determination of whether or not property qualifies could be relatively straightforward, as in those situations where the property is clearly eligible; but in other cases the answer is not as apparent. With respect to a communication network system, the following analysis could apply.

Station equipment. Station equipment, which includes telephones, terminals, and personal computers, clearly qualifies for an investment tax credit. This property is considered five-year recovery property, under the ACRS provisions, and falls within the Section 48 definition of tangible personal property. Thus the basis of the property is multiplied by the applicable percentage rate, 10 percent in this situation, to determine the available investment credit.[37]

Private branch exchange. The network switching device is considered tangible personal property as defined in Section 48 and thus qualifies for an investment tax credit. Considered 5-year recovery property, the basis of this property is multiplied by the applicable percentage rate of 10 percent to compute the available investment credit.

As mentioned previously, a PBX system may require certain software packages in order to perform specific functions. The availability of an investment tax credit in this situation is governed by Rev. Rul. 71–177.[40] In this ruling, the service held that an investment credit is allowable only in those situations where the cost of the software is included within the cost of the hardware on the invoice. Essentially, the service ruled that for depreciation and investment credit purposes, the cost of a new computer includes software costs not separately stated. In those situations where the software is purchased separately, the IRS takes a position that the software package is an intangible asset and thus not depreciable.

PBX room air conditioning. An issue may arise as to whether or not a raised floor built to accommodate the PBX equipment or an air conditioning unit installed to maintain certain temperature requirements for the computer system would qualify for an investment tax credit.

Section 48 provides that buildings and structural components do not qualify as Section 38 property. Regulations Section 1.48–1(e)(2) states in part that the term *structural components*

> includes such parts of a building as walls, partitions, floors, and ceilings, as well as any permanent coverings thereof, such as panelling or tiling; windows and doors; all components (whether in, on, or adjacent to the building) or a central air conditioning or heating system, including motors, compressors, pipes and ducts; plumbing and plumbing fixtures, such as sinks and bathtubs; electric wiring and lighting fixtures; chimneys; stairs, escalators, and elevators, including all components thereof; sprinkler systems; fire escapes; and other components relating to the operation or maintenance of a building.

With respect to an air conditioning unit installed to maintain certain temperature requirements, the regulations address this specifically as follows:

> [T]he term *structural components* does not include machinery the sole justification for the installation of which is the fact that such machinery is required to meet temperature or humidity requirements which are essential for the operation of other machinery or for the processing of materials or foodstuffs. Machinery may meet the "sole justification" test provided by the preceding sentence even though it incidentally provided for the comfort of employees, or serves, to an insubstantial degree, areas where such temperature or humidity requirements are not essential. For example, an air conditioning and humidification system installed in a textile plant in order to maintain the temperature or humidity within a narrow optimum range which is critical in processing particular types of yarn or cloth is not included within the term *structural components.*[38]

Thus an air conditioning unit installed to regulate certain temperature requirements for the PBX system would qualify for an investment tax credit.

Raised flooring. Raised flooring built to accommodate a computer system will also qualify for an investment tax credit. In Rev. Rul. 74–391, a raised false floor built to accommodate computer equipment and certain catwalks constructed to provide access for inspection of equipment were held by the service to be accessories of such equipment and not structural components of the building. However, in the same ruling, a wood block flooring fastened with mastic to the existing concrete floor was considered a permanent covering and thus a "structural component" of the building within the meaning of Section 1.48–1(e)(2) of the Regulations. Additionally, the service held that those catwalks installed to provide access to various sections and levels of the building served the function of building stairways and hallways and thus were "structural components" of the building.[39]

Wiring. Essential to a PBX system is wiring or cable which travels from the switching device to those areas of the building where the station equipment is located. Referred to as "backbone" wiring, this wiring is encased within the walls of the building and serves the function of connecting the station equipment with the PBX system. The issue as to whether this wiring qualifies for an investment tax credit is not readily answered and, moreover, may depend upon the facts and circumstances of each case. It would have been too easy if the taxpayer had only to argue that since the wiring constituted an integral part of the communication system, it qualified for an investment tax credit. Not being the case, the determination of whether or not the wiring qualifies hinges upon the issues of permanence and whether or not the wiring is a structural component of the building.

Whether or not a particular piece of property is considered a structural component is a factual determination. As cited previously, Section 1.48–1(e)(2) defines *structural components* mainly by example:

> (2) The term *structural component* includes such parts of a building as walls, partitions, floors and ceilings as well as . . . *electric wiring* and lighting fixtures . . . *and other components relating to the operation or maintenance of a building.* (Emphasis supplied.)

At first glance, one could analogize backbone wiring to electric wiring, which is classified above as a structural component. However, despite the similarity, the backbone wiring is quite different and serves a distinct purpose from that of the electric wiring. As noted in Scott Paper Co. v. Commissioner, 74 T.C. 137 (1980), the court held:

> Although we give great weight to respondent's regulations, it would be improper to read the words *electric wiring* in a vacuum and conclude that those electric cables, therefore, must be structural components. Rather, the effect of the final element of that same subparagraph, which reads "and other components relating to the operation or maintenance of a building," must be taken into account. That final element functions as a descriptive phrase intended to present the basic test used for identifying structural components. The preceding elements are examples of items which meet that test as a general rule. Items which occur in an unusual circumstance and do not relate to the operation or maintenance of a building, should not be structural components despite being listed in Sec. 1.48–1(e)(2). Income Tax Regs. [at 183].

The court went on to state that "the critical test . . . is whether [the components] relate to the overall operation and maintenance of a building" [at 183].

In light of the above decision, a taxpayer could argue that despite the similarities between electrical wiring and backbone wiring, the latter is not covered by the regulations, since it does not relate to the overall operation and maintenance of the building. The taxpayer would have to argue that the phrase "overall operation and maintenance of the building" means those primary functions without which the building could not be operational. These would include such basic items as plumbing, electricity, heat, and air conditioning—and would exclude an added feature, such as a PBX system.

Additionally, the taxpayer could argue that the backbone wiring is an integral part necessary to the operation of the PBX system, which is qualified property. Without the wiring, the PBX system would be rendered useless.

Another hurdle that the taxpayer may have to overcome centers around the issue of permanence. In the definition of tangible personal property, the regulations provide:

> For purposes of this section, the term *tangible personal property* means any tangible property, except land and improvements thereto, such as buildings or other inherently permanent structures (including items which are structural components of such buildings or structures).[41]

Supplementing this, the service ruled in Rev. Rul. 75–178:

> [T]he problem of classification of property as "personal" or "inherently permanent" should be made on the basis of the manner of attachment to the land or the structure and how permanently the property is designed to remain in place.[42]

The issue of permanence is also a factual question to be determined based upon the facts and circumstances of each case. Case law has set forth certain basic questions that should be asked in deciding whether property is inherently permanent. These are the questions, as formulated in Whiteco Industries, Inc. v. Commissioner, 65 T.C. 664 (1975):

1. What is the manner of affixation of the property to the land?
2. Is the property capable of being moved, and has it in fact been moved?
3. Is the property designed or constructed to remain permanent?
4. Are there circumstances which tend to show the expected or intended length of affixation?
5. How substantial a job is removal of the property, and how time-consuming is it?
6. How much damage will the property sustain upon its removal?

The answers to the above questions may vary in each case. Thus a taxpayer who installs a PBX system subsequent to the completion of a building may have better facts than those of a taxpayer who installs during construction.

As mentioned previously, the issue as to whether the backbone wiring qualifies for an investment credit is not easily answerable. To this date, there are no revenue rulings or case law on point. Thus the tax practitioner must analyze all of the relevant facts before determining whether or not an investment credit is permissible.

■ CONCLUSION ■

In light of the above discussion, the reader should now have a general understanding of the depreciation and investment credit rules and their applicability to high tech property. An understanding of these rules is essential in order for the taxpayer to be cognizant of potential tax savings. Recognizing property that may have the benefit of an investment credit is the first step toward sound tax planning. However, as discussed in the first section, tax questions are only one consideration.

Successful participation in the high tech real estate industry depends on several factors. The high tech market can become a cornerstone for growth and profitability for the developer or owner. The business decision to enter the market requires careful analysis of the risks and rewards. The feasibility study approach described herein may be the most meaningful tool in making this decision.

The results of the feasibility study must also be evaluated on a broader scale. If the study indicates that economic benefits are obtainable, the organization must then decide if the high tech implementation strategy fits in with the overall organizational goals and objectives. This qualitative evaluation will provide a clear business direction to management, which will enhance the effectiveness of the strategic planning process.

The technology of a system is important, but it is not the most critical success factor. It is more important for the manager and/or vendor to be committed to the tenant services industry. This commitment requires a product design that meets the tenant's needs, financial stability, a responsive support organization, and the ability to upgrade the system as changes occur in the industry.

As the high tech real estate industry continues to grow, the leading group of participants will gain a competitive edge. Those business organizations that have succeeded in developing a clear and financially sound strategy for high tech real estate will prosper.

■ NOTES ■

1. *Lexicon of Tax Terminology*, 182 (1st ed. 1984).
2. IRC Sec. 167(a); Reg. Sec. 1.167(a)–1(a).
3. Reg. Sec. 1.167(a)(2).
4. Reg. Sec. 1.167(a)(2).
5. IRC Sec. 167.
6. For 1985 the percentages are based on the 175 percent declining balance method with a switch over to the sum-of-the-years-digits method. This is changed to a 200 percent declining balance method for property placed in service in 1986 and thereafter. With respect to real property placed in service after June 22, 1984, the Tax Reform Act of 1984 uses rates based on the use of a midmonth convention and the 18-year, 175 percent declining balance method switching to the straight-line method at a time to maximize the amounts deductible.
7. IRC Sec. 168(c).
8. IRC Sec. 168(f)(2)(C).
9. This convention does not apply to 18-year real property. IRC Sec. 168(f)(2)(E).
10. For property placed in service after 1982, TEFRA requires that the basis of the property for the ACRS write-off must be reduced by half the amount of the investment credit taken on the property [IRC Sec. 48(a)]. As an alternative to reducing the basis of the property, a taxpayer may elect to take a reduced investment credit [IRC Sec. 48(a)].
11. IRC Sec. 168(b); in the case of 18-year real property, the applicable percentage rate depends upon the month (using a midmonth convention) the property is placed in service.
12. IRC Sec. 168(e).
13. IRC Sec. 168(e)(4)(D).
14. S. Rep. No. 1881, 87th Congress, 2d Sess., reported in 1972–3 C.B. 707.

15. A credit is "an amount that directly offsets tax liabilities as opposed to a deduction that only offsets income." *Lexicon of Tax Terminology*, 154.

16. IRC Sec. 48(a)(1).

17. IRC Sec. 48(a)(1).

18. IRC Sec. 46(c).

19. For nonrecovery property, the applicable percentage rates are as follows:

If the Useful Life Is:	*The Applicable Percentage Is:*
Three years or more but less than five years	33⅓%
Five years or more but less than seven years	66⅔
Seven years or more	100

20. IRC Sec. 46(c).

21. IRC Sec. 46(c) provides that for eligible recovery property, other than three-year property, 100 percent of the cost qualifies for the full 10 percent credit; and for three-year recovery property, only 60 percent of the cost qualifies, which results in a six percent credit.

22. IRC Sec. 46(a) provides for this election. The election must be made on the taxpayer's return for the year the property is placed into service.

23. The ceiling limitations imposed under the code have differed in the past as noted below:
a. 100 percent of the first $25,000 of tax liability, plus

b.

Taxable Year	*Percentage above $25,000*
1978	50%
1979	60
1980	70
1981	80
1982	90
1983	85
1984	85

24. IRC Sec. 39(b).

25. IRC Sec. 46(c)(8).

26. IRC Sec. 46(c) provides an exception to this rule. Essentially, nonrecourse financing that is "qualified commercial financing" won't reduce the credit base.

27. IRC Sec. 48(a)(1).

28. IRC Sec. 48(a)(1).

29. IRC Sec. 47.

30. IRC Sec. 47; Reg. Sec. 1.47–2, –3.

31. IRC Sec. 48(a)(1)(B).

32. Reg. Sec. 1.48–1(d).

33. Reg. Sec. 1.48(d)(3).

34. Reg. Sec. 1.48–1(c).

35. Reg. Sec. 1.48–1(c).

36. S. Rep., No. 95–1263, 1978–3 C.B. 315, 415.

37. This 10 percent rate assumes that taxpayer is not electing a reduced investment credit under IRC Sec. 46(a).

38. Reg. Sec. 1.48–1(e)(2).

39. Rev. Rul. 74–391, 1974–2 C.B. 9.

40. Rev. Rul. 71–177, 1971–1 C.B. 5.

41. Reg. Sec. 1.48–1(c).

42. Rev. Rul. 75–178, 1975–1 C.B. 9.

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Chapter 24

Financing Shared Tenant Services Projects

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Outline

INTRODUCTION

In this chapter we will concern ourselves with the vital issue of financing an enhanced shared tenant services (ESTS) project for a large new office building. A given project is assumed to be a computer system and a private branch exchange (PBX) used to provide computer and telecommunications services to the tenants of a new office building that is 100,000 square feet or larger. Many of the same financing issues will exist for retrofitting older office buildings; serving smaller office buildings; and providing similar services to hotels, college campuses, convention centers, or other points of concentrated telephone traffic.

The ESTS project may be owned by the building developer, an outside contractor who manages the project, or a financing vehicle or entity, such as a limited partnership; or it may be owned jointly by several of these entities.

The project we will consider financing will provide local telephone service, a discount long-distance service, a message center, and a variety of computer services (such as electronic mail, word processing, data processing, electronic filing, personal computing, graphics, and personal schedule management capabilities) to tenants in the building. Telephones, workstations, computer terminals, and personal computers may be sold or leased to tenants in the building. The leased equipment must be financed. There will be a need to finance the building wiring as well as its design, engineering, and installation. Capital is required for leasehold improvements, such as a halon fire protection system, special air conditioning, and an equipment room for the PBX and computer. Finally, there will be a need to provide financing for the start-up costs and working capital needed to take a project to a point of profitability and positive cash flow.

The types of financing to be considered will be lease financing, debt financing, and equity financing. There are various options for financing capital expenditures through leases—including "true" leases, wherein the lease company retains the depreciation on the equipment or capital expenditures and the investment tax credit can go to either the lessor the lessee. A conditional sale agreement, another type of financing, provides that the buyer gets both the depreciation and the investment tax credit. In all of these types of leases, the lessor retains title to and owns the equipment until the end of the lease. At that time the lessee may purchase the equipment for fair market value in the case of a true lease, or for a fixed price in a conditional sale agreement.

A portion of the ESTS project may be financed through debt. In that case the project owner would own the equipment. The equipment would be subject to a lien by the debt provider. The remainder of the project would be financed by equity. Whether the project capital expenditures are financed by leases or by debt, there will still be a need to provide equity financing for the project. The equity financing sources we will consider include funds from the developer, the project manager, the lease financing entity, the debt lender, individuals, corporations, and venture capitalists.

CAPITAL EXPENDITURES

To understand the financing requirements for an ESTS project and to determine the appropriate type of financing and when the financing will be required, one should first understand the capital expenditure program.

Having made the decision to build an office building, the developer will need to make arrangements for providing telephone service. In the new era of telecommunications after the AT&T divestiture, the local telephone company may only provide access to local telephone service at one central point in the building, or it may provide connections at each floor. If service is provided at only one point in the building, the developer will bear full responsibility for connecting tenants' telephones to the local telephone company facilities. In a typical arrangement, the developer will need to provide wiring on each floor from the telephone and computer jacks or outlets in each tenant's office to a wiring closet on the floor. There may be one or more groups of riser wiring connecting the individual floors' wiring closets to a central telephone connection point. From that central point, connections would be made to a PBX. The PBX would handle the intrabuilding switching of calls, the routing of local calls to the telephone company, and the connection of long-distance calls to one or more long-distance networks.

If the developer is not providing ESTS, the local telephone company may offer to connect tenants to its network on each floor by providing riser cable, probably free. Developers who wish now or in the future to provide ESTS to building tenants will need to provide their own riser cable to the building. In any case, developers will need to provide for the telephone and computer outlet wiring on each floor. Since not all tenants may wish to use the ESTS services provided within the building, the developer must provide for direct connection of tenants to the local telephone company, or to their private networks.

Within this context the kinds of expenditures required to provide enhanced shared tenant services prior to tenant occupancy include:

Design, engineering, and installation of the wiring system.

Tenant surveys and market research to determine service offerings for the building.

PBX and computer selection—including equipment analysis, writing a request for proposal for the equipment vendors, and vendor analysis and selection.

Design and construction or installation of building enhancements—including a halon system, the equipment room, and the air conditioning appropriate for the selected equipment.

Installation of equipment—including the PBX, computer, and other ancillary equipment, such as a station message detail recorder (SMDR) for billing or diagnostic equipment for analyzing the telephone network and maintaining it.

The PBX will include a minimum configuration prior to tenant occupancy. As tenants move in, additional telephone lines in the building and telephone trunk circuits will have to be accommodated through additions to the PBX. Also distribution wiring connecting each tenant telephone and computer jack to the building riser wiring system will need to be provided.

Telephones will need to be provided on a rental basis to tenants. They may also be sold to tenants. The telephones may be simple standard telephones, feature telephones having programmed options, or telephones capable of being used in conjunction with a computer data device. Also, integrated telephone and computer workstations may be provided as well as different kinds of personal computers or computer workstations.

In arranging for the financing of the capital expenditures for the building, it is necessary to look at the type of expenditure that must be made, when the financing is required, and the risk of obsolescence or loss of value of the expenditure after it is made.

The first period of capital expenditures is prior to the ESTS system becoming operational. It is likely that the Internal Revenue Service will require that such expenditures be capitalized, including interest expenses. These expenditures would probably qualify for investment tax credits and the same depreciation lifetimes as the other system components. Once the project is operational, it is probable that only expenditures for capital equipment and additional leasehold improvements will be capitalized. During the preoperational period, there may be five main types of capital expenditures for which financing will be required, namely:

Stand-alone equipment, such as the computer and PBX, which can be easily removed from the building and will have a value for loan or lease collateral purposes.

Wiring that is vital in providing telephone service to building tenants but is not removable from the building. This may have less value as collateral, but it may be financed by the developer's mortgage on the building.

Leasehold improvements that are not detachable from the building and may be required only for provision of ESTS services. These probably have little value for loan or lease collateral purposes but may be financed through the building mortgage.

Design, engineering, and installation costs of the wiring and the equipment, which may have little value for loan or lease collateral purposes; although some or all of them may be capable of being financed through an equipment loan or lease.

Transmission facilities used to provide a discount long-distance service. The local telephone company may be used to make connections to long-distance companies; or the local telephone company may be "bypassed" by a microwave, fiber optic, infrared, or other transmission system that provides connections directly to a long-distance carrier. Whether local bypass will be possible or will be economic will depend on local regulation, the cost of local long-distance access charges, and the cost of bypass. Debt or lease financing of these expenditures may be possible. Because such a bypass system is not readily resalable, financing of such expenditures may be more costly and more difficult to obtain.

As much as 100 percent of preoperational capital expenditures may be financed by debt, lease financing, and the building mortgage—depending on the creditworthiness of the borrower, the interest rate paid, the nature of the equipment, and the lending policies of the lender. Equity financing may be required for a portion of these expenditures.

As tenants move into the building, additional capital expenditures will be required. If the lease up of the building occurs over a two- to four-year period, there will be continuing capital expenditures for PBX additions, telephones, data communications, and computer equipment. Again, as much as 100 percent of these expenditures may be financed by debt or lease financing, with equity financing providing the remainder.

FINANCING EXAMPLE

A general way to look at the financing requirements of a large new office building is the capital expenditures per square foot of office space. One must first estimate the number of telephone instruments per square foot. In our example, we will use 200 square feet per telephone instrument. Next, we must determine what percentage of the tenants are likely to use the ESTS system. A realistic estimate is about 60 percent penetration, although this number could vary widely depending on the type and size of tenants in the building. In our example, we will examine the financing for an ESTS project for a 1 million-square-foot office building. Thus, the eventual number of ESTS users might be 3,000 out of a total 5,000 telephone instruments in the building. A large minicomputer and computer workstation may be included in the project. This ESTS project might require an investment, including working capital of $1,500 per ESTS user, for a total investment of $4.5 million. Thus a total of about $4.50 per square foot of office space might be required for an ESTS system for a large new office building. Typically, about 70 percent of this might be capital expenditures for equipment; 10 percent might be other capital expenditures, such as wiring and building improvements; and 20 percent might be working capital.

First we will examine the financing of the capital expenditures, either through debt or lease financing. Then we will consider the equity financing that might be required.

LEASING

Lease financing involves having an outside lender or lessor purchase and own equipment or other capital expenditures. These facilities are then leased to the lessee who has the use of the facilities in return for making payments to the lessor.

For an ESTS project, the term of the lease might be five to seven years. Lease payments would be made for the full term of the lease. At the end of the lease period, the lessor would still own the equipment. The lease might be extended at that point; the lessee might buy the equipment or facilities; or the lessor might take possession of the equipment and resell it.

The equipment or facilities being leased currently will be eligible for investment tax credits. These investment tax credits can be used to reduce current income taxes and therefore have a value. Either the lessor or lessee might take the investment tax credits. If the lessor has the benefit of the investment tax credits, the lease payments to the lessee will be lower.

The equipment being leased will be depreciated for tax purposes. Typically, a five- to seven-year lifetime for Internal Revenue Service tax reporting purposes would be appropriate for ESTS capital expenditures. Once again the depreciation can be taken either by the lessor or the lessee. If the depreciation is taken by the lessor, the lease payments to the lessee will again be lower.

To qualify as a lease for IRS tax purposes, the lessor must own the equipment and be at risk for some portion of its value. In a typical lease, the lessee will have an option upon termination of the lease to buy the equipment at fair market value (which may be no more than 20 percent of the original purchase price) at the time the lease expires. Therefore there are three likely possibilities for leasing equipment. If the lessor has the benefit of the investment tax credits and the depreciation, this would be a "true lease" and would involve the lowest lease payments. Another type of true lease would be one in which the lessor has the benefit of the depreciation, and the lessee gets the investment tax credits. This would still be a true lease, but the lease payments would be higher. The final example we will consider is a "conditional sale contract," wherein the lessee has the benefit of both the investment tax credits and the depreciation. Here the lease payments might be less than the payments for straight debt financing because there may be a residual value for the equipment at the end of the lease; but the lease payments will be higher than under a true lease where the lessor has some of the tax benefits. In addition to who benefits from the ITC and the depreciation, there are tests which determine whether the transaction is a "true lease" or a "conditional sale contract" as discussed below.

True lease. An individual, partnership, corporation, or subchapter S corporation can lease equipment. Thus leasing is a viable financing option for most ESTS projects.

A true lease is tax-oriented in that it transfers some or all of the tax benefits from the equipment user (lessee) in return for lower rental or lease payments. The user may also expense the lease payments. In a typical ESTS project, there will be substantial capital expenditures and depreciation prior to the project becoming profitable. Thus early project losses will result. If the ESTS project owner cannot use the investment tax credits and depreciation expenses to reduce its current income, these tax benefits can be shifted through a true lease to a leasing company in return for lower lease payments. There will be circumstances where it will be attractive to have a partnership or subchapter S corporation own an ESTS project. If the project is owned by more than one entity, such as the developer owning a portion of the project and the project manager having an ownership interest, the tax situations of the joint owners may differ. For this or other reasons, leasing may be a very attractive method of financing.

True lease tax considerations. The benefits of a true lease are considerable. For a lease to qualify as a true lease for IRS tax purposes, a number of conditions must be met by the lease. They include:

The lessor must maintain a 20 percent minimum at risk equity investment, or the lease should be structured such that the equipment value at the end of the lease is 20 percent or greater of the initial investment.

At the end of the lease, the remaining useful life of the equipment must be 20 percent of the originally estimated useful life or one year, whichever is longer. If the lease term is 7 years, the equipment must have an 8.75-year or longer lifetime. If the lease is for 5 years, the equipment lifetime must be 6.25 years or longer.

The lease term includes all renewal periods, except renewals at the option of the lessee at a fair market value rental.

The lessee may not have a right to purchase the property from the lessor at less than fair market value at the end of the lease.

The lessee may not provide any part of the cost of the property. Therefore, the lease must finance 100 percent of the property.

Meeting the above restrictions put on a lease by the IRS results in a lease having lower payments. Because the property must be 100 percent financed, and the term of the lease must only be 80 percent of the plant lifetime, the lessee will only be paying for 80 percent of the equipment cost. The lessor will have an equity investment of 20 percent of the value of the equipment. This lowers the amount of the lease payment. This is in addition to the fact that the depreciation and investment tax credits available to the lessor will also lower the amount of the lease payments.

Operating Lease versus Capital Lease

A possible advantage of leasing could be that the lease qualifies as an "operating lease" under the Financial Accounting Standards Board (FASB) rules. In that case the lease would not show up on the balance sheet of the company as a debt item. This could allow more debt to be raised to finance other activities. The rental payments made under an operating lease are all deductible for tax purposes.

If a lease qualifies as a "capital lease," the present value of the total lease payments is included as an asset and a debt liability on a company's books. The company's book income is reduced by the interest portions of the lease payments but not by the portion attributable to the purchase of the equipment. The book income is also reduced by the depreciation on the equipment.

There are a number of criteria, any one of which will cause the lease to be a capital lease. If the lease transfers ownership to the lessee by the end of the lease payment or contains a purchase option at below fair market value, it will be a capital lease. If the lease term is 75 percent or more of the economic life of the asset, it will be a capital lease. If the lease term is five years and the economic lifetime of the equipment is seven years, or if the lease term is seven years and the economic lifetime is ten years, the lease will not necessarily be a capital lease. However, if the lease term is seven years and the economic life is seven years, it will automatically be a capital lease. The final criteria is that the present value of the rentals or other lease payments cannot be 90 percent or more of the fair market value of the leased equipment less the investment tax credit retained by the lessor—or the lease will be a capital lease.

Finance Lease

Beginning in 1984 a new type of lease, a finance lease, was allowed by the tax code. The only difference between this lease and a true lease is that it applies to special-use or limited-use equipment. Because of the special nature of the equipment, the lease may contain a purchase option as low as 10 percent of the equipment cost. This type of lease may be particularly applicable to leasehold improvements and building wiring, which has a limited value as collateral or for resale.

Conditional Sale Contract

A conditional sale contract, which may be called a lease, is very much like debt financing. The lessee acquires title to the equipment upon the payment of a stated amount of rentals or a nominal fixed option price. A portion of the periodic (rental) payments are applicable to an equity interest in the leased asset and therefore are not deductible for income tax payments. The amount of the periodic (rental) payments will be significantly larger than the payments under a true lease.

DEBT FINANCING

Another form of financing, and a very common one, is debt financing. The property is bought by the owner, who obtains a loan to help finance the purchase. The owner has the use of the depreciation and investment tax credits for tax purposes. The loan will normally be made with the property used as collateral. Typically the loan will not be for 100 percent of the purchase price without some other guarantee of the loan or other security. A bank might require that a certain percentage of the purchase price of the property be put in certificates of deposit (CDs) of the bank in return for a loan for the full amount of the property. This effectively makes the loan less than 100 percent of the property purchase price. The interest rate paid on the CDs would be less than the interest rate charged on the loan, raising the effective interest rate paid by the borrower.

EQUITY FINANCING

It appears that 25 to 50 percent of the capital required for an ESTS project may have to come from equity capital. If the project is wholly owned by one entity, such as the developer or the project manager, the equity can be supplied directly by that entity. The equity money provided can come from internal equity sources, venture capital investors, syndicators, or other equity investors. If the ESTS project is to be owned by two or more entities, a new corporation or a partnership can be established to own the project. In that case the co-owners would raise their own equity capital and contribute capital in proportion to their ownership interests. Another way of financing ESTS projects is through the use of a limited partnership. The limited partnership would own the ESTS project. A general partner of the limited partnership would manage the project for the limited partnership. The limited partner would get the tax benefits. At the end of a period of time, probably after the project becomes profitable, the limited partners would be bought out by the general partner. To understand some of the ramifications of some of these financing methods, we will examine them in more detail.

Working Capital

To provide ESTS to building tenants, there will be preoperational expenses related to arranging for the service offerings to be provided to building tenants. There will also be marketing expenses related to obtaining tenant users of the system prior to their moving into the building. These expenditures may occur for as long as three to six months prior to the first tenants occupying the building. It will also be necessary to begin operating the ESTS system prior to tenant occupancy to provide assurance that reliable telephone service will be available immediately upon tenant occupancy. These and other preoperational expenses will require working capital financing.

How much additional working capital financing will be required will depend on the size of the project, how quickly the building becomes fully leased, and how great is the tenant penetration (the percentage of the tenants contracting for the ESTS services). There will be a fixed component of ESTS operating expenses, which will be largely independent of the level of tenant occupancy of the building or tenant penetration. These expenses will include utilities, rental space, personnel costs, and administrative overhead. During the lease-up period there will also be lease or debt payments to be made, which are likely to increase somewhat as tenant occupancy increases. Additional capital is also required to finance the accounts receivables of the tenant users of the system.

Venture Capital

There are two primary sources of venture capital, individuals and established venture capital organizations. Individual venture capital investors might be sought to invest in individual projects. These venture capital investments could involve the investors providing all of the equity capital investment for less than a 100 percent ownership interest. The developer and the ESTS project manager might share in the remaining equity interest because of their importance in providing the ESTS franchise in the building, or because of their project debt financing and management skills.

Individual venture capital investment might be sought to finance the general partners in a limited partnership arrangement. This could be done for one ESTS project or a series of projects.

A more structured type of venture capital investment would involve establishing a company to own and manage ESTS projects. The ownership of individual projects by the company might be joint with the developer. The venture capitalists would put up the majority of the capital for the company in return for a substantial ownership interest. To make this a viable investment for the venture capitalists, the company needs to provide a method for the venture capitalists to realize a gain on their investment. This could be through the company doing a public offering, being bought by another company for cash, or by being acquired by a public company for stock. Without this prospect, a venture capital investment by established venture capital organizations is unlikely. In addition to the capital they can provide, these venture capitalists can help the company achieve success, particularly through improving their management skills and by helping recruit qualified personnel.

Limited Partnerships

A limited partnership can be established to own an ESTS project. The advantages of the limited partnership are that it can provide a source of equity capital while eliminating the impact of the start-up losses of the project on the profit and loss statements of the ultimate project owners, the general partners of the limited partnership, the project manager, or the developer. For example, a developer and an ESTS project manager might each decide to be 50 percent owners of the project but to use a limited partnership to provide an interim source of equity capital. A limited partnership would be established. A general partner of the limited partnership would manage the project for the limited partners in return for a fee, which might be a percentage of the revenues of the project. The general partner in this case would be the developer and the project manager, each having a 50 percent interest in the general partner. The limited partners would be individuals who are in very high tax brackets. They would be able to use the investment tax credits and the operating losses, up to the amount of their investment, as deductions for personal income tax purposes. The limited partnership would own the project during the early years until the project became profitable. The general partners would have an option to buy out the limited partners after a certain period of time, perhaps four or five years. The buy-out price would be based on a predetermined valuation method, such as fair market value of the project at the time of buy out. The limited partners would have a tax gain at the time of their being bought out. In addition to the limited partners transferring their tax liability to a later period, they can also show a gain if the project is successful and the general partners elect to purchase the limited partners' interest in the project. A general partner other than the developer or the project manager might raise the funds and also share in the ownership of the project.

■ CONCLUSION ■

Because ESTS projects are very capital intensive, financing will be an important issue for the owner or owners of a project. Financing will be required for the PBX and other telecommunications and computer equipment. This will normally be provided by lease or debt financing secured by the equipment. Other capital expenditures such as the wiring and building improvements

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will normally be funded by debt financing or will be included in the mortgage of the office building. Debt financing will have the highest cost because there are no tax benefits accruing to the lender. Mortgage financing will normally be lower cost than debt financing because of the real estate security involved. Lease financing will have the lowest cost because the lessor will not finance the equipment over its full life and it will therefore have a residual value which the lessor owns. Also, the lessor will have the benefit of the depreciation and may utilize the investment tax credits, thus lowering the cost of the funds.

Equity capital normally will be required to supply working capital or to fund capital expenditures not financed by the lease, debt, or mortgage financing. Possible sources of these funds include the project owners, the project cash flow, venture capitalists, or limited partnerships. Limited partnerships are an attractive source of funds because the investment tax credits and early losses from the project can be utilized to reduce the cost of the equity raised.

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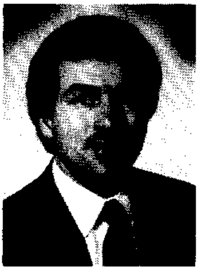

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Chapter 25

Insurance and Risk Management for Real Estate Telecommunications Ventures

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Outline

Commercial building owners who enter into ventures on their own or with telecommunications companies to provide shared tenant communication services to tenants need to address the potential liabilities and losses involved in such ventures and need to review their insurance coverages to protect themselves against future losses.

The review of insurance coverages should take place as the ventures are being structured and negotiated. The owner must have a general idea as to the cost and availability of the requisite coverages to determine the feasibility of the proposed venture. Moreover, an understanding of the cost and availability of appropriate insurance coverages can avoid negotiation deadlocks and acrimonious disputes. In all likelihood, the typical insurance coverage maintained by a commercial real estate landlord will not provide critical protection that may be readily available in the insurance markets. Landlords, tenants, and telecommunication companies, alike, need to reassess their insurance needs to assure that proper coverages are maintained.

Insurance is of course only one component of a comprehensive risk management program. Other components include a loss-prevention program, frequent safety inspections, proper planning for catastrophes and interruptions, redundant systems, reliable equipment, responsible and experienced providers of hardware, software, and telecommunications services, and an appropriate and defined allocation of risks in the various contractual documents.

RISKS IN HIGH TECH TELECOMMUNICATIONS VENTURES

Telecommunications rooms, rooftop microwave and satellite antennae, building and external conduit and cable systems, and central digital switches are exposed to the catastrophic effects resulting from such perils as floods, hurricanes, tornadoes, earthquakes, fire, smoke, and acts of violence. This type of equipment is also an easy target for sabotage, as well as the wrongful appropriation of information. Casualties can result in the loss of valuable information and the interruption of business activities, with corresponding erosion of goodwill among clients, customers, suppliers, and others. At worst, such emergencies result in loss of business, severely curtailed profits, and in extreme cases, a company's withdrawal from business.

The interruption, even for relatively short periods, of telephone and data communication services to tenants in many industries can have a devastating effect on their businesses. These losses are similar to losses from damage to

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computer facilities. One can easily predict claims from tenants for lost business, interruption in rent flow from tenants, and possibly claims from telecommunications venture partners due to the real estate owner's failure to meet obligations to the telecommunications partner. For example, the telecommunications company may claim that an employee of the landlord negligently damaged cables or damaged the PBX system owned by the telecommunications company.

Telecommunications users and real estate owners are frequently unmindful of these possibilities and assume that the telecommunications services will flow without interruption or event. Landlords and tenants executing shared tenant telecommunication services agreements may also assume without justification that if a catastrophe occurs, the telecommunications vendor will have developed sufficient loss-control procedures to effectively restore procedures and that adequate insurance coverages are in place to enable recovery of losses.

In considering insurance for telecommunications ventures, a useful analogy is the coverage of risks arising out of the provision of computer services. As a matter of fact, a PBX or shared tenant switch is a sophisticated computer complete with complex software. A provider of shared tenant services is in a position similar to that of a provider of time-sharing computer services. Finally, many building owners plan to offer additional services—including time-sharing usage of central computers and word processing services—squarely placing themselves in the traditional businesses of time-sharing service bureau companies. For these building owners, this chapter will explore issues relating to those traditional data processing businesses. These issues also have in each case a direct bearing on risks arising out of the provision of telecommunication services.

This chapter will discuss the following areas of exposure. There is an overlap because many insurance policies will provide coverage for more than one area of exposure. To the extent possible, where two policies cover the same risk, the owner should attempt to have the coverage excluded under one policy in exchange for a reduction in premium. In addition, the owner should attempt to obtain coverage through a single insurance company to minimize claims and disputes among insurance carriers.

Loss or damage to equipment and cable systems.

Liability assumed under a lease or agreement for loss or damage to equipment.

Third party errors and omissions insurance—claims from tenants and unrelated third parties.

Rent proceeds insurance.

Business interruption insurance.

Extra expense insurance.

Data storage media insurance.

Accounts receivable insurance.

LOSS OR DAMAGE TO EQUIPMENT AND CABLE SYSTEMS

The first area appropriate for insurance coverage is property damage to equipment owned by the insured, or for which the insured may be responsible under a lease or other agreement. Special considerations related to leased equipment are discussed below.

The building owner should look for the broadest possible protection available to protect against damage or loss to the equipment and cable and wiring systems. However, the owner cannot look solely to the standard real estate insurance that may be adequate for ordinary real estate landlord operations. For example, although the standard fire policies vary from state to state, they generally exclude (among others) losses caused by the following:

Earthquake.

Flood.

Burglary or theft.

Electrical injury.

Accidental breakage.

Collapse of roofs.

Water damage.

Loss while in transit.

Vibration.

Simply stated, standard fire policies are not designed for buildings with major telecommunications systems. Such buildings are too vulnerable to the types of risks and situations not covered under the myriad of limitations and exclusions contained in a standard fire policy. This fact will become clear to the building owner who reviews leases (see below) and agreements with the telecommunication vendor or has an extensive capital investment in the equipment or cable systems.

Several insurance companies offer policy forms that are specifically designed to insure against all risks of direct physical loss or damage to data processing and similar equipment. Such policies normally include coverage for the following: earthquake, flood, burglary or theft, and electrical injury, all of which are excluded in a standard fire policy. However, such important perils as water damage are still excluded even under these policies. Because PBX rooms may be located in basement areas, this is an important concern.

The broadest forms of insurance coverage available for computer and PBX operations provide comprehensive coverage and exclude only the following risks:

Errors in programming.

Latent defect.

Wear and tear.

Gradual deterioration.

War and nuclear destruction.

Dishonest and criminal acts by employees.

The availability of insurance at a reasonable cost and with the fewest exclusions may in part depend upon the risk management programs that the owner has in effect. For example, the lack of a Halon fire-protection system may make fire coverage prohibitively expensive or unavailable.

The foregoing has been a discussion of the types of standard policies that are offered by various insurers. It must be emphasized that an owner can always attempt to negotiate with the insurer to have various exclusions deleted by endorsement. Insurers are generally willing to delete most exclusions for an additional premium. The question for the owner is whether or not the additional protection is worth the additional cost.

Having determined in what situations the policy will apply, the next issue is how much the insurer will pay if a covered loss occurs. Generally, the owner should want a policy to state that in the event of loss, the amount of the insurance will equal the repair or replacement value of the equipment. Alternatively, the owner may wish a policy to provide for a set dollar amount in case of loss. This is known as an agreed amount or stated value policy.

One further important point: When purchasing equipment insurance, it is important not to accept a policy that provides coverage only for specific pieces of equipment (i.e., that covers a loss only if the equipment damaged has one of the equipment serial numbers listed on the policy). Too frequently, a malfunctioning piece of equipment is returned to the manufacturer and a substitute sent in its place. Under the aforementioned type of policy, if that substitute item were damaged on your premises, the insurance company could deny liability because the serial number would not match the one shown in the policy. Therefore, if a policy must be accepted that lists equipment, be sure it describes the type of equipment in general terms only, such as "one IBM 3318 CPU." Do not include the serial number.

THE DIFFERENCE-IN-CONDITIONS POLICY

Data processing and similar policies offer broad coverage for users of electronic data processing and telecommunications equipment. For most real estate owners, though, it may be advantageous to include data processing and telecommunications equipment under the basic property insurance program that protects the other assets of the firm and then to purchase additional insurance under a difference-in-conditions policy. This policy, commonly called "DIC" (Dee-Eye-See) is usually a tailor-made, typewritten form that provides the type of coverage its name suggests. It adds to the basic property insurance policy those additional coverages included in a standard data processing coverage. (Since the policy is not a standard form, the coverages and exclusions are generally the subject of negotiation between the insurer and owner.) In fact, purchasing property insurance and DIC coverage has certain advantages over a standard data processing policy:

Newly acquired equipment may be automatically covered without special notice to the insurance company.

The all-risks coverage applies to all property, not only electronic data processing equipment, and can be extended to include media, extra expense, business interruption, and accounts receivable on a blanket basis. These coverages are discussed below.

The rate per $100 of insurance purchased is often lower because of less adverse selectivity against the insurance company and largely unregulated rate filings.

DIC coverage is usually available with a deductible of $5,000 or higher and is most advantageous with a deductible that exceeds $25,000. It is more beneficial to the larger owner who has a greater capability to carry high deductibles (risk retention) and who already has a sound basic or underlying insurance program. Smaller owners are best advised to purchase a data processing policy that carries a lower deductible and is not contingent on an underlying or basic program of insurance.

LIABILITY ASSUMED UNDER LEASES AND AGREEMENTS FOR LOSS OR DAMAGE TO EQUIPMENT AND CABLE SYSTEMS

Even though the building owner may not own telecommunications equipment (such as a PBX system), the building owner may have equivalent exposure as a result of liability assumed under an equipment lease (such as when the owner is providing the PBX service directly) or under an agreement with a telecommunications company making the building owner liable for damage to the PBX system or cabling. An example of the type of loss that could result in the owner incurring liability under the second type of clause would be the failure of the building owner to comply with obligations to provide air conditioning and security for the equipment room.

Critically, although most equipment leases specify in which instances the lessee will be liable and in which cases the lessor, there could be a situation for which the lease does not provide who should be liable. If damage is caused by owner or employee negligence, the owner may, as a matter of law, incur liability. Thus, liability may be incurred even in the absence of liability expressly assumed under an agreement, or notwithstanding the assumption of liability by the other party.

Although some firms own their electronic and telecommunications data processing equipment, many lease it and sometimes falsely believe that the manufacturer or leasing firm assumes responsibility for loss or damage to the computer under terms of the lease. This may or may not be the case, and most long-term leases impose the liability on the lessee.

Moreover, the fact that the manufacturer or lessor has insurance on its equipment does not automatically free the user of liability. The high cost of the equipment provides an incentive to the lessor's insurance company to exercise its subrogation recovery rights (claiming damages from the third party that caused the catastrophe), and the lessor's insurance company is not likely to feel bound by the lessor's good intentions toward the user. Thus the lessor's insurance company may bring a claim against the lessee, unless it has waived the right to bring such claims. A "waiver of subrogation" should be negotiated between the user and the lessor's insurance company to avoid any attempt at recovery. Prior to loss, this subrogation waiver may well be able to be negotiated at little or no cost. Following a loss, if the user has not procured a waiver, the cost could be enormous. The same is true as to liabilities assumed or existing under agreements with shared tenant communications companies.

The agreement between an owner and manufacturer (or other party) is germane only as to the sharing of liability between these parties. If a manufacturer assumes liability, a third party is injured, but the manufacturer is insolvent—the owner may, as a matter of law, still be liable for the loss. Thus when an owner could be held liable, but for another party's assumptions thereof, the owner should be concerned about the other party's and/or its insurer's solvency.

UNDERSTANDING EQUIPMENT LEASE AND CONTRACT CLAUSES

The vast differences in wording and terms of equipment leases and contracts require the parties to analyze the wording and terms carefully to determine the extent of the liability being assumed. Here are some examples of common liability assumption clauses found in computer lease agreements and shared tenant contracts:

> Lessor relieves the user for loss or damage to the equipment caused by fire, lightning, and smoke.

This clause relieves the user from these three perils, but is silent as to loss or damage caused by other perils such as water or negligence by the user. In this instance, the user would be well advised either to renegotiate the agreement or to purchase a supplemental all-risks or difference-in-conditions policy to cover the other perils—but excluding fire, lightning, and smoke, which should be available at a reduced cost (fire is usually the most expensive peril to insure against).

> Lessor relieves the user of liability for all risks of loss or damage to the equipment, except where the user has contributed to same by its negligence.

Here, the user or lessee is exposed in the event the equipment is negligently damaged by the lessee or user or its employees. Although a standard comprehensive general liability policy does provide coverage for negligent acts of the insured or its employees that result in property damage to third parties, the policy does not normally cover damage to the property of others in the care, custody, or control of the insured. This language may be deemed to include equipment not formally subject to a lease such as that belonging to a telecommunications company and being provided under a shared tenant services agreement. The lessee (or person holding care, custody, and control of the equipment) must obtain insurance to cover damage to the lessor's equipment caused by the negligence of the lessee or its employees. Without this type of coverage, one lessee, who executed a lease containing such a clause as above, was held liable for damage to the lessor's equipment caused by burglars. The lessor contended that the lessee exercised less than ordinary care by providing inadequate security measures. Judgment was rendered in favor of the lessor for $175,000. The insured's policy did not cover this award, and the insurance company was not obligated to provide a defense.

> Lessor relieves the user of liability for all risks of loss or damage to the equipment except for loss or damage caused by nuclear reaction, nuclear radiation, or radioactive contamination.

This clause is the most desirable from the lessee's standpoint, since it relieves the user of liability for virtually all damage, including losses resulting from the moving of equipment, negligent handling, flood, and so on.

Accordingly, even if the other party is insured and assumes the liability in many cases, the lessee/building owner needs assurance that insurance provides protection in those instances where the other party is not so protected. As noted, many leases and contracts impose legal liability for loss or damage due to the negligence of the lessee or its employees. Many shared tenant agreements with telecommunications companies also impose this liability upon the building owner. As noted above, in negotiating the agreement, building owners should seek on behalf of themselves and their employees a waiver of subrogation clause.

Although the standard Comprehensive General Liability Policy does not cover the exposure for damage to equipment caused by the building owner or its employees, coverage may be secured in several ways:

- A separate legal liability policy may be purchased to cover liability for damage to leased equipment. Defense of claims, even frivolous ones, is provided by the insurance company without additional charge.
- The existing Comprehensive General Liability Policy may be extended to include legal liability for damage to the leased or other equipment in the care, custody, or control of the user. Again, this coverage is normally excluded and must be added by special endorsement.
- An umbrella excess liability policy may be purchased to insure legal liability above a self-insured retention of $10,000 or $25,000. Make sure the costs of defending a suit against you by the insurance company are on a first-dollar basis.

The umbrella policy is recommended because of the additional benefits derived. Not only will it cover losses of electronic data processing and similar equipment not included in the standard Comprehensive General Liability Policy, but it will also cover certain types of losses that are excluded in all forms of primary liability insurance policies, including automobile insurance. Losses that are covered by the primary insurance benefit from higher limits because the umbrella policy provides excess coverage.

THIRD-PARTY ERRORS AND OMISSIONS LIABILITY INSURANCE

Paramount in the minds of many building owners, and telecommunications vendors as well, is the potential for third-party claims from tenants or unaffiliated third parties in the event of disruption or interruption of vital telephone and data communication services. Also related, and to be discussed in the next section, is the potential for interruption of rent due from unhappy tenants.

It has been said that many modern business tenants can operate without heat, light, desks, walls, elevators, and air conditioning—but they cannot operate without telephones. Accordingly, this risk is one that a risk management and insurance plan must address.

Telecommunications services sold to tenants usually expose the building owner and telecommunication company to liability for financial loss due to error, omission, negligence, malicious acts, dishonesty of employees, and PBX and other equipment malfunction. Contracts with tenants usually attempt to restrict the liability of the company providing the telecommunications service. However, the legality of such restrictions is questionable in many states, especially if the building owner or telecommunications company is negligent.

Also, building owners can find themselves in suits brought by parties with whom they have no direct relationship. For example, a tenant's customers or business associates may join the building owner or telecommunications company in a suit against the tenant for failure to provide adequate services. Such a suit could possibly allege the owner's improper maintenance, improper design, and so on.

Accordingly, it is advisable to carry insurance against third-party liability. Since this insurance cannot be provided under the special data processing policies and similar policies (because it involves third-party claims), separate policy coverage is required.

Data processors' insurance and similar errors-and-omissions liability insurance is often available from a few U.S. insurance carriers as well as from certain underwriters at Lloyd's of London. The coverage is generally impossible to purchase unless the insured agrees to the following exclusions:

Liability assumed under any contract.

Faulty systems design and programming.

Losses caused intentionally by the insured.

Personal injury, bodily injury, and property damage.

Any dishonest or criminal acts of employees.

Loss or damage to property of others in your care, custody, or control.

Although some of the exclusions, such as the last three, may be coverable under other policies, there is still considerable exposure. The first exclusion—liability assumed under any contract—can be very significant in the shared tenant context, since there may be liability assumed by either the telecommunications company or the landlord as between each other; and, there may be assumptions of liability in the agreement with tenants. Unless the insurance carrier reviews the contractual provisions and agrees to provide coverage for specific assumed liabilities, then in all likelihood the insurance company will attempt to deny coverage. Where the insured has not obtained insurance coverage for assumed liability, these situations often become complicated. Often the underlying suit against the insured includes a claim for negligence (which likely is covered under the policy) as well as the contractual indemnification or assumption of liability, which is not covered. In such an instance, the insurer will likely be required to provide completely for the insured's legal representation but will only have to pay the damages assessed by reason of the insured's own negligence. The second exclusion is also important: The policy of the largest insurer of data processors' errors and omissions liability excludes the critical exposure of losses resulting from faulty systems design and programming errors. Thus, this is one area where insurance may not be available for the building owner. This is perhaps an area in which it is appropriate for the telecommunications company to assume all liability.

If the tenant agreement between the telecommunications provider and the tenant-user has a provision under which the telecommunications provider is relieved from any responsibility for its errors and omissions, it might be possible to modify the Comprehensive General Liability and/or Umbrella Liability Policy to include coverage for Hold-Harmless Agreement exposure. This appears to be the most economical way to approach the high premiums normally levied for this coverage, and it will probably afford the easiest access to higher limits of protection.

RENT PROCEEDS INSURANCE

The next major risk of concern to building owners who provide or participate in the provision of shared tenant communication services to tenants is the possibility, albeit remote, of tenants withholding rent. Tenants may do so because the telecommunications system (1) is not operating properly, (2) is interrupted due to a casualty, or (3) is not placed back in service expeditiously due to the failure of the building owner or telecommunications company to have a disaster recovery plan, or to effectively implement such a plan. Obviously, the interruption of rent could have major consequences to a building owner and could cause concern to a lender.

Although one can assume that the telecommunications services agreements with tenants and the leases will expressly prohibit a tenant from withholding rent or claiming constructive eviction, one cannot assume that such provisions will be given effect by a court. In any event, the building owner should review rent proceeds insurance and ascertain the feasability of expanding its coverage.

BUSINESS INTERRUPTION INSURANCE

Understandably, many building owners and telecommunication companies are reluctant to assume liability for damage to a tenant's business, particularly where the tenant is involved in a business that relies heavily upon telecommunications. Since tenants cannot assume that this liability will be imposed on the landlord, the tenants must have their own risk management plan, including alternate methods of operations in the event of damage to the telecommunication system. In addition, the tenant can consider obtaining business interruption insurance. Indeed, the owner and the telecommunications company should urge or require the tenant to obtain such coverage. Finally, the telecommunications company may also suffer a loss of its own income due to business interruptions and may need to review its coverage.

When telecommunications facilities are damaged, a company may suffer a substantial loss of net profit from current operations. This loss may result from either a reduction in operating income or extra expenses incurred to continue normal data processing operations.

Business interruption coverage is available by endorsement to the data processing and other policies that cover equipment and media. It covers loss or damage to equipment, media, or the premises that results in a provable and definite reduction in income. The policy should be reviewed to be sure that it does not limit the business interruption coverage to damage to equipment and media only but embraces the premises housing the data center as well. For example, if the data processing or PBX center is on the sixth floor of a building, and the first five floors are burned out, the telecommunications and computer operation will obviously be interrupted.

Business interruption coverage can be written to provide a stated dollar-amount recovery for each day of total interruption and a prorated amount for partial interruption. Extra expenses (to be discussed more fully in the following section) are covered under business interruption, but only to the extent that the business interruption loss is reduced. This is an important point because many insureds have been falsely led to believe that business interruption insurance is a substitute for extra expense insurance.

EXTRA EXPENSE INSURANCE

It is a fair assumption that few operations have only business interruption exposure; most have both business interruption and extra expense exposure. A business with a well-integrated data processing operation and telecommunications seldom maintains the backup personnel and facilities that, in case of telecommunications breakdown, can perform manually or mechanically those functions normally performed electronically. It is therefore essential that telecommunications and electronic data processing operations be continued at any price following a loss. This may involve extraordinary measures—such as installing a truck-mounted satellite link or renting a portable electric generator. Thus the purchasing of both business interruption and extra expense coverages is recommended.

Once again, extra expense insurance can be added by including it on the data processing or telecommunications policy that covers equipment, media, and business interruption. Under a pure form of extra expense coverage, the insured is reimbursed for all expenses incurred to continue data processing operations without having to prove any resulting income. Normally, this insurance provides a stated limit of liability and covers a period of time judged adequate for the repair and replacement of the lost or damaged property, including the computer facility itself. The exclusions are essentially the same as those applying to equipment, media, and business interruption.

It is sometimes difficult to convince a user of the need for extra expense insurance. However, businesses are well advised to consider purchase of this coverage. One note of caution: Extra expense insurance is not a substitute for basic risk control. If alternate facilities and compatible equipment as well as program and transaction media are not available, operations must cease; and an extra expense insurance payment may not be enough to save the business.

One area that may be of concern is the extra expense that may be incurred if a building owner has leased a transponder on a satellite, and the satellite is lost. An owner should ascertain in advance how to be protected in such event. For example, one may need to lease time on a different transponder, realign satellite receivers, and make other modifications.

It is difficult to determine the amount of extra expense insurance required, since there is no set formula for doing so. For an approximation, however, the following factors must be analyzed:

Normal costs.

Availability and costs of backup facilities and equipment.

Increased personnel costs.

Increased transmission costs.

The probable maximum period of interruption.

All of the figures should be projected against a background that includes the most adverse circumstances, remembering that nothing will go right following a disaster.

DATA STORAGE MEDIA INSURANCE

The cost of reproducing or replacing lost or destroyed data storage media (referred to as data processing media in insurance jargon), including duplication of research, by far exceeds the amount recoverable under standard policies. Unless specifically stated, data processing policies do not cover any form of media. Other types of contents insurance will cover media but only to the extent of blank value and simple transcription expenses. At the time of loss, it is like offering a parched individual a thimbleful of water. However, if agreed upon, data processing policies will cover all risks of loss or damage to active media, including programs or instructions, and all information stored thereon.

Where the building owner is operating a shared tenant services system, one may wonder why data storage media insurance is required. Remember that there will be software and computerized data relating to the switching and configuration of the PBX and information relating to tenant telephone numbers and usage. In a large building, retrieving or reassembling this information could be time-consuming.

A data storage media policy pays the actual cost to reproduce or replace the information on the media. A separate or blanket limit of insurance can be designated for all remote locations where media are stored. The coverage is subject to the exclusion for loss due to "electrical or magnetic injury of electronic recordings." This exclusion is not mandatory with most carriers, however. An insurance broker or agent familiar with data processing loss exposures can likely have the exclusion eliminated by endorsement for a nominal charge. However, unless the policy terms and conditions are properly tailored, this painful exclusion never fails to appear.

Data storage media represent only one form of valuable documents and records for most businesses. It is unwise to single out media for insurance coverage while ignoring other forms of valuable records, including accounts receivable. The most advantageous way to purchase all-inclusive records insurance is to amend the definition of data processing media in the policy to include all valuable records and papers.

ACCOUNTS RECEIVABLE INSURANCE

To many firms the loss of accounts receivable records represents a potential disaster. Even with total confidence in the honesty and sincerity of debtors, dependence upon customer goodwill to settle their accounts voluntarily will inevitably lead to problems. It will lead to doomsday in businesses where help from customers cannot be anticipated. In the shared tenant telecommunications context, a major accounts receivable will be the charges due from tenants for local and long-distance charges. This information will probably be stored in the PBX system, and a fire could result in loss of a month's information (if not more) and therefore revenue.

Fire is the major peril to records, and since fire insurance will not reimburse a business for its loss, there is much cause for concern. Fire insurance pays only for the cost of blank tapes, blank computer storage disks, or other materials, plus the actual cost of the labor to transcribe such records. It does not provide coverage for records destroyed or damaged unless duplicate copies are available to make copying or transcribing possible. The fire policy will not reimburse uncollected money resulting from loss or damage to accounts receivable records.

The purchase of accounts receivable insurance is a prudent measure, even when a business has taken every precaution possible to avoid loss. The premium is relatively low, and the policy conditions are liberal. Any internal loss-prevention program is subject to human error—there may be a time lag in record duplication; new operations may create new problems; a sudden fire or explosion may destroy records during the working day when they are unprotected (60 percent of all fires reported occur from 7 A.M. to 6 P.M.); and off-premises exposure may be more or less uncontrollable.

Accounts receivable policies are of the all-risks type, have a minimum of exclusions, and may be purchased separately or as a part of a general electronic data processing or similar policy. Moreover, accounts receivable coverage is for consequential rather than direct damage. Most policies require monthly reporting of the accounts receivable balance, but nonreporting forms are also available.

The policy will specify the type of cabinet, safe, or vault (called receptacles) in which the records must be kept when the premises are not open for business and when the records are not actually in use. It is generally possible to avoid this requirement by doubling the rate. It is also possible to obtain rate credits of as much as 40 percent for receptacles that afford a high degree of protection.

Accounts receivable insurance will reimburse you for:

The amount of money due from others, provided you are unable to collect as a direct result of loss of or damage to the receivable records.

Interest charges on any loan to offset impaired collections. (Coverage of this type is quite broad and includes interest charges until insurance is settled or until outstanding balances are collected.)

Extra collection costs made necessary by loss of accounts receivable.

Other expenses reasonably incurred in reestablishing records. These can include travel, advertising, overtime, and auditors.

The following risk management approaches should be considered:

Purchase limits of liability high enough to cover the maximum amount that would be required to cover complete losses or to reconstruct records.

Exclude certain assured large accounts if they exceed 20 percent of the average monthly amount of accounts receivable.

Submit multiple locations for average rate treatment.

Include transit coverage for an additional premium.

Obtain discounts of 25 to 50 percent by duplicating records and storing them at another location.

■ CONCLUSION ■

Telecommunications and data processing centers represent a risk classification that has one of the highest concentrations of value with which the insurance industry has ever had to contend. The loss from a fire in one computer facility involving only 650 square feet of space (56 squre meters) amounted to $5 million. The same type of exposure could result from damage to a single PBX system. The compactness of future systems will greatly increase the easy possibility of theft.

In spite of this high probable loss, the underwriter to date generally has received a low premium because data processing and shared tenant communication centers generally are located in office buildings where fire and extended coverage rates are low. Fire rates do not accurately reflect the heavy concentration of value or the delicate hardware and software involved.

With sensitivities this high, many insurance underwriters can make a smaller commitment for their company and generate premiums that are just as substantial. Moreover, some recent, large, well-publicized losses have cast gloom over the data processing and telecommunications insurance industry. For example, the losses of two satellites in 1984 resulted in a complete reexamination of the premiums charged for satellite insurance, notwithstanding the dramatic rescue of the satellites by NASA astronauts.

The situation for insurance buyers is not hopeless, however, and there is no reason adequate coverage cannot be purchased with the exercise of good insurance sense. The following suggestions should prove helpful:

Take the account approach. You can improve your bargaining position with underwriters by combining your property and casualty coverages, wherever possible, with the same company. This account leverage is an important ally when placing data processing coverage.

Think in terms of deductible. Sometimes even a modest deductible may induce an underwriter to accept business that might otherwise have been rejected. Remember that deductibles also reduce premium costs.

Utilize loss prevention systems. Fire detection and extinguishing equipment is evidence to the underwriter that you are as interested in minimizing loss potential as she/he is. The expenditure rarely exceeds 1 percent of the total values at risk.

Develop contingency plans. A disaster plan that protects essential records and prepares your firm for continued operations under emergency conditions is also essential.

The more dependent upon telecommunications and computers that a business becomes, the greater its financial risk. Disruption of telecommunications and data processing can bring the operation of any organization, no matter how large or small, to a screeching and complete halt. The costs of repairing or replacing telecommunications and data processing equipment and media can be phenomenal. The income lost and the expenses incurred during a slowup or work stoppage can spell ruin. To be forewarned is to be forearmed.

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From 1974 to 1976 Migliaccio was manager of the Plainview, Long Island, office of Marsh & McLennan, at the end of which he returned to New York City as manager of the metropolitan division. He assumed his present responsibilities in 1983. He was elected vice president in 1975, senior vice president in 1978, and managing director in 1982. Migliaccio is a member of Marsh & McLennan's Commercial Broking Steering Committee and the Professional Development Committee.

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Chapter 26

The Role of Local Cable and Fiber Optic Networks to Corporate Voice and Data Users

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High Tech Real Estate Dow Jones-Irwin 1985
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Outline

CABLE COMPANIES AND INSTITUTIONAL NETWORKS (I–NETS)

From a modest beginning with improving broadcast television reception as a primary purpose, cable TV has gone on to provide 20, then 36, and more recently greater than 100 channels of TV capacity. Along the way, it has added new functions—pay television, public access programming, simple versions of consumer polling, and more. All of these are uses intended to serve, entice, and entertain the home market. Recently, however, the ability of cable TV to serve different markets with different kinds of services has begun to gain attention. Among these new services are those aimed at the business market and provided over an "institutional network," or as it is beginning to be called, an I–Net.

Institutions and organizations—rather than residential subscribers—have become a new market for cable television. The services that this market is interested in buying include communications services such as data transmission, videoconferencing, and private phone system link-ups. To serve this institutional market, cable systems are being built with a coaxial cable that is separate from the wires that bring entertainment and other services "downstream" from a main transmission facility into residential homes. This separate cable allows users in institutions and organizations to send as well as receive communications. This means that an institutional user can send a signal to one or more other institutional users and receive a signal coming from another user or from the cable system's head-end facility. These new nonentertainment uses are known as institutional uses, and the cable plant that is dedicated to serving organizations rather than homes is known as an institutional network, or I–Net.

Institutional networks exist primarily in cable franchise contracts. Relatively few cable companies have yet translated I–Net contract promises into actual operations, and most of these promises, as well as actual projects, are still in an early stage.

Like most innovations, I–Nets did not spring fully grown from the minds of cable or municipal dreamers. Rather they grew in response to institutions, public and private, that conceived of ways that coaxial cable might solve a problem or realize an idea.

In capacity the I–Net usually carries anywhere from 20 to 60 television channels. It can integrate audio, video, data, and text services, and with the right end-user equipment, the I–Net can also provide voice-grade (telephone) service. Unlike the primarily downstream residential cable, which in newer franchises will also contain about four upstream channels, the

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I–Net is generally planned so that there is an approximately even division between upstream and downstream channels. This midband split thus provides an equal number of channels on which to send and receive signals.

I–NETS AND THE MARKETPLACE

To understand the commercial niche that cable companies are trying to carve for themselves, it's important to look at the new telecommunications marketplace and to understand some basic facts about its needs. Telecommunications managers are continually seeking means to transmit information at higher speeds and lower costs. Additionally, they seek to integrate and simplify the transmission of data, voice, and video communications over one medium and with as few vendors or providers of service as possible.

However, despite technological advances and the emergence of new competitive long-distance telecommunication carriers, the nation's major communication system remains the typical telephone, the 4,000-Hz, twisted copper wire pair limited to passing 9,600 bps with special conditioning. Moreover, telephone switching equipment was planned to handle the simultaneous use of only a certain percentage of telephones in any one area at any one time. It was also designed to accommodate the typical voice telephone user, not one who hooks a computer to the telephone line for a seven- or eight-hour "call."

In contrast, CATV coaxial cable can transmit information at very high frequencies of up to several hundred million hertz, and, depending on the cable plant, can simultaneously transmit up to some 54 different 6 MHz channels. Though not a switched system, cable is, in contrast to the narrowband telephone, an extremely wide transmission medium, able to handle very high transmission rates and the integration of data, voice, and video transmission.

More and more cable plant is being installed in local areas, passing increasing numbers of homes and businesses. By 1983 the country's 50 largest cable operators had installed nearly 400,000 miles of cable plant, and they planned to install another 44,000 plant miles in their local franchise areas in 1984. It is the cable company's ability to provide economic, high-speed wideband transmission in the local loop over its I–Net or I–Net–like plant that gives cable the opportunity to develop a position for itself in the evolving commercial telecommunications marketplace. It is a position that could grow stronger as increasing numbers of telecommunications users seek to send more wideband signals within the local loop and over long distances into the local loop—that "last mile" that remains the most difficult and costliest to cover.

THE ROLE OF LOCAL CABLE NETWORKS

Tenants who are attracted to the high tech building because of improved telecommunications capabilities inherent in its design will want to have the same advantage when communicating out of the building to other locations in the vicinity or to a common carrier for longer-distance links. In many cases, a customized local cable network can be used to gain that advantage.

Using presently proven technology, a local cable network can provide reliable high-capacity communications within a radius of at least 10 miles of the high tech building. Fast-paced technological advances, particularly in the field of fiber optics, are increasing that range rapidly. These cable systems can therefore be used to interconnect buildings in a campus environment, to link multiple locations within a city, or to provide connection to common carrier nodes, thereby gaining improved access to intercity and international facilities.

DATA TRANSMISSION AND CABLE I-NETS

There are several types of cable that can be included in a local cable network, each having inherent functional characteristics that make it optimal for specific uses. Cable systems can therefore be designed using several types of cable combined in customized configurations in order to meet a diversity of applications. Those applications can include data, voice, and video requirements in a multitude of combinations.

The data communications capabilities of local cable systems include, but are not limited to, the following types of communications links:

Dedicated point-to-point links can be used to interconnect two computers, two terminals, or a computer and a terminal on a permanent basis. Any standard data rate up to and including 1,544,000 bps can be accommodated. Equipment for still higher rates is now becoming available. Higher data rates can also be used with end equipment that multiplexes, or combines, data from many devices onto a single data link.

Dedicated point-to-multipoint links operate in a similar way. These links provide permanent connections between a computer and a number of terminals or other devices in order to enable the computer to exchange data with each on a sequential basis. Dedicated point-to-point and multipoint links are functionally comparable to traditional services offered by local telephone companies. However, such standard services typically operate only up to 9,600 bps. The much higher rates provided by local cable systems are therefore a distinct advantage.

Multipoint switched links allow many computers, terminals, or other devices to be connected to each other dynamically through the use of addressing. Any such device can then communicate to any other device on the link on a temporary, switched basis. This link is a functional extension of the Local Area Networks (LANs) being marketed by a number of companies for office automation purposes. The local cable system can be used to provide multipoint switched links, or LANs, that encompass several buildings. They can also interconnect independent LANs in several separated buildings and provide access from devices on a LAN to long distance services from a common carrier. These links are equivalent to standard telephone switched services. They provide higher data rates and, in most cases, greater flexibility and ease of operation.

The high capacity of the cables used in the system can permit many links of the three types described to operate simultaneously on a single cable.

VOICE SERVICES AND CABLE I-NETS

One of the important advantages offered by a high tech building is the availability of improved voice service inherent in the use of a private telephone system. In many cases the building owner or manager provides the necessary wiring from each floor to an advanced telephone switching system located within the building for the shared use of tenants. Such a system offers low-cost interconnection of the telephones within the building, and many also include a number of advanced features designed into newer telephone systems. Typical of such features are teleconferencing, call forwarding, least-cost routing, and detailed call accounting.

Where there is a complex of buildings, or where a particular tenant occupies several buildings in the same area and wants his/her own system, the private telephone switch can be divided and a portion of the system extended to and included in each building. Also, it is possible that each building may require its own independent telephone system. In either case voice links between buildings are necessary.

The local cable network can be used to provide those links. It can also provide required connections between a private telephone system and a common carrier for longer-distance voice communications. The cable system offers several options for providing such local voice services. The primary consideration in the selection of an option is the number of voice links needed.

Small numbers of point-to-point voice links can be transmitted through the cable system on an individual basis. Such an approach is most practical when several end points require roughly 10 or fewer connections between them. It also provides flexibility when the link end points are subject to relocation.

In cases where larger numbers of links or trunks are needed, a local cable system can provide several options. Equipment called channel banks, or their equivalent, can encode and combine several voice signals into a single binary bit stream having a data rate of 1,544,000 bps. That signal can then be transmitted through the cable system in a fashion identical to that of the high-speed dedicated point-to-point data link discussed previously. Present standard channel banks can combine 24 voice signals. However, more sophisticated equipment is now becoming available that can increase this number to 48 signals or more. This technique is practical when fixed-end equipment, such as telephone switches, must be linked by at least 10 voice trunks.

Other types of equipment can combine even greater numbers of voice signals in either encoded or nonencoded form and provide transmission by direct connection to a dedicated cable. For example, some telephone switches are now capable of combining several hundred voice signals to produce a 45 million-bps binary encoded stream of light pulses. For transmission this pulse stream can be coupled directly to a single optical fiber contained in the local cable system.

VIDEO SERVICES AND CABLE I-NETS

The cable system can also satisfy a number of video transmission requirements. Video images can be transmitted through the cable in either an encoded or unencoded form.

Equipment called a codec is now available. It can sample, encode, and simplify a video signal to produce a digital pulse stream at a standard data rate. Present codec designs permit full-motion video to be transmitted at a rate of 1,544,000 bps. To the cable system, that signal appears the same as a high-speed data or encoded voice signal. Freeze frame video, in which the image is changed every few seconds, now requires a 56,000-bps data link. Development of improved equipment will lower the data rates needed. A codec-equipped videoconferencing room in the high tech building can therefore be connected through the local cable system to conventional long-distance data services.

Standard unencoded video links can also be provided between buildings or to long-distance carriers. A security system encompassing several buildings is a typical application requiring such links. The high-resolution video required by suppliers of programming services and by medical diagnostic systems requires more capacity but can be easily accommodated on the local cable networks.

CABLE TYPES AND CHARACTERISTICS

There are several types of cable that can be included in a local system designed to satisfy the applications discussed above.

Twisted Pair

Cables composed of twisted copper wire pairs have been used for traditional telecommunications services for many decades. They remain the predominant facility offered by local telephone companies. Each pair can provide a point-to-point connection for a single signal. Although designed primarily for voice purposes, a twisted pair can also be used for data when equipped with modems as end equipment. Typical modems convert data signals to voice form for transmission on the cable pair. The maximum data rate achievable is usually 9,600 bps. Other modem types can transmit data signals directly over the cable for a maximum distance of several miles. The distance of possible transmission decreases proportionally as the data rate increases. The maximum data rate achievable between buildings with this approach is typically 56,000 bps. For this reason, copper pairs are not suitable for most high-speed data, or for video applications.

A wire pair is needed for each signal; therefore, cables of this type are quite large and bulky compared with newer cable types having greater capacity. Twisted pair cables are also more susceptible to a number of electrical noise and interference conditions, which can disrupt proper operation. They are relatively easy to tap for signal monitoring purposes and therefore provide less security for information of a private nature. For these reasons, twisted pair cable has relatively limited usefulness in most local cable networks.

Coaxial Cable

Coaxial cable was developed to meet new requirements that were beyond the capabilities of twisted pairs. Applications with such requirements included radio, television, radar, and video signal transmission. The telephone industry also began to use coaxial cable for the bulk transmission of many voice links combined into a single signal.

The physical structure of coaxial cable makes it suitable for such applications. It transmits its signal energy through a single center conductor, which is totally surrounded at a uniform distance by a shield and ground return, which serves the same function as the second wire of a twisted pair. This structure permits coaxial cable to have a signal capacity many times that of twisted pair and also provides effective shielding against electrical interference. In recent years the improved performance of coaxial cable has caused its use to be expanded to include a variety of new data and voice applications.

Baseband. These applications can be functionally divided into two groupings: baseband and broadband. In systems using baseband operation, a single digital data signal having a rate up to 10 million bps or greater is transmitted on the cable at any instant of time. It can be sent several thousand feet without having to be regenerated to its original form. In many operations, interface equipment is located at either end of a point-to-point cable. As an alternative multiple signal sources may be easily tapped onto the cable throughout its length in order to share use of the cable capacity on a time sequential basis. A LAN is an example of such an application. A typical LAN permits many compatible interface devices to communicate with each other on a dynamic, switched basis. The high cable data rate permits each system user to operate as if a private, dedicated connection were being provided. A local cable system that includes coaxial cable can provide the baseband applications described above within a complex of adjacent high tech buildings.

Broadband. Broadband coaxial cable technology has been developed largely to satisfy the need of the cable television industry to distribute a number of high-capacity video signals throughout a city-size area on a single cable and to tap those signals into a great many locations. This is accomplished by assigning each signal a separate portion of the overall cable capacity, that portion being proportional to the information content of its assigned signal. Since total coax capacity can be as much as 100,000 times that of a conventional voice twisted pair, a great quantity and variety of signals can potentially be accommodated. Present techniques permit at least 50 unencoded television signals on a single cable.

In recent years techniques have been refined to permit two-way data and voice to also share the active cable. Present equipment permits transmission of about 130 1,544,000-bps, two-way data signals. Alternately, several thousand lower-speed data or voice connections can be provided. A flexible mix of data, voice, or video signals is possible.

Amplifiers spaced every 1,000 to 2,000 feet permit distribution of high-quality signals throughout a radius of 5 to 10 miles. Beyond that distance quality begins to gradually decrease. Within its area of operation, a broadband cable system can easily be tapped to provide use of the cable to many buildings and to many locations within each building. A well-designed broadband system will provide preinstalled access to the cable at all locations having potential need for its use. New applications can therefore be readily connected into the cable and can then communicate with any other access point, or combination of access points, on the system. Several suppliers are now providing local area networks that are compatible with broadband operation. Using this approach a LAN composed of several hundred terminals can be accommodated on a broadband cable in the capacity normally allocated to a single television channel.

A local cable system that includes broadband coaxial cable will provide its users with great capacity and flexibility in communicating within high tech buildings and to the outside world.

Optical Fiber

The development of fiber optic systems has become a very rapidly evolving part of the communications industry. This extraordinary growth is based on relatively recent breakthroughs in several interrelated areas of technology.

Strands of ultrapure glass fiber are capable of transmitting light signals for long distances. Those light signals can be varied in several ways in order to convey intelligence. The technique most applicable to telecommunications functions involves transmission of narrow pulses of light that are coded to represent voice or data information. These light pulses are produced by electronic components called laser diodes in response to comparable pulses of electrical current. Light coupled onto the fiber and transmitted through it is sensed at the far end by complementary components, which convert the light pulses back to electrical form.

Rapid advances in the technology of both fiber and end equipment are serving to enhance several advantages inherent in the use of optical fiber systems. Improved end equipment permits use of progressively narrower pulses. New fiber types can transmit those pulses with acceptable distortion. As the pulses become narrower, more of them can be transmitted in a given time; and therefore, the capacity of the system is increased. Advances in the capabilities of end equipment, in the purity of glass used in producing fiber, and in the techniques for splicing sections of it together result in less attenuation of the light. This permits communication over increasing distances without the need for pulse regeneration. Many fiber systems now in operation can transmit approximately 100 million pulses per second for distances of five miles or more. A newer fiber type, now readily available, increases both speed and distance by a factor of at least two. In a number of labs, speeds of more than a billion pulses per second and distances approaching 100 miles are being achieved.

The failure rate of end equipment components has been greatly reduced in recent years. Coupled with the stability of the glass fibers themselves, this results in highly reliable operation. This reliability is enhanced by the fact that considerable distances can be achieved without the use of intermediate equipment.

Optical fibers are approximately the size of a human hair. Newer types are considerably smaller. Many fibers, having a tremendous collective capacity, can therefore be included in a composite cable of reasonable size. Individual fibers can then be broken out of the cable at strategic points to serve specific functions.

Because only light energy is transmitted through a fiber system, the system is immune to electrical interference of all types. This is particularly important when high-quality transmission is required in the vicinity of electrical power facilities, near an elevator system, or near any other equipment requiring surges of power.

Its physical characteristics and mode of operation make fiber a very secure transmission medium. It is relatively difficult to remove the surrounding protective material and then the opaque coating of a fiber in order to gain access to the information-bearing pulses of light. It is probable that the effort to do so will disrupt proper operation and therefore be detected. Highly sophisticated equipment is also needed to detect the light signals and to interpret their informational content.

The same factors that make fiber secure also make it relatively difficult to work with. Coupling light between end equipment and the fiber, splicing the fiber, and testing its operation are all rather precise operations requiring complex equipment and a high level of training.

At the present time most fiber optic systems are configured similarly to those that use twisted pair cable. Each fiber conveys a single signal between two fixed end points. Equipment to divide the capacity of a fiber to permit simultaneous multiple signals is now in laboratory development. Improved techniques to connect, splice, and tap fiber to multiple locations are also being developed. It will probably be several years before these developments result in practical and inexpensive products suitable for general use.

Coaxial Cable versus Optical Fiber

For the foreseeable future, coaxial cable and fiber will each continue to have advantages relative to the other. Fiber provides reliable, high-capacity, point-to-point links over relatively long distances. Coaxial cable, on the other hand, can handle a number of independent signals simultaneously and distribute them among many intermediate points in a very flexible and timely fashion. Many local cable systems will therefore contain both types of cable, each being used in the applications for which it is best suited.

There are several potential sources of local communications capability. In many cases, it may prove advantageous to use a combination of such sources in order to develop an overall system.

Local telephone companies are working hard to upgrade their cable plant facilities. They are removing voice-oriented equipment from a portion of their twisted pair cables in order to permit customers to transmit 56,000-bps data, or higher, to the nearest central office. They are also installing fiber optic capabilities between central offices and to the locations of prime customers having high-speed data requirements of 1,544,000 bps or more. This is a major effort, and some customers may continue to encounter significant delays in receiving such services for several years to come. Leasing of the high-speed telephone company services described makes the most sense when they are used to provide access to comparable capabilities from long-distance carriers or to interconnect high tech buildings beyond the range of a local cable network.

In some instances, telephone companies have installed dedicated cables for specific customers and have leased those cables on a long-term basis. However, provision of such services is not a primary business for most telephone companies. Therefore, they are not expected to be a major supplier of dedicated cables for inclusion in local distribution systems.

Cable companies supplying CATV services have access to cable distribution facilities within their franchise area. They can also have new facilities constructed if they are needed. This is an important advantage, particularly in urban locations, where ducts in the underground system are often scarce and a considerable level of expertise is required to use them advantageously.

URBAN CABLE TELEVISION SERVICES

Manhattan Cable Television (MCTV) has been supplying a range of services to the New York City business community for a number of years, and will be used as a specific example of the types of capability a cable company can offer.

Manhattan Cable operates a broadband coaxial cable system dedicated to the provision of two-way data communications services. That network is active in more than 60 buildings in New York's prime business and financial districts. In many of those buildings, it is functional on every floor. A number of corporate clients each lease a portion of the system's capacity in order to communicate between buildings at data rates ranging from 1,200 to 1,544,000 bps.

For a fixed monthly fee, which is proportional to the data rate used but independant of a client's particular locations, Manhattan supplies and maintains all facilities up to the standard digital interface that connects to the customer's data equipment at each end of the link. Maintenance service is available around the clock, seven days a week, and has a typical response time of less than two hours.

In addition to monthly costs, clients pay a nominal installation charge. When services are required in an unwired location, users share in costs to bring the cable into the building and to make it active. This tends to limit the customer base to companies having substantial communications requirements.

System Usage

Clients are attracted to use the system for a variety of reasons. Some require the quality operation and high data rates provided. To others availability is of great importance. Within wired buildings new circuits can be added, speeds can be changed, or end points can be relocated within a matter of days. Services in unwired buildings have a lead time of about three months. The availability of long-term, fixed rate contracts is also of importance to many customers.

Within the past two years, typical usage of the system has been shifting. The trend has been toward use of higher-speed circuits. Data, voice, and video applications are now all being supported by those circuits. A strong recent trend has been toward greater use of the system to link end-user locations and carrier facilities, usually at high speed.

The success of its shared data system has caused Manhattan Cable to initiate several steps to expand and augment its operation. New equipment is being implemented that will functionally double the capacity of the system. Redundant facilities are being supplied for the primary cable network. Switch-over capability that will permit immediate restoration of service is included. A diagnostic system will sequentially test operating parameters of all active system components and report any abnormalities. Through its use, a source of failure will be immediately pinpointed, and marginal conditions can be reported and corrected before they result in an actual outage. Manhattan has no immediate plans to expand its services to include responsibility for end equipment, such as terminals, data multiplexers, or channel banks.

Several users of the shared network have also contracted for similar systems dedicated to their private use between a number of buildings they either own or occupy as a prime tenant. In such cases the client pays for the construction and activation of the system under a long-term contract. Manhattan Cable again supplies all cable equipment and maintenance for which the client pays a fixed monthly fee per circuit. However, a discount from normal rates is provided in order to compensate the customer for initial implementation costs.

A dedicated system can be custom designed to meet the particular needs of the client. Such techniques as the use of a ring configuration and alternate cable routing are typically used to provide a highly reliable system. Provision of on-line spares for all active components is also possible if required.

Installation and maintenance of dedicated cable links is now becoming a major segment of Manhattan Cable's nonentertainment business. Its access to the underground duct system and its experience in the use of that system permit Manhattan to install and maintain private cable systems customized to meet the particular needs of the customer.

Customer Uses

Several companies have installed their own cable systems within a number of buildings. The interbuilding cables supplied by Manhattan serve the purpose of linking those systems together into an overall network. Others customers need high-capacity links to tie together telephone switch equipment located in dispersed buildings. Carriers having several node sites within the city need to interconnect those nodes. Either coax or fiber cable can be provided to serve those purposes. In some cases it is farsighted to install both types of cable at the same time.

The customer typically pays the initial cost of cable installation and test, and some clients also choose to supply the cable used. Manhattan assumes responsibility for the installation and then maintains the cable under a long-term contract. The monthly maintenance fee is based upon the number and types of cables involved and upon the length of those cables. Periodic testing and preventive maintenance of the cable system can also be performed at

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specified intervals for an additional charge. Thus far the users have assumed responsibility for all end equipment connected to the cables.

Based on the experience of Manhattan Cable and on the growing demand for local cable capabilities, a growing number of cable companies are now beginning to offer services such as those described above.

Some companies desire to own all or part of their local cable network. They therefore assume full responsibility for its design, installation, and maintenance. This option is most practical in a controlled environment—a college campus or hospital complex, for example—wherein cable installation and maintenance do not become a major problem.

Cable Installation

In an urban location, cable installation and maintenance present much greater difficulty. Access to the duct system is rigidly controlled. In New York City private companies may gain limited access to available ducts for their private needs by making application to the proper city agency. This can be a complicated and lengthy process. In many other cities, this is not possible at all as yet. Maintenance is also a primary consideration. A very limited number of companies are permitted access to the underground system in order to test and repair cables needing maintenance.

A limited number of firms are now offering consulting services geared to gaining access to the duct system, design, installation and test of cable networks, and provision of cable maintenance. Services from such firms naturally add to the cost of establishing a private cable network. The expertise needed to perform the services mentioned above is now limited to a relatively few individuals. It is therefore difficult to engage a firm that can supply the full range of services and do a turnkey development of a private cable system. It is more common to hire several firms and have each contribute to a particular aspect of the overall job.

Technical Advantages

Independent of their source and ownership, there are important technical and operational advantages that result from the use of improved types of coaxial and fiber optic cable. The great capacity inherent in their design also produces several related improvements. The bit error rate performance of links using these cables is superior to that provided by the use of twisted pairs. Better immunity to noise and interference also contributes to this improved signaling capability. The relatively small number of cables required makes it much simpler to install redundancy and switchover, and greater reliability is the reward. Their limited number also makes it much easier to implement diagnostic and test capabilities on the cable and makes it quicker to repair cables in the event of a failure. Speed in the modification and

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initiation of applications is greatly improved because of the preinstalled capacity provided by a well-designed cable network.

Financial Options

As discussed above, there are a number of options available when implementing a local cable capability. The traditional approach has been to lease all facilities and to pay on a monthly basis. Fear of rapidly escalating costs and the availability of viable alternatives has led to the present trend toward more independence and innovation. Users are now more willing to assume significant operational control and responsibility relative to their communications facilities, and many will make significant capital investments in equipment and cabling in order to reduce or guarantee long-term expense. A preference for longer-term contracts is also becoming more common. The benefits of this strategy can be substantial. Several of the projects in which Manhattan Cable has participated resulted in payback periods of one to two years. The savings in the longer term will prove to be substantial. In addition to these direct financial benefits, assumption of greater control, if effectively exercised, can result in improved operation and faster maintenance response by personnel who are more directly accountable to management.

This more aggressive approach on the part of communications users is an integral part of a rapid evolution taking place in the entire communications industry. The breakup of AT&T, coupled with a general trend toward deregulation, has provoked an era of unprecedented competition. A great number of new carriers are offering improved transmission options. Rapid technological progress, particularly in the field of microelectronics, has produced a flood of new hardware and software products offering greatly expanded capabilities. Communications users are rushing to develop the expertise needed to function effectively in this new era. Consultants are gearing up in order to provide proper help where needed.

The primary focus of much of this activity is now shifting from long-distance communications to the local connection. There are great savings and improvements to be made in local communications and in gaining efficient access to the long-distance network. The concept of the high tech building lies at the heart of an effective local communications strategy. Functional, efficient, and reliable local cable networks will provide the webs of wire and glass needed to tie it all together.

BENEFITS TO THE I-NET USER

Why would a business buy telecommunications services from a cable operator? What are the benefits of such a service and how cost effective is it?

In a few cities today, cable offers business wideband, high-speed capacity that may be (1) unavailable elsewhere, (2) available only at greater cost, or

(3) obtainable only with much delay. Currently, just a handful of cable systems serve a handful of commercial users, but two major catalysts could lead business to greater use of cable services—the divestiture of AT&T and the growing desire of companies to integrate their voice, data, and (in the future) video telecommunications services.

EFFECTS OF THE DIVESTITURE OF AT&T

The major impetus to the use of alternative technologies and new vendors is the economic uncertainty caused by the breakup of AT&T. On January 1, 1984, the 22 Bell Operating Companies (BOCs) became officially separated from AT&T.

AT&T has aggregated its remaining units into two major sectors: AT&T Communications and AT&T Technologies. The first consists entirely of the former long-lines division. Under AT&T Technologies are AT&T Technology Systems (formerly Western Electric); AT&T Bell Labs (research and development); AT&T Network Services (selling transmission, switching, and central office products and services to telephone companies and internally); AT&T Consumer Products (dealing in the consumer market); AT&T International, serving markets abroad; and the AT&T Informations Systems Group. Although the last falls under AT&T Technologies, it is now set up as a financially independent subsidiary, which will service specific markets, selling digital PBXs and other business communication products.

As a result of divestiture, AT&T will no longer be a one-stop shopping center for service, equipment, and installation. Additionally, users will be confronted with new rate structures as they use communication services within and between the approximately 165 Local Access and Transport Areas (LATAs) that replace the 22 BOC service areas which generally followed state boundaries.

Where once service between two cities fell under one pricing pattern, service between the same two cities may now trigger a totally different rate structure, depending on whether they are in the same or different LATA. All intra-LATA service will be provided by the respective BOCs, which retain their separate identities within each regional network.

As the United States moves from the dominance of a quasi-national entity, AT&T, to a highly competitive market with many different and unintegrated service and equipment providers, there will be new opportunities for entrepreneurs and users, as well as formidable problems and the potential for chaos.

INTEGRATION OF SERVICES

Data information is no longer the exclusive domain of the data processor and the mainframe computer. Using microcomputers, more and more end users are aggregating, accessing, and manipulating information themselves. These end users not only want to use information, they want, if necessary, to send and receive it within and between buildings and within and between cities.

As greater numbers of people become sophisticated computer and information users, they will want more sophisticated communications services. And as the use of telecommunications of all kinds proliferates, the end user, especially telecommunications managers in larger companies, are becoming advocates for the integration of voice, data, and video services.

Integrating services means eliminating or reducing the time it takes to deal with multiple vendors, learn their peculiarities, pay multiple bills, and match up and interface multiple kinds of equipment. So when business evaluates the benefits of alternative technologies, it will consider not only cost, but the capacity to integrate services and possibly obtain them from a single vendor, whether a phone entity, a cable company, or a carrier like MCI.

CHALLENGES TO INSTITUTIONAL NETWORKS

Challenges to I-Net expansion come from regulatory bodies and competing technologies. In the technological arena, the cable industry's openness to new technologies and system architecture will determine how competitive cable will be in the next five years. On the legal front, cable operators are active in the courts and before legislative and regulatory bodies, trying to make sure that they do not wake up to find themselves legislated or regulated out of new nonentertainment businesses. A formidable competitor is the telephone industry, which believes that tariff and regulatory decisions—not technology—will determine the outcome of competition.

CABLE'S UNIQUE POSITION

Today, cable operators are in an excellent competitive position. Laying miles and miles of new cable monthly, they are setting in place a special local loop and carving a niche for themselves in a flexible and growing telecommunications market.

Through I-Nets, cable companies have an opportunity to add new profit centers to their traditional residential base. Commercial users have the opportunity to obtain services that might otherwise be unavailable or available only at a higher price or with greater difficulty.

To enter the commercial market, cable companies will need staffs with particular kinds of technical skills and knowledge, as well as the ability to understand business needs and to tailor cable services to company requirements. The compensation for the effort and investment is a broadening of cable's economic base, new service offerings, and revenue from large channel capacity.

The small but growing use of cable for business applications is evidence that these offerings have a market. The key for the business user and the cable company provider is getting to know each other and understanding what each can offer the other. If cable can give business what it needs, when it needs it, and at a competitive price, then cable can develop a market position within the continuously expanding telecommunications market. Although important regulatory issues have yet to be settled, the regulatory climate is such that the odds may be in cable's favor.

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Chapter 27

Enhancing the High Tech Building through Metropolitan Digital Networks

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Outline

METROPOLITAN AREA DIGITAL NETWORKS

Central to the continuing advancement of any technical society is the need for an effective communication system. For 100 years the voice telephone seemed to meet our informational needs. However, with the wide use of computers, requirements changed and demands on informational systems increased. Today's modern, technological society wants more than just voice from its communication systems. It wants new capabilities and services, such as voice with enhanced features, data transfer, and videoconferencing. The growing desire for these services is the driving force behind the evolution toward a total service network. The heart of this evolution is located in the developing metropolitan area.

Metropolitan areas have always been at the forefront of technological change and evolution. In communications, the metropolitan area will be the focal point of developing an Integrated Services Digital Network (ISDN). This digital network will meet all the varied informational needs of many different users. Customer services will be provided through a single interface to a large integrated network. This network will feature end-to-end digital connectivity and complete customer control of the data transfer process.

To fully appreciate the development toward an ISDN and the contributions of metropolitan area digital networks, a fuller understanding of the information transfer process is needed. This chapter is divided into four sections. The first explains in detail the communication/information transfer process of today's network. The second shows how the network is evolving toward an ISDN. The third section explains divestiture's impact on the network. Finally, Philadelphia will be examined as a case study of a typical developing metropolitan area network.

COMMUNICATIONS—UNDERSTANDING THE NETWORK

Communications is the transfer of information from one place to another with speed, reliability, and accuracy. A desired attribute of communications is to achieve this transfer at a reasonable cost. The most effective method of accomplishing these goals is through a communications network that is a system of lines, channels, or circuits providing transmission of information. One of the most extensive and sophisticated communications networks today is the public switched network in the United States.

Components of the Public Switched Network

There are three major components to the public switched network: subscriber loop (customer lines), central office (switching facilities), and trunks (lines connecting central offices). Each of these three parts is integrated into one network, which gives the customer the capability to send information to any other location where access to the network exists.

Local loop. The subscriber loop provides the customer with an interface to the network. The loop forms the transmission path between the customer's premises equipment and the network over which information can be sent. The customer premise equipment can be a phone, data terminal, or video equipment, depending on what type of information is being sent. Traditionally, the subscriber loop or line was thought of as a twisted copper wire pair, but today other transmission mediums are also used. For high-speed data or video signals, fiber optics over thin glass strands provide interference-free, high-quality communications. The copper wire pair, however, is still the preferred choice in many instances for short-distance voice conversation and low- to medium-speed data due to its ease of installation and low cost. Whether the subscriber loop is made of copper or some other material, the main function is the same: to give the customer a medium for sending information from one location to the next part of the network, the central office.

Central office. The central office is the center of the communication network. Through the use of switches and other circuits, it establishes a transmission path for sending the information to its final destination. The best way to understand the importance and function of the central office is to consider what the network would look like without the ability to switch calls.

Assume there is a community where eight people lived, and each one had a phone. A person who wanted to call any of the other seven would need a direct line to each of the other telephones in the community. Each of these phones would in turn need separate connecting lines to the remaining ones. A total of 28 lines would be needed to interconnect the eight phones in the community. The number of lines needed in this type of network can be calculated by this formula:

$$\text{Number of lines} = N(N - 1)/2$$

where N represents the number of phones in the system.

Such a network would require millions of lines for just a few thousand telephones. This would not be practical or affordable.

To improve the efficiency of the network, a switching system located in a central office can be used to receive calls and switch them from one line to another. In this type of network only one line is needed to connect each phone to the central office. The switch greatly improves the efficiency and lowers the overall cost of the network.

In the early development of the network, switching was performed manually at the central office by an operator. The caller gave the name of the party they wanted to the operator, who then routed the call to the proper destination by connecting wires on a switchboard. As technology advanced, the method of completing calls became more sophisticated. Direct dial used electromechanical devices, which routed the calls by sensing the numbers dialed by the user as electric pulses. Each set of numbers gave a sequence of commands to a switch, which decoded into a specific location and phone in the network. Today, highly sophisticated computers connect thousands of calls in a fraction of a second. Calls can even be dialed directly overseas.

When a call originates and terminates within the same central office, it is an intraoffice call. If, however, the destination of the call lies outside the area served by the local central office, the call must go out over a circuit called a trunk. At the other end of this trunk is the destination central office, which then switches the call to the proper subscriber loop. This type of call, using two different central offices for completing a connection, is called an interoffice call.

Just as it would be impractical to connect all the telephones in the network with separate lines, it is impractical to have a direct line or trunk connecting all the central offices together. To avoid this, a system of tandem switching centers was developed. A tandem center is a switching office between two central offices that do not have a direct connection. When a central office cannot find an available trunk to the destination central office, it sends the call to a tandem switching facility. This tandem must then decide on how to complete the call. If there is a connecting trunk, it can send the call directly to the destination central office. When there is no direct connection, the call will be sent to another tandem switch. The call can be handled by several tandem switches before it reaches its destination because there are hierarchical levels of tandem switches defined in the network that permit the systematic and efficient routing of calls.

There were four levels of tandem offices in the network prior to divestiture. Now the local telephone companies primarily use the local central office and one or two levels of tandem centers to complete calls. Calls that need a higher level of switching, international or interstate long distance, are handled by a long-distance carrier.

The ability of the tandem offices to search for available routes gives the network its flexibility. If all the direct circuits between two central offices are busy, the switching system can provide an alternate path, called indirect routing. Suppose a call was being placed between downtown Chicago and one of its northern suburbs. The most direct route would be a direct line between the two areas. If direct routing was the only way to complete the call and all the trunks were busy, the caller would receive a busy signal and would have to try the call again later. Fortunately, the hierarchical structure of tandem switches gives the system other alternatives. A less direct routing of the call can be made. The call might go from downtown Chicago west and then terminate in the northern suburbs. The system constantly monitors the usage of the circuits, and if they are all busy in one section, the call can be handled by excess capacity elsewhere. Such a process is transparent to the customer. It is executed automatically by the system without any effort by the user, who is never aware that this process is taking place. The user thinks the call is direct from downtown to the north and is only billed for a direct call.

The trunk. We have already briefly mentioned the third part of the network. It consists of the connections between central offices and tandem centers, called trunks. They are normally carried on higher-capacity facilities, which can simultaneously carry many voice and data channels between offices. Copper cable, coaxial cable, lightguide, or microwave radio for these transmissions. All these mediums are suitable for carrying high volumes of traffic. Although the backbone of the long-distance traffic was formerly carried by cable and microwave radio, lightguide is now becoming an increasingly popular replacement. This especially holds true as the network converts to the use of more digital facilities.

When information is transmitted over the network, it can exist in two different forms: analog or digital. An analog signal has certain characteristics that make it very different from a digital signal. Analog is continuous and has an infinite range of amplitudes and frequencies. The human voice is a good example of an acoustical analog signal. When the human voice is converted into an electrical signal by means of the telephone, an electrical analog signal is created that exactly duplicates the acoustical signal. Analog signals suffer from loss, noise, and distortion during the transmission process. To counteract this loss, which is created by attenuation, the signal strength is boosted by amplifiers. Unfortunately, noise, which is any unwanted signal, becomes mixed with the informational signal during the transmission process. Amplifiers cannot distinguish between noise and the informational signal and therefore amplify both the noise and the informational signal. After many amplifications the signal becomes distorted. Filters help reduce the noise and distortion, but over long distances the signal still loses some quality and part of its informational content. Transmission of analog signals are therefore distance limited by the number of times the signal can be amplified.

Distortion and signal loss of analog signals were tolerable when voice conversation was the only type of signal transmitted over the network. Even when the signal was distorted, if the other party could understand enough of the conversation, communication could still occur. However, today computers are using the network for transfer of data in ever-increasing numbers. Unfortunately, they are not nearly as tolerant as people are of noise and distortion. Distortion and signal loss problems, when dealing with computers, would result in data transmission errors. The use of digital signals greatly reduces the potential for transmission errors.

Digital signals differ from analog signals in two ways. Digital signals are discrete in time (noncontinuous) and have a discrete number, not an infinite range, of amplitudes or values. They carry encoded information in a series of on or off pulses called bits. The standard format used in the United States for digital signals is called the T-carrier system. The T-carrier system uses a 1.5 Megabits-per-second transmission rate and can carry 24 simultaneous voice or data channels.

To convert an analog signal to a digital signal is a three-step process: sampling, quantizing, and encoding. First, the signal is sampled at a rate of 8,000 times per second. Each of these samples is then quantized into one of 256 discrete levels by comparing it to a segmented scale. Finally, the signal is encoded into a binary word consisting of eight bits. Each of these eight-bit words describes a certain portion of the original analog signal. Using these words, the entire analog signal can be reconstructed at the receiving end of the circuit.

Digital signals are still plagued by the loss, noise, and distortion affecting analog signals, but there is a much more effective way to deal with these problems. While analog signals are amplified to counteract loss of signal strength, digital signals are not. Instead, digital signals are completely regenerated at regenerator stations. It is a relatively simple task to build electronics to sense the digital pulses and regenerate them. Since the digital signal is completely regenerated or renewed, there is no amplified noise or distortion to worry about over long transmission distances. Using this method the signal can be regenerated many times using multiple regenerators. Additionally, the chances of inducing errors in the signal are greatly reduced.

Digital signals have other advantages, too. A digital signal carrying voice would require 64 kilobits per second, which is composed of 56 kilobits of voice information and 8 kilobits used by the network for signaling and supervision of the call. By multiplexing signals together, much higher bit rates can be achieved, and many signals can be sent simultaneously over the same facilities. Twenty-four voice channels can be multiplexed to produce the T-carrier signal of 1.5 megabits per second and can be sent over copper transmission facilities. Even higher bit rates, such as 560 Mbps, with the capability of carrying 9,264 voice channels, can be achieved using lightguide over two fiber optic strands. Rates of over 1 billion bits per second are expected to be possible in the near future. By use of multiplexing, digital signals can achieve even greater utilization of these transmission facilities.

There are many advantages to a totally digital network, but it is impossible to convert all the analog facilities to digital overnight. The public switched network was originally designed to handle analog voice conversation, and although analog and digital signals cannot normally be handled by the same equipment, many of the existing facilities have been adapted to handle both types of traffic. This makes possible some services that offer end-to-end digital connectivity, even though they do use some analog facilities.

THE EVOLVING NETWORK

The present switched network is working toward the concept of an Integrated Services Digital Network (ISDN). Today's network is a combination of analog and digital, transmission and switching equipment, but the ISDN will be an exclusively digital network. It will support a wide range of voice, data, and video services. The customer will have access to these services through a limited set of standard interfaces. The ISDN is not yet available, but there is already a wide range of services now available through the network.

There are two basic types of informational transmission services provided by the network: switched, and nonswitched. Three services best illustrate the difference between these two: WATS/800 service, which is switched; Private Line, which is nonswitched, and Foreign Exchange, which has switched and nonswitched components.

WATS Service

Wide Area Telecommunication Service (WATS) is probably one of the most familiar services available through the network. It permits the customer to make a bulk purchase of long-distance voice or data service rather than being billed on an individual call basis. This service is very attractive to businesses that do a lot of long-distance calling. The service can be purchased on an outward WATS (bulk charge for outgoing calls), inward WATS/800 service (bulk charge for all incoming calls), or both. No matter which option is chosen, the business has full access to the entire switched network. This service is really quite similar to residential or regular business lines and only differs in the method of billing.

Private Line Service

A more restrictive type of service is a Private Line (PL). A PL is a nonswitched, or hard-wired, service. It is very useful for businesses that require immediate or continuous communications with another location. One phone is connected directly to a second one with no switching facilities. With a PL the other phone can be located anywhere—in a different building or even in another city. The business customer purchases the exclusive rights to the circuit linking the main phone with another extension. The connection exists constantly and there is no worry about dialing or about the line being busy. This service might be used by brokerage houses to contact the trading floor where immediate, continuous communication is needed. Another use might be a connection between a main corporate computer and branch office computers in other cities or states.

Foreign Exchange Service

A third type of service, Foreign Exchange (FX), contains elements of nonswitched and switched service. FX is used when a company is located in an area served by one local exchange or central office but wants a phone number in a different central office. An example would be a firm located in Baltimore that wants a local number listed in Washington, D.C. In this case the company would have a normal subscriber line to the Baltimore central office but, instead of connecting to the local switch, it would connect to a dedicated circuit leading to a central office in Washington, D.C. The company would receive its service and dial tone from the Washington central office and not from the office in Baltimore. This arrangement is very useful if the company does a lot of business in the area served by the distant central office and wants a local listing in that office's directory.

WATS, PL, and FX are very good examples of the difference between switched and nonswitched services, but they do not begin to tap the vast potential of voice and data services available through the network.

Centrex

Centrex uses the capabilities of the local telephone central office to provide enhanced services to the business customer. The central office has a separate line extending out to each subscriber's station. These stations can be telephones, data terminals, or printers. Over these lines the customer can transmit voice or data. The difference between these lines and residential lines is in the features available.

The available features include call forward, call waiting, and four-digit dialing to any other station in the Centrex. In addition, the user has complete access to the public switched network. Centrex Station Rearrangement (CSR) permits the customer to rearrange numbers and features via terminal access to the Centrex switch. Centrex also provides digital data capabilities in the central office switch for 9,600 bps to 56,000 bps.

There are several advantages to the use of Centrex by businesses. As a part of the switched network, service is provided 24 hours per day, even during power outages. There is no bulky equipment located on the customer's premises. There is growth capability, both in the number of stations and in the features available. A subscriber can add both lines and features as needs grow. Billing is provided on a per-phone basis, making accountability and usage recording simple. Finally, since Centrex is a leased service, there is no large capital outlay for expensive switching equipment.

As part of the public switched network, Centrex is a constantly growing and developing system. New features are being added on a continual basis. Future services include selective call waiting, selective call screening, and access to circuit and packet switching services, which will be explained later. Citywide Centrex is another future service.

Alarm Service

Alarm service is another type of service available through the public network. It utilizes the subscriber's existing telephone service to transmit alarms (such as fire, theft, and medical alert). Monitors are set up to scan the premises. Lines connected from the monitors transmit signals back to the alarm company. While the service is now limited to alarming, its growth potential lies in expanded use for continuous premises monitoring of power consumption, environmental control, and many other services that now require a separate computer and interface for each service.

Data Communication

There are also many types of digital services for enhancing computer data communications. When transporting voice over the telephone lines, the conversation is almost continuous with only short pauses. When interactive computer data is transmitted, it occurs in small, high-density bursts of information. A majority of time the circuit is idle. A Public Packet Switching Network (PSSN) uses a more efficient method of transmitting computer data (PPSN) is a communication network that uses packet switching technology, digital transmission facilities, and existing loop plant. It provides economical common user transport for "bursty" data within a local serving area. In addition, it provides access to interexchange carriers for transmission of data outside the local network.

Packet switching. Packet switching uses an entirely different switching technology from the type used in the analog voice network. It more efficiently uses the transmission and switching facilities for data transfer. There are no permanent circuits established. The transmission circuits are only intact for the time it takes to actually transmit the data. In packet switching, information is stored in discrete packets using a format called X.25. This X.25 packet of information is a section of serial bit stream that is buffered and divided. It can vary in size and contains all the data needed to route the packet through the network—place of origin, destination, sequence in message, error checking.

The first step in sending data over a packet switching network is to establish a transmission path for transmitting the information. A message is then sent out, and the destination computer sends back an acknowledgment indicating completion of the circuit. Now a permanent virtual circuit between the two computers has been established. The initiating computer now enters the transfer mode. Data is divided into packets and sent. At the first switch the packet is examined. Once its destination is determined, it is sent to the next switch. This process is continued until the destination computer acknowledges receipt of the packet. The only time the network is in use is when the packets are in transit between sender and receiver.

Packet switching has distinct advantages over using conventional phone lines. The establishment of a virtual circuit causes no facility usage or reservation. There is efficient use of resources, since they are dynamically allocated only when actual data is sent and are free the remainder of the time. The entire process is transparent to the user, who has the perception of exclusive use of the resources. Digital transmission is provided throughout; plus the error checking nature of X.25 protocol almost eliminates undetected errors.

Protocol conversion. X.25 is a synchronous form of transmission. However, many terminals and computer systems are designed to transmit data on an asynchronous basis. Converting data from asynchronous to synchronous is an example of protocol coversion.

The FCC in 1985 gave approval for the former Bell System Operating Companies to offer protocol conversion from asynchronous to synchronous. When the public network provides the user with the conversion, the individual users will not need to buy the equipment to convert at each operating station. it can be performed at a central location in the network. This service puts the public network in a position to economically meet the sophisticated data transmission needs of customers who are connected to this network.

Public Switched Digital Service. Another digital service under development for use in digital metropolitan networks is Public Switched Digital Service (PSDS). PSDS provides end-to-end digital connection through the network at rates up to 56,000 to 64,000 bps. PSDS features high-quality, cost-effective transfer of moderately heavy data among multiple locations. The high bit rates make bulk data transfer, high-speed facsimile, computer graphics, and encrypted secure voice possible. In addition, the dial-up line is still available for normal voice communications when needed.

PSDS, unlike packet switching, will not require an entirely different communication technology. It will be able to use the already existing network of digital switches, analog switches with digital connectivity, and digital trunk facilities. The customer will need digital access lines, which will extend directly to the customer's premises. Customer premise equipment will also need rate adapting electronics to synchronize it to the 56,000 to 64,000 bps access line if the customer wants to transmit slower-speed data.

High Capacity Digital Service. The digital service that now offers the highest available data rate is High Capacity Digital Service (HCDS). This type of end-to-end digital service is on the DS1 or 1,500,000 bps level, with the potential for even higher rates in the future. The service provides enormous capacity, but it does have some limitations. HCDS is a hard-wired circuit. This means it is installed between predesignated locations and does not have any switching capabilities. In the future, as digital switching technology develops, HSDS will eventually become a switchable signal.

DIVESTITURE

The most publicized event in telecommunication history was the divestiture of AT&T from the Bell Operating Companies (BOCs) on January 1, 1984. The world's largest corporation was separated into AT&T and seven regional holding companies. The holding companies contained the 22 former local telephone companies, BOCs. The breakup's most profound impact was on the division of service responsibility among the now separate entities of the formerly integrated Bell System.

BOC Responsibilities

The BOCs will be responsible for the traffic in a specific geographical area called a local access transport area (LATA). LATAs were developed as a result of divestiture. Within the boundaries are located areas of common economic interests. The BOCs will provide dial tone, local calling, and toll calling within the LATA. This type of traffic is called intra-LATA. Any traffic outside the LATA is called inter-LATA and will be handled by a long-distance carrier, one of which is AT&T.

Equal Access to Long Distance Services

Prior to divestiture, customers had the choice of whom they wanted to handle long-distance calls, but selecting AT&T was much easier than selecting another long-distance carrier. AT&T could be selected by merely dialing a 1, the area code, and then the number. To select another carrier required a much more involved process of calling the carrier, dialing an access code, and then dialing the desired party. With divestiture, all this changed as a new concept was born: equal access.

Simply stated, equal access gives the customer equal access to and a choice of long-distance carriers. When the serving central office converts to equal access, notification of the conversion is sent out to all the customers. At this time they must make a choice of which long-distance carrier they want to provide service. Then any time a customer dials 1 to make a call, inter-LATA, it will be automatically handled by the selected primary carrier. A customer who wants to use a different carrier to handle a particular call can dial a five-digit code identifying the carrier, and the carrier will handle the call. The primary carrier will remain unchanged and will handle any subsequent call unless another carrier is again selected by dialing a five-digit identification code. A customer who wants permanently to change primary carrier can do so by notifying the local telephone company.

Equal access is only one of the many advantages created for the customer by divestiture. There is now a much wider range of communication vendors and equipment available. More service providers are appearing in the market, giving more options and enhanced features of telephones, data, and video services.

PHILADELPHIA, A GROWING NETWORK

The Philadelphia communication system serves as an example of a typical metropolitan area network. It is a key factor in serving and attracting businesses to the Philadelphia area. It is a dynamic network constantly growing and evolving, and typifies the standard of excellence found throughout the public switched system. The success of this network can be found in its ability to meet the local business community needs, both present and future, and translate them into working communication systems. It is the resource that links the city and business tenants with the Information Age.

The Philadelphia communication network can provide the latest digital services; 95 percent of subscriber plant has capability for data speeds up to 56,000 bps per second; 100 percent of interoffice routes are equipped for 1,500,000 bit per second transmission. In addition, 100 percent of the switching is Stored Program Control (SPC), and 1984 saw the completion of Philadelphia's first lightwave ring capable of providing high-capacity, optical-digital service directly to the customer. Additional rings are scheduled for installation in the future. With all these digital facilities, Philadelphia is rapidly approaching an end-to-end public digital network, or an ISDN.

One of the first essential elements of an ISDN is digital transmission facilities between the customer and the central office. In Philadelphia, as in many other cities, the plant is well suited for providing this connection. As previously mentioned 95 percent of the customer serving links are capable of providing 56,000 bps service. This data rate, which has the capacity to transmit two typewritten pages of text per second, is fast enough to meet the need of most businesses' data rate requirements now and in the foreseeable future. The close proximity of customers to the central office is the reason for the high percentage of availability.

Another vital element to building an ISDN is digital interoffice transmission facilities. The entire downtown area is blanketed with digital carrier routes. The basic transmission rate of these facilities is 1,500,000 bps, enough for a large company to place a headquarters computer in Philadelphia and communicate with branch offices. The capacity of these systems will expand well above the 1,500,000 bps rate with the increased use of fiber optic lightwave systems.

The last building block of an all digital system is electronic switching. This type of switch is controlled by a computer that can be programmed to provide new types of service. Philadelphia has replaced all of the electromechanical equipment with 100 percent electronic switching. As PSDS and packet switching come into wide use, the center city area will be ready to handle these services and to give the business customer the new features.

The importance of these new digital capabilities is the end service they will provide to the business customer and high tech tenants. Whether the customers are the government, banks, hospitals, universities, insurance companies, law firms, manufacturers and distributors of goods and services, retailers, wholesalers, or any other type of business, the metropolitan area network can meet their growing informational needs. For voice communications, the digital network can provide custom calling, call waiting, call forwarding, speed calling, and three-way calling. With the greater reliance on computer systems, the digital network is ideal for data base inquiry/response, videotex, teleconferencing, electronic message systems, on-line polling, time-sharing computer terminals, energy and environmental controls, high-speed computer data transfer, and remote utility meter reading.

All these services further enhance the Philadelphia downtown area and serve as a valuable resource in attracting new tenants and increasing real estate values. With the 1983 interconnection of Philadelphia with AT&T's Northeast Corridor lightwave system, which serves major East Coast cities, and other long-distance carriers, the city took another step toward becoming a major East Coast teleport. As new technologies and telecommunication services become available, the metropolitan area networks will be the first to capitalize on these new capabilities.

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After graduating from Lehigh University in 1961 with a degree in Electrical Engineering, **G. William Ruhl** joined Bell of Pennsylvania. Most of his experience with this company has been in Engineering and Planning, including participation in the Bell Laboratories Operating Engineers Training Program and as an instructor in long-range technical planning at the Bell System Center for Technical Education. For several years, as the division manager for area planning, he was responsible for the central office and interoffice facilities modernization for the company. In his present assignment as division manager—Network Operations—Systems Planning and Technical Services, he is responsible for the planning of all operations systems and engineering technical support for Bell of Pennsylvania.

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Randall Frantz graduated from the United States Air Force Academy as a Distinguished Graduate in 1977 with a B.S.E.E. In 1983, after serving in the air force as a pilot, he came to Bell of Pennsylvania and entered the management training program as an assistant manager in network design. In his present job he works primarily with digital and fiber optic transmission systems, performing economic analyses and evaluations.

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Chapter 28

Enhancing the High Tech Building through Satellite Networks

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Outline

In the previous chapters, the methods of transferring information within the high tech building and among high tech buildings within the local area via Local Area Networks (LANs) were described. This chapter discusses using satellite technology for the interconnection of high tech buildings in order to meet their information transfer requirements. These requirements range from low-speed data through voice and video conferencing up to high-speed data transfer.

In order to adequately address the subject, this chapter analyzes the various aspects of establishing a satellite telecommunication system among high tech buildings, including a basic description of the satellite transmission system, specific examples of existing satellite networks, the actual position of the satellite, and how this positioning along with other geographical or environmental issues affect the specific design of the high tech building.

WHY SATELLITE COMMUNICATIONS?

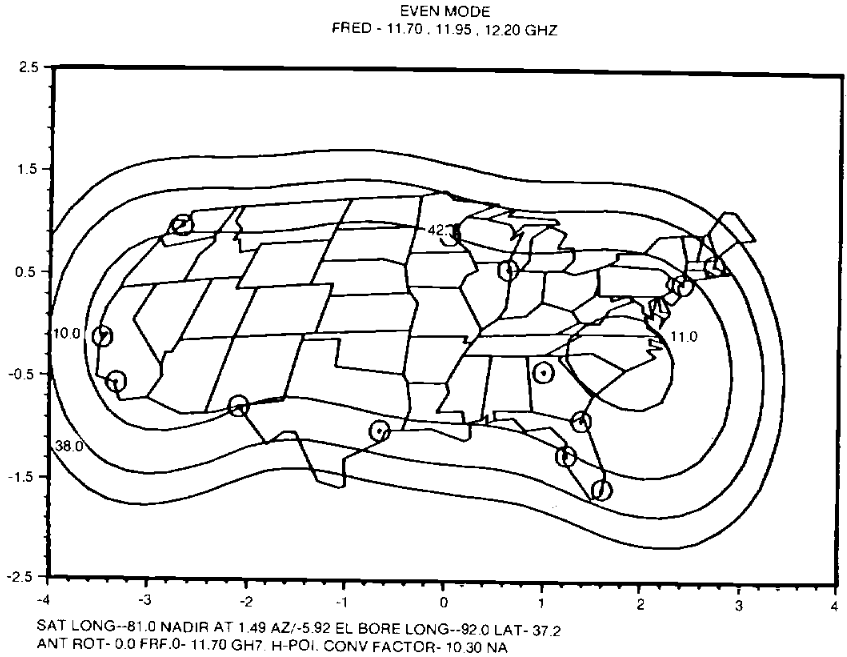
In discussing the use of satellites to transfer information between high tech buildings, one of the questions that arises is "Why satellite?" Why not terrestrial systems, such as fiber optics or digital microwave? This type of question implies an either-or situation. In reality, most networks will utilize a combination of technologies in the design of the system, balancing the advantages of each against the specific requirements of the situation.

The main advantage of satellites is the ability to transmit signals anywhere from the continental United States to the satellite and have the satellite retransmit these signals from space to earth. The signals can then be received at any point on earth that lies within the region covered by the satellite's "down beam" or "footprint." These footprints can include large regions, such as Canada, the Continental United States, Mexico, Colombia, and Brazil. In some cases offshore points, such as Hawaii and Puerto Rico, are also included. Figure 28–1 depicts the Ku band footprint of ASC I.

The coverage provided by the satellite beams enables satellites to provide unique wide-area broadcasting capabilities for such applications as television distribution to over-the-air and cable broadcasters, direct-to-home television broadcasting, and private network teleconferencing. This wide-area point-to-multipoint capability is unique to satellites and cannot be matched by terrestrial radio (except for voice-only broadcasting) or by wireline telephone carriers.

In addition to providing TV and teleconferencing, the satellite broadcast mode is also used for such business applications as facsimile transmission and information dissemination. Such newspapers as *The Wall Street Journal* and *USA Today* are printed simultaneously in many cities throughout the country from reproducible master copies broadcast to the printing plants

FIGURE 28–1
ASC–1 EIRP Contours



via satellite. Stock market quotations and news agency copy are disseminated to broadcasters, cable operators, and business subscribers via satellite. In some cases interactive services are offered in which the customers can request specific information from a central data base. Requested information can be received via satellite with a small-dish receiver (0.6 meters) and can be displayed on a monitor or printed.

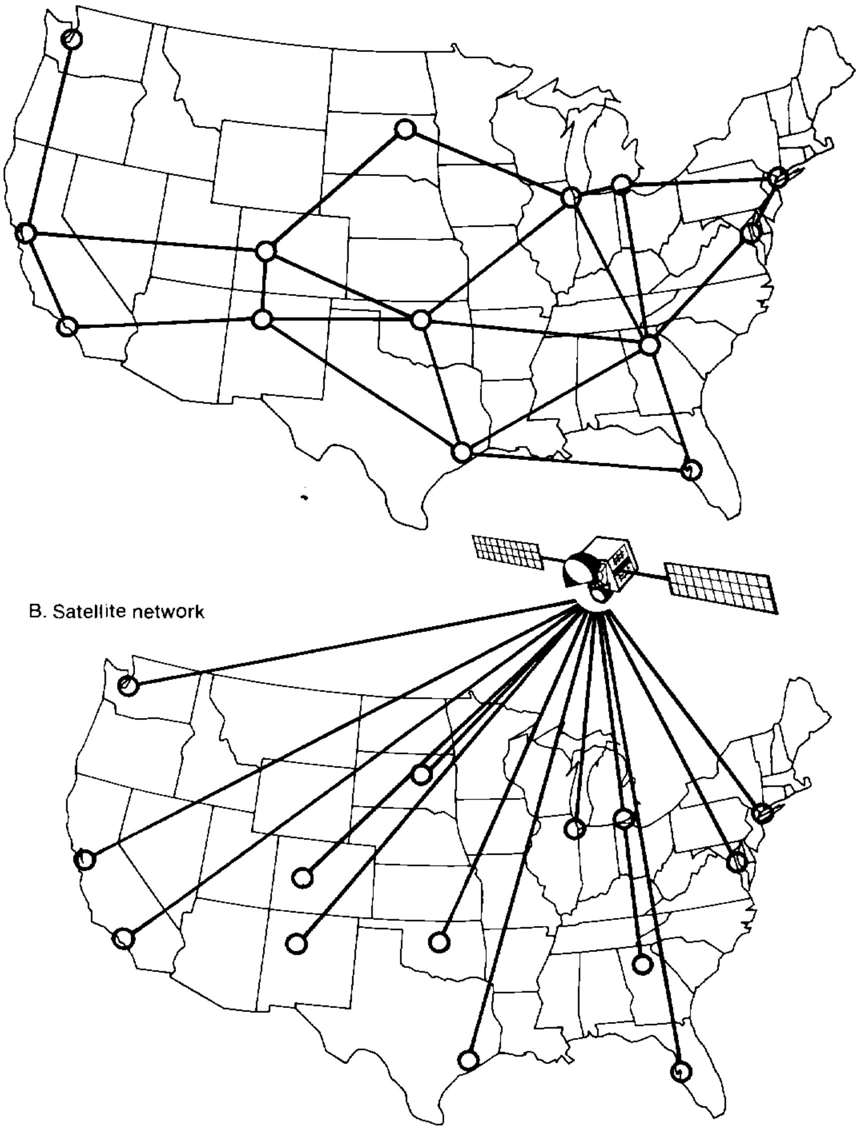
Government and business users of telecommunications are served by satellite networks that include on-premise transmit/receive earth stations. Another arrangement for private business networks makes use of carrier-owned earth station and central office facilities usually located in major metropolitan locations—New York City, Chicago, Los Angeles. Access from customer locations to these facilities may be provided either through facilities leased from the local telephone company or via alternative means, such as microwave radio links or fiber optic cables, that bypass the local telephone facilities.

Point-to-point and multipoint networks are employed by users for private voice and data communications and for teleconferencing. The advantages

FIGURE 28–2

A. Terrestrial network (simplified)

B. Satellite network



of satellite over interstate terrestrial networks include low cost, high availability, and high quality.

The main reason for these advantages is the differing geometrical characteristics of satellite and terrestrial communications networks (e.g., connectivity, signal path length, and ground distance between end points of a path), which lead to fundamental differences in their technical and cost characteristics.

Examples of connectivity maps for terrestrial and satellite networks are shown in Figure 28–2. Major land routes (such as those of the AT&T long-distance network) are depicted in Figure 28–2*a;* the full network includes hundreds of additional routes and about 160 switching centers. A typical end-to-end signal path traverses between 4 and 10 switching centers. A private business network can comprise a large number of such paths.

By contrast, the connectivity map for a corresponding satellite network is very simple. As seen in Figure 28–2*b,* all satellite earth stations "see" the satellite, and vice versa. All signals sent up to the satellite are rebroadcast to all earth stations. A business network can be established simply by installing on-premise earth stations at all locations. Adding one new location to an existing network requires the addition of only one new earth station.

When compared with terrestrial signal path length, satellite path lengths are essentially distance insensitive, although much longer, since the signal is routed through a satellite located approximately 22,300 miles above the equator.

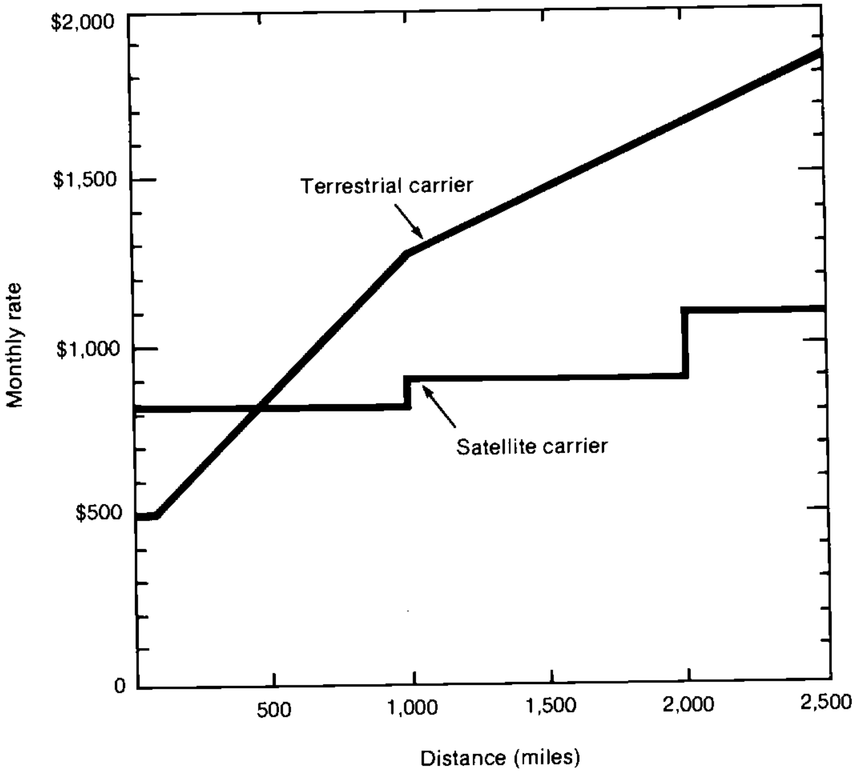
The contrast between distance-sensitive terrestrial path lengths and distance-insensitive satellite path lengths is reflected in the costs of terrestrial and satellite circuits. This is illustrated in Figure 28–3 (p. 572), which compares private-line voice circuit tariffs quoted by terrestrial and satellite carriers in June 1984. The figure shows that tariffs for terrestrial circuits are indeed quite distance sensitive, and those of satellite circuits are much less so. For this reason, local networks rarely employ satellites; regional or national networks represent typical applications for satellite services.

In applying the general concept of telecommunications networks against a specific situation, the issues of types of applications supported, traffic volumes, connectivity requirements, quality, and costs all have to be considered. The network that results from the subsequent design is a single-point optimization and must be modified based on changing conditions.

SATELLITE COMMUNICATIONS NETWORKS

Over the past few years, the telecommunications environment has undergone some radical changes, the effects of which have significantly altered companies' approaches to networking. Of the various alternatives, three types of satellite networks are emerging. They are dedicated private networks, shared private networks, and virtual private networks. An example of each of these types of networks is given below. Communication network services

FIGURE 28–3
Tariffs for Private-Line Voice Circuits



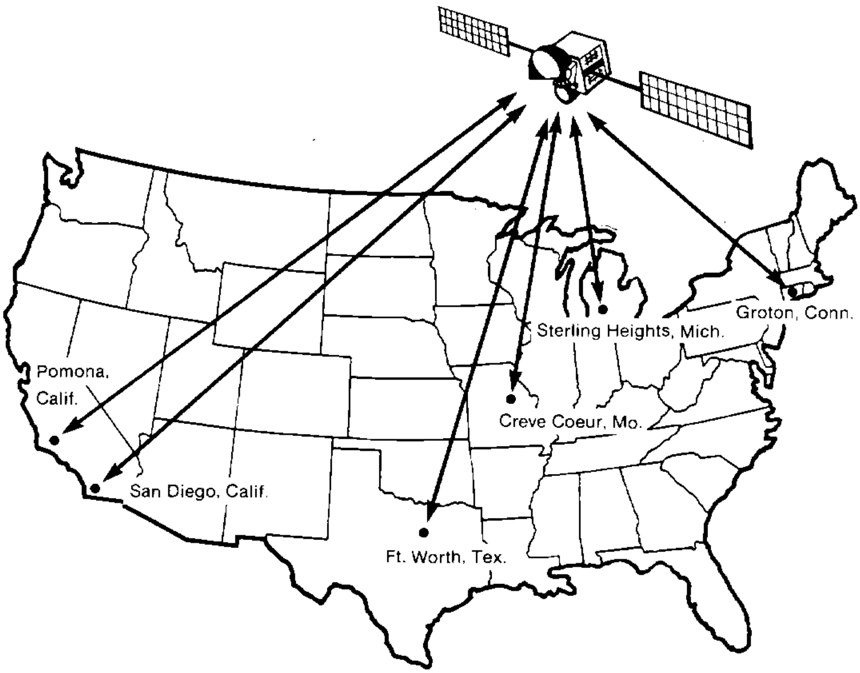
for the business users cited are provided by American Satellite Company and other companies.

Dedicated Private Networks

A dedicated private network is the most common type of network in today's environment and is the most likely network to be accessed or utilized from high tech buildings. These networks generally have between three and eight major nodes or centers and are distinguished by having both the switching function and the transmission paths dedicated for the customer's sole use. An example of this type of configuration is the General Dynamics Integrated Digital Network. The General Dynamics Network is configured to meet corporate requirements for voice and data services and consists of six customer premise nodes: Pomona, California; San Diego; Sterling Heights, Michigan; Fort Worth; Creve Coeur, Missouri; and Groton, Connecticut. As shown in Figure 28–4, the system utilizes the DEX 400S as its primary switching vehicle. The network consists of more than 250 intermachine trunks (IMTs); 83 full-duplex data circuits (ranging from 2.4 kbps through 230.4 kbps); 719 access circuits; and 278 WATS, FX, and DDD circuits.

The major benefit of this type of network is the flexibility of having dedicated resources colocated at the customer premise. This type of arrangement allows the customer to quickly reconfigure or to rebalance the network as changes in requirements dictate. A major drawback is the requirement for significant traffic volume to operate cost effectively.

FIGURE 28–4
General Dynamics Dedicated Network



● General Dynamics Locations
All nodes utlize DEX 400S Switches
Connectivity between all locations is 512 kbps or multiples thereof.

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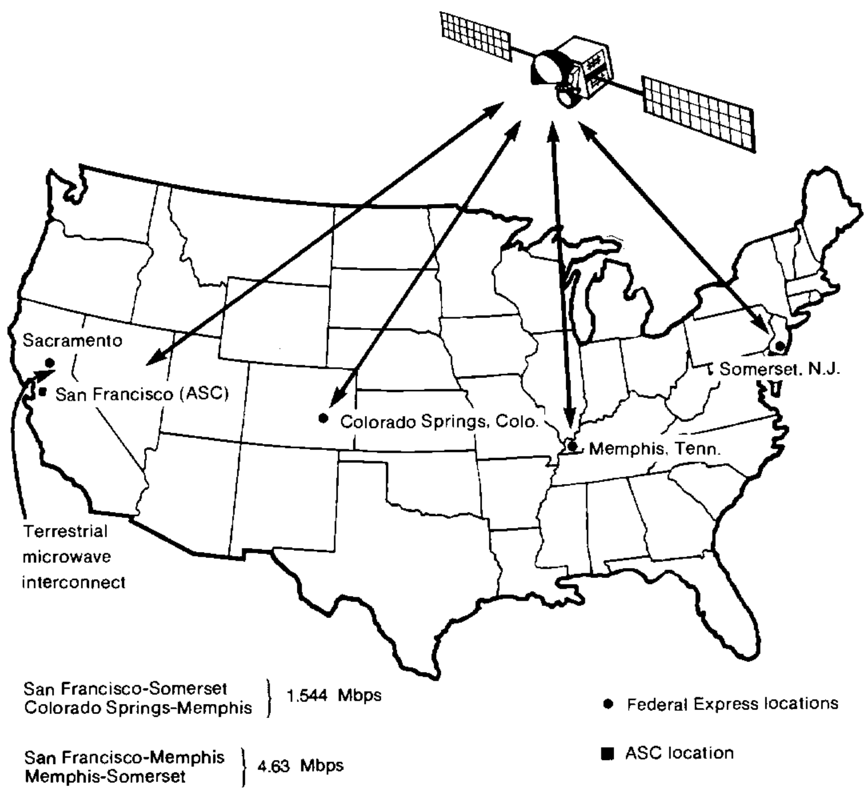
Shared Private Networks

A second type of network that is gaining popularity is the shared private network. The main distinction between this network and the dedicated private network is that some of the switching and/or transmission resource is not located on the customer's premise but at a centralized location, which aggregates different network requirements to achieve the economies of scale that result in a cost-effective system.

An example of this type of network is the Federal Express network. The Federal Express network consists of four nodes: one shared (San Francisco) and three dedicated (Colorado Springs, Memphis, and Somerset, New Jersey) as illustrated in Figure 28–5. The system utilizes Collin's digital switches

FIGURE 28–5
Federal Express Shared Network



for the voice traffic and utilizes more than 300 IMTs and the data capability of nine 56 kbps point-to-point, full-duplex circuits.

This type of network provides many of the same advantages as does the dedicated private network. Where the traffic requirements and other considerations warrant, dedicated customer premise equipment is provided. However, where the traffic requirements are insufficient to warrant dedicated locations, additional flexibility is provided through the utilization of shared locations. The trade-off is some loss of direct control over that portion of the system.

Virtual Private Networks

One of the emerging network types gaining ascendancy is the virtual private network. The main feature distinguishing this type of network from the others is that all of the locations at which a customer terminates traffic are shared. They not only are shared in the sense that multiple customers are terminated at the centralized location, but also with respect to the switching and/or transmission paths utilized. Although components are shared, they appear not to be for the user, and for that reason, the term *virtual* is used. The only items that are truly dedicated to a particular customer are the access circuits that connect the customer's location to the centralized location. This sharing significantly improves network flexibility while minimizing the capital risk to the network user.

In order to maintain the required privacy and to keep the various networks separate, the switches and transmission facilities are "partitioned" by modifying the switch software. An example of such a system is the planned Sears network.

The concept behind this network is to connect the various Sears locations to approximately nine centralized sites: New York; Washington, D.C.; Miami; Atlanta; Chicago; Dallas; Los Angeles; San Francisco; and Seattle. At these locations, Sears will use a partition on a Digital Switch Corporation's DEX 400/400S and will have the option of either dedicated or shared transmission facilities. In addition to the centralized locations, the network will grow to approximately 400 IMTs, which will provide connectivity among the various partitioned switches as shown in Figure 28–6.

This type of network is significantly different from either the dedicated private network or the shared private network, since only the access facilities are dedicated to a specific user. Implicit is a loss of direct control by the users over their network. In order for this service to be accepted by the users, the network manager must provide detailed information on a timely basis to the users and must also be extremely responsive to user change and trouble reporting requirements.

Loss of control and greater dependence on the network manager due to the sharing of lines and equipment are weaknesses of this type of network, but the strengths arise from those same traits. Because of the extensive amount

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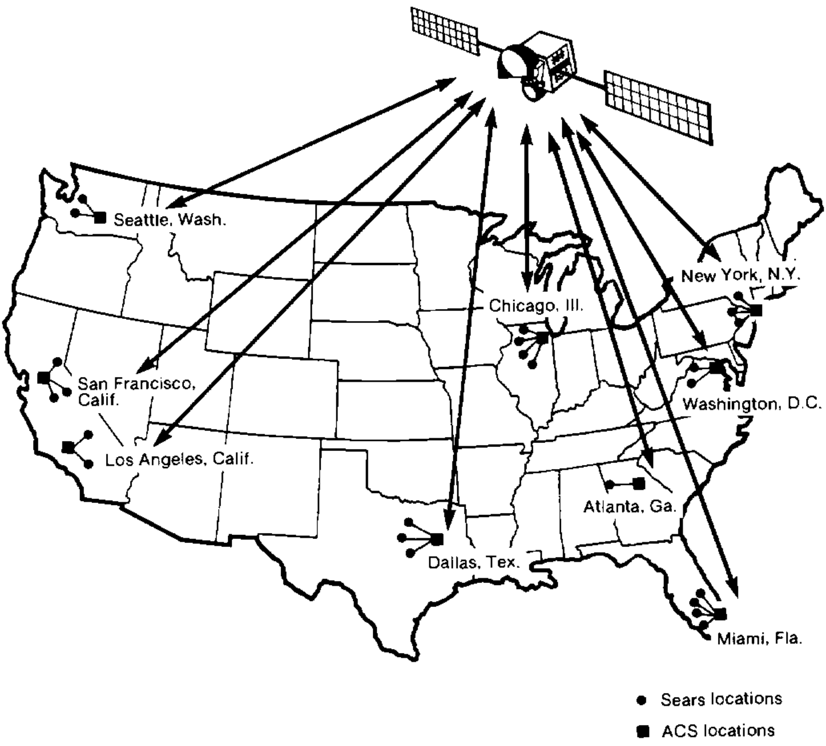
FIGURE 28–6
Sears Virtual Private Network



DEX 400S Switches at all ASC locations; software partition, utilized. System operates at 60 to 120 Mbps.

of resource sharing, virtual private network services can accommodate the necessary traffic volumes to cost effectively provide for a wide range of services, such as protocol conversion, switched data services, and packet switching. Additionally, this type of network does not require the user to provide dedicated direct trunks between the switching vehicles. Since the connectivity factor[1] is no longer an issue, the users are not limited to only a few centralized locations for their network nodes but can expand their networks to 20 or more centralized locations or nodes. This allows companies to cost effectively connect a much larger number of their locations with advanced communications services.

INCORPORATING A SATELLITE NETWORK INTO THE HIGH TECH BUILDING

After it has been determined that a satellite-based network is cost effective and meets the general requirements of connectivity, types of applications, traffic volume, and quality, a specific network design must be generated. As part of that design effort, a determination must be made of the best way to integrate the high tech building into the network. This integration can consist of:

- A rooftop satellite access antenna with a diameter between 3 and 7 meters, depending on the satellite network the user intends to access.
- A terrestrial microwave antenna that interconnects a remotely located earth station (especially if C band is used) with the user's building.
- Local area networks interconnecting high tech buildings within an industrial complex (i.e., fiber optic cable, coaxial cable).
- A fiber optic cable connecting to a teleport or off-site antenna.

In determining which of these is the optimum integration technique, the following areas must be investigated: regulatory, orbital arc look angles, microwave line-of-sight and interference, and building asthetics.

Regulatory Impact

FCC approval. Provision for satellite network access involves more than acquiring the requisite technical components. Various regulatory requirements must be met, such as (1) obtaining a license from the FCC, (2) obtaining local community approvals (depending on zoning regulations), and (3) achieving frequency coordination that is successful in that it demonstrates compatibility with both existing systems and those terrestrial and satellite communication systems whose applications have been filed with the FCC.

A license must be obtained from the FCC to build and operate a transmit/receive earth station or terrestrial microwave stations. Constraints on earth station and microwave relay configuration and performance are imposed by the FCC; station technical characteristics must meet FCC standards and various environmentally imposed microwave power flux density radiation constraints.

An important part of the process of obtaining FCC approval is demonstrating compatibility with existing or planned (approved) transmission/reception systems. A frequency search of existing or planned communication systems, conducted by one of the firms specializing in this process, is the first step in this demonstration of frequency compatibility/coordination. Location of the satellite antenna is critical to avoid interference with existing systems;

acceptable locations within the complex should be identified early in the development process. This is especially critical for C band satellite access, since current C band terrestrial microwave interconnections utilize the same frequency band as do communications satellites. Interference standards or preliminary frequency search results may show that an originally planned location is unacceptable; if so, alternative locations within the complex should be found. If this is difficult or impossible, shield walls may be used to reduce interference to acceptable levels, but only if not in a direct line with existing terrestrial communications systems.

Local zoning. If construction of the high tech building or complex involves zoning changes within the local community, requirements for zoning approvals should include the total configuration, especially if an earth station is incorporated into the high tech building design or if a multiple antenna earth station (teleport) is planned to serve the industrial complex. Height limitations may be imposed, restricting antenna placement, as well as constraints on the number and size of antennas. Aesthetic appeal is a major consideration within established communities, coupled with strong concern over radiation hazards. Many local communities require demonstration of minimum environmental impact—for example, that the radiation from a satellite transmissions antenna or from a microwave relay antenna presents no danger to the local community. The problem is compounded by the absence of universally accepted standards.

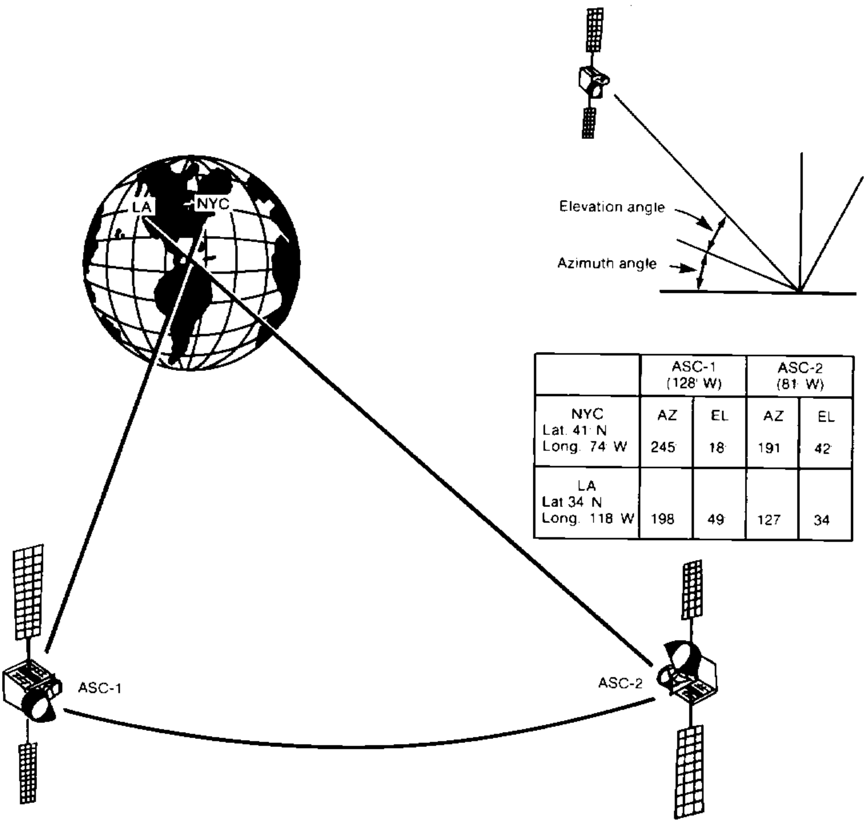
Most communities don't have specific zoning ordinances or environmental guidelines that adequately cover satellite earth stations. If an antenna is part of a building function, it may be included within certain zoning regulations. Usually not included are maximum radiation levels and constraints on location and pointing of earth station antennas. Some communities have passed ordinances that govern the number, location, and placement of satellite antennas, including maximum levels for power flux density. Also imposed is periodic verification of not-to-exceed limits. High tech building developers should work closely with community representatives and communications experts in the initial stages of program/complex development to ensure the multiple satisfaction of goals and avoid later redesign or modification when approval is sought.

Orbital Arc Look-Angles

As discussed above, the integration of network access capability into a high tech building or complex must take into account a number of factors, which include frequency coordination, terrestrial interference, and zoning requirements. The location of satellite access or microwave interconnect antennas is affected by orbital arc look-angle requirements, existing interference from terrestrial microwave communications links, and microwave interconnect line-of-sight (if access to a remotely located satellite station is required).

The antenna look-angle—antenna-pointing azimuth and elevation angles to the satellite location—is a function of both satellite location within the U.S. domestic orbital arc and location of the high tech building in the United States. An example of these satellite angles as they relate to earth station location is illustrated in Figure 28–7. Representative azimuth and elevation angles from selected locations within the United States to satellite locations with the U.S. domestic orbital arc are also shown.

FIGURE 28–7
Earth Station Azimuth and Elevation Look-Angles



	ASC-1 (128° W)		ASC-2 (81° W)	
NYC Lat. 41° N Long. 74° W	AZ 245°	EL 18°	AZ 191	EL 42°
LA Lat 34 N Long. 118 W	198	49°	127	34

A minimum antenna elevation angle of 10 degrees is necessary to achieve proper communications performance; higher elevation angles are desired to minimize blockage, atmospheric and rainfall attenuation, and interference from terrestrial communication services. Lowest elevation angles are experienced from earth station locations in the northernmost tips of the United States (i.e., Maine and Washington) and to satellite locations at the eastern and western extremes of the U.S. domestic orbital arc (approximately 63° west to 143° west longitude—refer to Table 28–1).

TABLE 28–1
Existing (or planned) Orbital Arc Assignments—67° West to 143° West Longitude

Longitude	*Satellite Name*	*Longitude*	*Satellite Name*
67.0	SATCOM (C)*	101.0	Unassigned
67.0	RCA (Ku)	103.0	GSTAR (Ku)
69.0	SPACENET II (H)	104.5	ANIK D (C)
71.0	Unassigned (Ku)†	105.0	GSTAR (Ku)
72.0	SATCOM IIR (C)	105.0	ANIK C–2 (Ku)
73.0	Unassigned (Ku)	107.5	Canada (Ku)
74.0	GALAXY II (C)	108.0	Canada (C)
75.0	Unassigned (Ku)	109.0	ANIK B (C)
76.0	TELSTAR (C)	110.0	Canada (Ku)
77.0	RCA (Ku)	111.5	Canada (C)
78.5	WESTAR III (C)	112.5	Canada (Ku)
79.0	WESTAR II (C)	113.5	Mexico (H)
79.0	RAINBOW (Ku)	114.0	ANIK A (C)
81.0	ASC (H)‡	116.5	Mexico (H)
83.0	ABCI (Ku)	117.5	Canada (Ku)
83.5	SATCOM IV (C)	119.0	SATCOM II (C)
85.0	USSSI (Ku)	120.0	SPACENET I (H)
86.0	WESTAR (C)	122.0	USSSI (Ku)
87.0	RCA (Ku)	122.5	WESTAR V (C)
87.0	COMSTAR D3 (C)	124.0	SBS (Ku)
88.5	TELSTAR (C)	125.0	TELSTAR/COMSTAR (C)
89.0	SBS (Ku)	127.0	COMSTAR D4 (C)
91.0	SPACENET III (H)	128.0	ASC (H)
93.0	Unassigned	130.0	ABCI (Ku)
93.5	GALAXY III (C)	131.0	SATCOM III–R (C)
95.0	SBS (Ku)	132.0	RAINBOW (Ku)
96.0	TELSTAR (C)	134.0	GALAXY I (C)
97.0	SBS (Ku)	137.0	Unassigned
98.5	WESTAR IV (C).	139.0	SATCOM I–R (C)
99.0	SBS (Ku)	141.0	Unassigned
		143.0	SATCOM V (C)

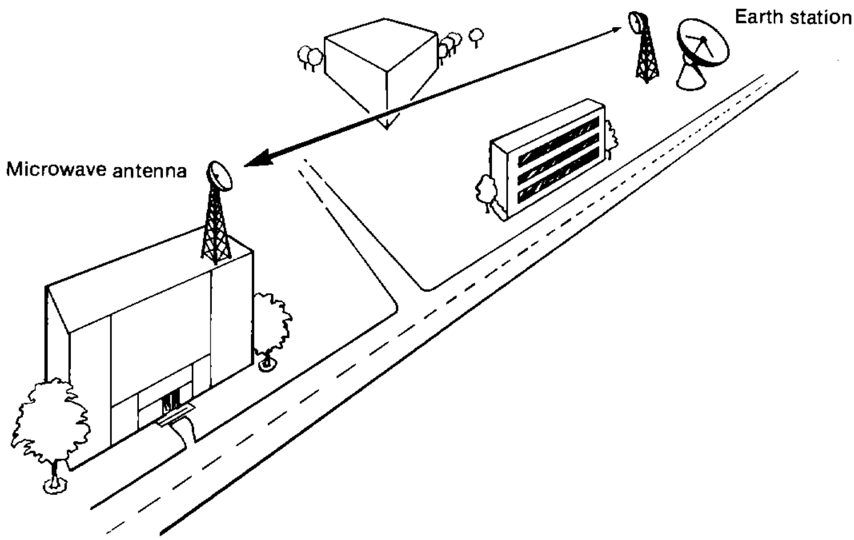
* C band.
† Ku band.
‡ Both C band and Ku band.

Microwave Line-of-Sight and Interference

A high tech building developer who is considering the use of satellite networks to fulfill business communications requirements within a complex must make a choice on the access method to be employed for establishing an interface with the satellite network. As mentioned previously, the earth station may be located either on or off the user's premises. The determining factor in this choice is usually cost. If a dedicated (on-premise) earth station is employed, its cost is borne by the user—either directly or indirectly. By sharing the use of a centrally located earth station with others, this cost can often be reduced substantially. On the other hand, use of such a remote earth station entails either access-line charges imposed by the local telephone company or the cost of a microwave interconnect.

The siting of a microwave antenna to interconnect a high tech building with a satellite earth station involves conflicting requirements. On the one hand, location at a point of maximum visibility to the remotely located earth station is desired, as well as maximum protection from physical construction/obstruction. On the other hand, that same location is most vulnerable to interference from existing terrestrial microwave communication links. An illustration of microwave interconnect line-of-sight requirements is given in Figure 28–8. If at all possible, the use of existing terrain and buildings to

FIGURE 28–8
Microwave Interconnect Line-of-Sight Illustration



increase blockage of unwanted signals is desirable. Incorporation of the antenna into the building structure, using architectural features to block terrestrial interference, is also appropriate in many cases. Aesthetic considerations must be taken into account, not only from a business environment standpoint, but also in response to community requirements. Local zoning ordinances may impose constraints on the appearance and placement of network access antennas. The need for municipal design approval may levy additional requirements on system configuration.

FIGURE 28–9
Direct Satellite Access from Building

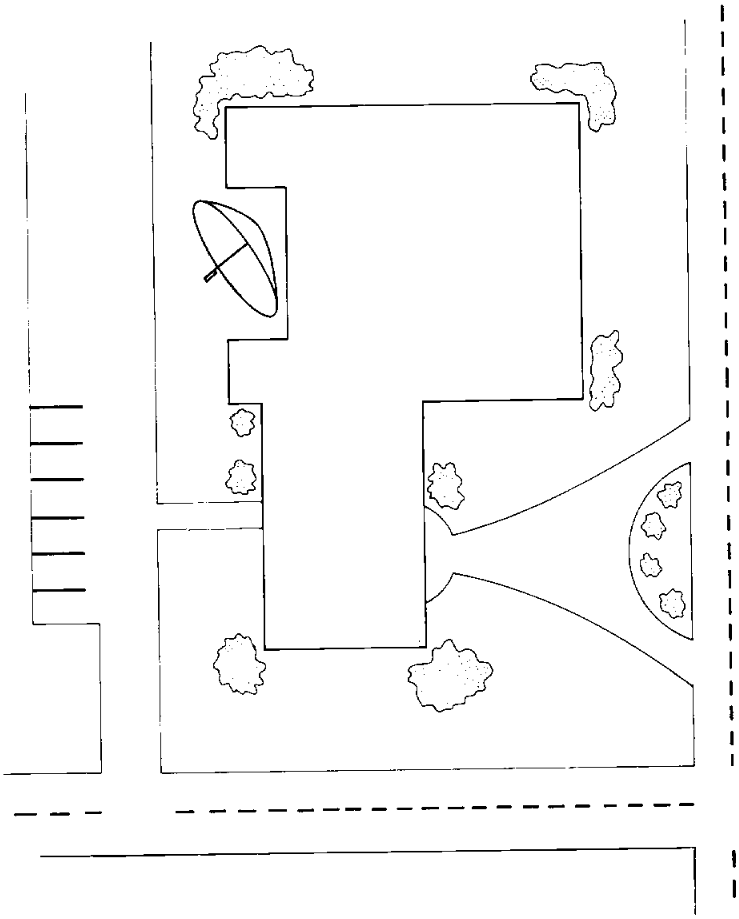
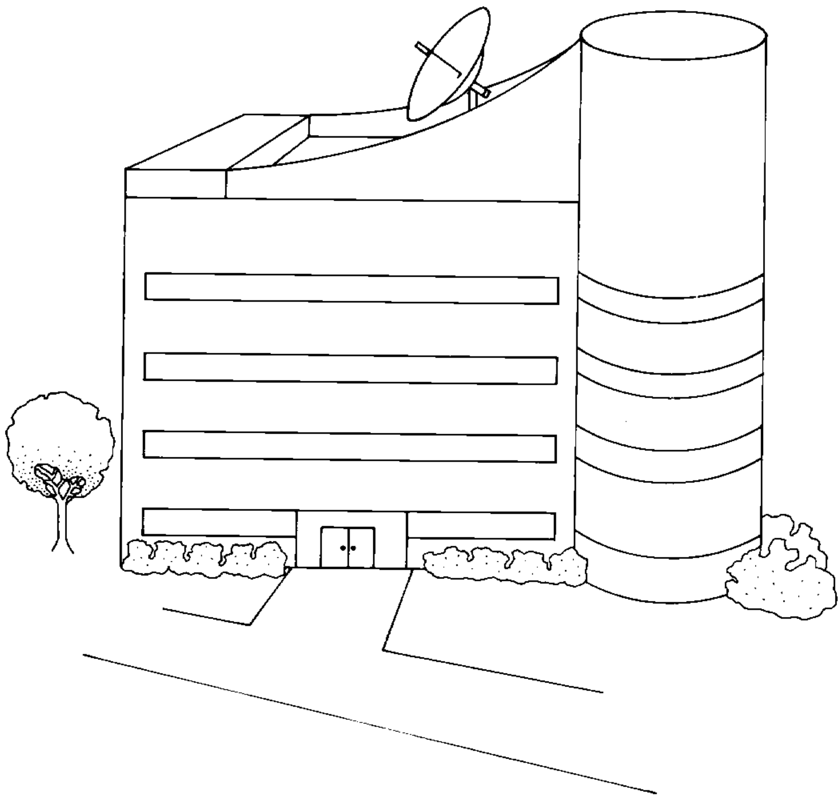


FIGURE 28–9 (*concluded*)



Building aesthetics. Overall high tech building appearance may be improved by masking access antennas with some type of existing terrain shielding—for example, landscaping and trees may be used as long as they are not placed within the antenna look-angle arc. A rough rule is to maintain an intrusion-free clearance cylinder equal to the antenna diameter and concentric with the antenna bore axis. A potentially more rewarding approach to aesthetic improvement is to incorporate access antennas into the building or complex design configuration. Illustrative examples of the approach for direct satellite access from high tech buildings themselves are given in Figure 28–9.

If the building location is such that unobstructed orbital-arc visibility is possible from the ground level, then the building design could be such as to "encompass" a good portion of the antenna, potentially achieving the dual objectives of visual screening from public view and shielding from electromagnetic interference. Alternatively, if ground-level visibility is not possible, it may be necessary to place antennas on the roof. Architectural design features that integrate the antenna visibly with the building could potentially produce more acceptable results than simply "tacking on" an antenna to a building whose design concept had not made provision for one. Since terrestrial microwave antennas have no need for orbital-arc visibility, they are more easily incorporated into building design.

With a remotely located antenna "teleport" serving an industrial complex, more opportunities exist to produce a configuration aesthetically acceptable to the developer and the community: flexibility in earth station placement and the ability to incorporate natural and artificial screening are examples. Surrounding terrain in a suburban setting may provide natural screening for both visual and electromagnetic interference purposes. Where conditions warrant, earth berms can be constructed or, conversely, antenna placement may be below ground level, permitting unobtrusive shielding. Figure 28–10 illustrates the concept of a centrally located antenna teleport serving an industrial complex.

High Tech Building—Evolution of the Satellite Network

Three examples of satellite networks into which high tech buildings could be incorporated were described earlier in this chapter, followed by a discussion of some of the more important considerations in incorporating the building into a network. It is appropriate to close this chapter with a short summary of the next step in the satellite networks evolution: the integrated services digital network, ISDN.

The example networks described have several major areas in common: (1) digital transmission paths that carry both voice and data traffic, (2) digital switching with stored program control, and (3) the necessity to meet the company growth requirements. The natural outgrowth of these networks is the ISDN.

The ISDN objective is to provide end-to-end digital telecommunications services supported by a common network. Therefore, such services as switched and nonswitched voice, switched and nonswitched data, video teleconferencing, facsimile, and packet switching traffic would all be serviced via the same network.

This does not mean that all of these services are aggregated via one common "black box." Instead, these services will utilize the necessary equipment that translates them into a standard digital format. These formats can then be integrated and transmitted over a common digital transmission path (as illustrated in Figure 28–11).

FIGURE 28–10

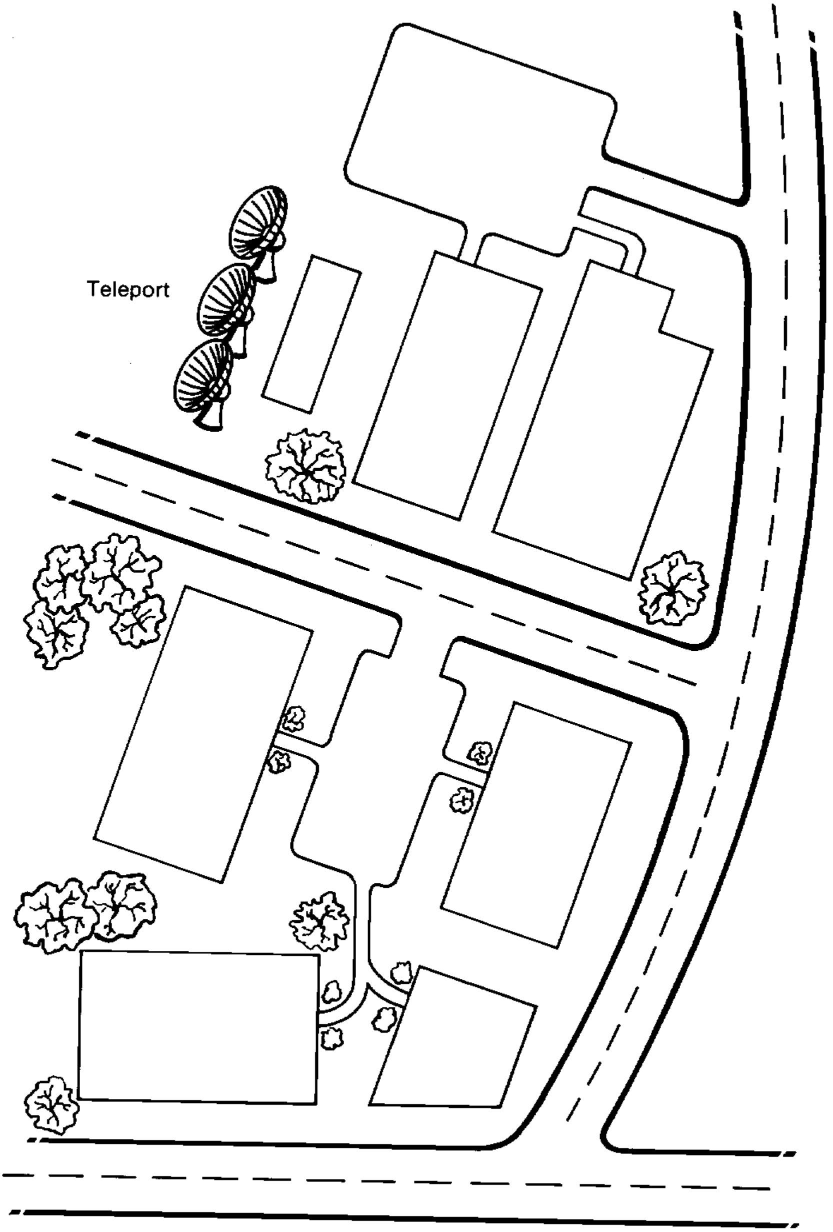


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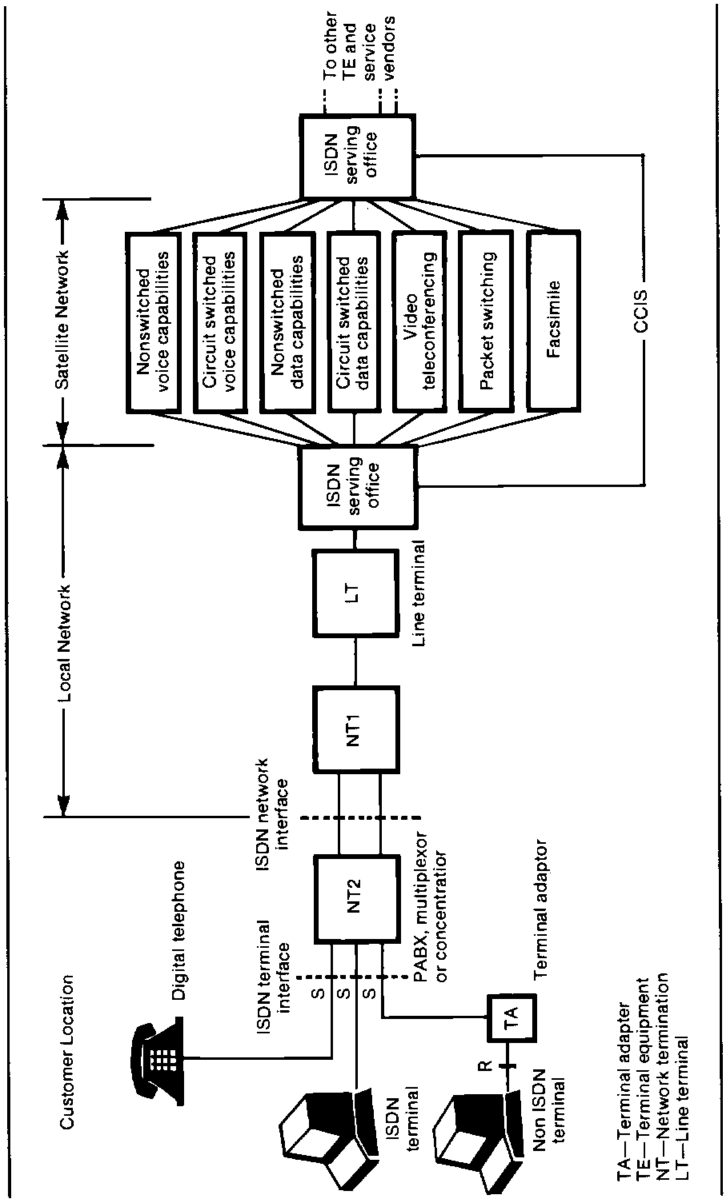
FIGURE 28–11
Integrated Services Digital Network



The basic features of the ISDN are:

Sharing of digital switches and digital transmission paths among different/multiple services (e.g., voice, data, video teleconferencing, facsimile).

Common Channel Interoffice Signaling (CCIS) for transportation of network information and signaling messages.

Intelligence at the switching nodes to store and to process information for a wide range of enhanced information and telecommunications services.

Standardized network interface and protocols.

The ultimate goal of the ISDN is to economically provide a wide range of basic and enhanced services designed to meet the user requirements through the use of shared equipment and standardized interfaces/protocols.

■ CONCLUSION ■

The preceding has described how satellite technology can be used to meet business information transfer requirements by integrating high tech buildings into satellite-based telecommunications networks. The advantages of satellite communications were discussed, as were examples of existing business satellite networks. Constraints and guidelines for incorporating satellite network access into the high tech buildings were addressed, together with a summary of what the future will bring in digital telecommunications systems which will provide voice, data and video services in one integrated network.

■ NOTES ■

1. In designing a fully connected network, the number of dedicated direct trunk groups is dependent upon the number of nodes. As the number of network nodes (n) increases, the number of trunk groups increases at the rate of $n(n-1)/2$. Therefore, for a network with 3 nodes, the number of trunks is $3(3-1)/2$, or 3; for 10 nodes, the number of trunk groups would be $10(10-1)/2$, or 45, and for 20 nodes, the number of trunk groups required becomes 190!

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Chapter 29

Teleports: What's It All About?

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Outline

The jury may still be out on the question "What is a teleport?" The American Teleport Association organizing committee agonized over a definition of *teleport*, and the question was tabled more than once. Eventually a definition evolved which includes the following items as essential ingredients of a teleport.

Provides satellite up- *and* downlink capability (eliminates receive only).

Has some form of terrestrial link to a market area (fibre optic, microwave, etc.).

Provides more than one class of service, voice video, or data (eliminates video-only uplinks).

Provides service to multiple users on a commercial basis.

Within that broad definition there is still room for many variables, primarily in scope and level of service. In theory a teleport operator could provide two-way access to one or two satellites, provide a video channel to one major subscriber, sell a small number of audio or low-speed data circuits, and qualify as a legitimate teleport. This service could be provided to one building with relatively few users and would still fall within the scope of the proposed definition. The jury is still out in the sense that economics will eventually dictate who is the real teleport.

The broader scope of teleports is the "gateway" concept; and it appears that most developing teleports see themselves as full-service providers of voice, video, and data communications on a regional level. Therefore the teleport becomes the communications gateway to a region. The service area (region) may be one large commercial building (the National Press Building, Washington, D.C.), a metropolitan center (the New York Teleport), a geographic region (Gulf Teleport, Inc., Houston), or a statewide network (the Ohio Teleport). In each of these cases, the teleport will provide satellite access and interconnect capability to a customer base. The market potential of each geographic area must be the single most important factor in determining the level of service offered. Almost as important is the business objective of the teleport developer; specifically, is the teleport a real estate development or a communications project?

Teleports are being developed with direct real estate participation and involvement, and teleports are being developed with no real estate plans. Teleports can also be service providers to unrelated third-party real estate projects, buildings, or business parks.

The New York Teleport is definitely a part of a real estate development; and certainly teleport capability can be utilized to enhance a real estate project.

When the teleport/real estate project in New York is properly planned and marketed, there will be communication users who will wish to locate at the site of the satellite communication center.

The Bay Area Teleport has a similar real estate involvement, as do several others.

However, several potential teleports are serious communications projects without a real estate involvement. The Seattle Teleport is a project of Pacific Telecom and has no real estate plans. Gulf Teleport, Inc. has no real estate plans. The Ohio Teleport has no direct real estate interest, but one of its equity partners is a real estate developer who may potentially benefit from land development at or near the teleport sites.

Similar to the Ohio Teleport, Gulf Teleport will potentially benefit unrelated real estate developers. The map in Figure 29–1 shows the proposed microwave network through which Gulf Teleport will access its intended market area. At the time of this writing, a preliminary agreement had been reached with an unrelated third party whereby one of the teleport microwave trunk lines would terminate in a 3,000-acre industrial/commercial development. The benefit to the developer is the enhancement of the new development, and the teleport receives an expanded customer base and favorable terms for access.

IS IT A REAL ESTATE OR COMMUNICATION VENTURE?

For the real estate developer who is not experienced in communications technology, there are many traps. The technology is not simple and is rapidly changing. The marketplace will no longer tolerate unreliable service. For data communications, 99.99 percent reliability is the minimum acceptable design goal. Personnel *truly* qualified in communications technology are rare. A communications-enhanced business park could face economic ruin because its communications network proved unreliable. Great claims are made in the marketplace with new technology; many are never realized.

It is the position of this writer that the communications venture must be sound—technically and economically. If the venture is sound, a real estate development is not essential to success; however, an equally sound real estate venture can provide a mutually beneficial marriage.

The real estate developer must realize that in a service network like that planned by most teleports, a user located at the teleport site has no real technical advantage over a user remote from the site. Any advantage is limited to the marketing skills employed to enhance the real estate and is largely a matter of "image" or "cosmetics." The real key to using the teleport to full advantage will be the in-house networking capability of the real estate developer or tenants.

Without treating in depth the subject of smart buildings, it is fairly obvious that any building or commercial/industrial development that can deliver tele-

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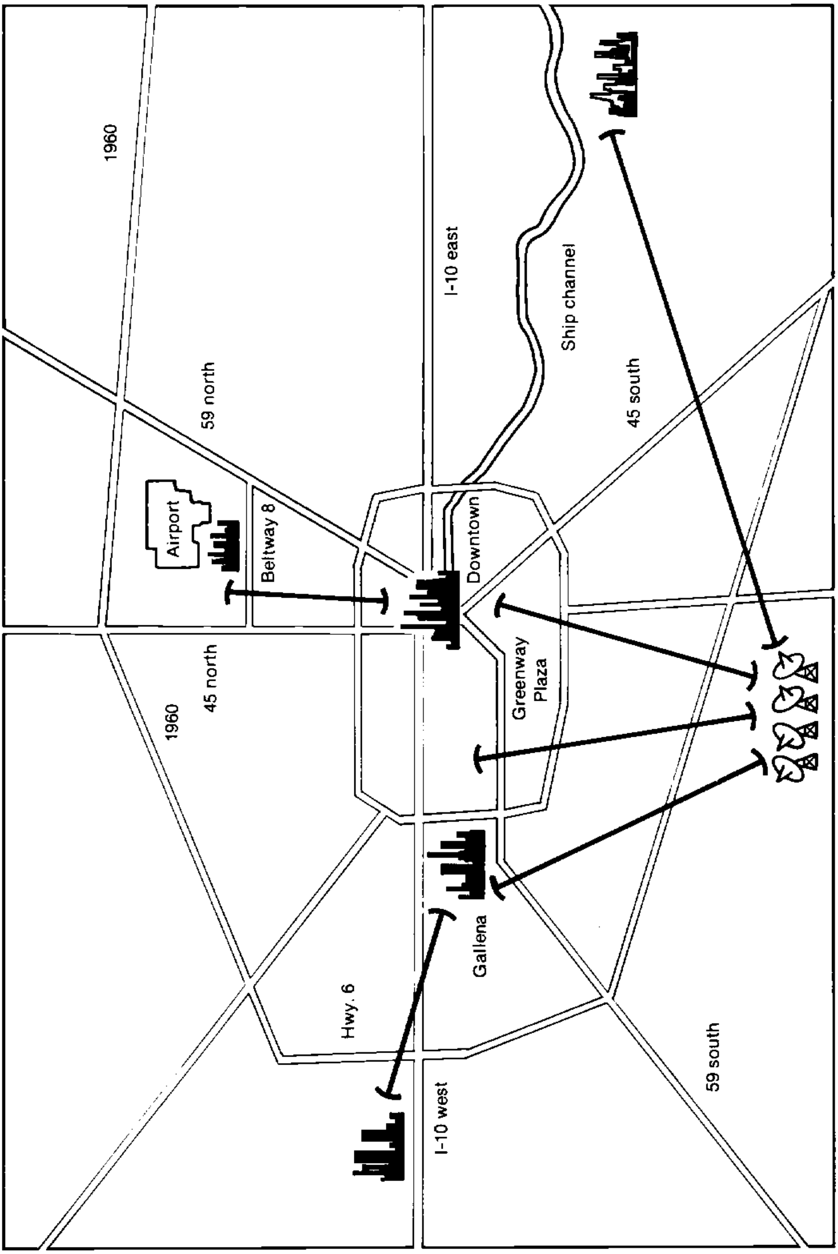
FIGURE 29–1



port services to its tenants can acquire a substantial advantage over competitors who have no such capability.

WHO WILL USE THE SERVICES?

For a real estate teleport, the questions, Who are the expected tenants? and What is the market? are the same. A major danger in high tech enterprises is the tendency to let technical capability be the driving force in market planning, rather than addressing what the market wants to buy. There are many technically sound endeavors that have not been able to reach profitability due to a failure to realize that the market is unwilling to pay the price requested by the entrepreneur for a technical skill or service that is dear to the entrepreneuring heart. SBS stands out as a business in trouble because the marketplace would not respond to an imagined need. Likewise, videotext endeavors are yet to reach market acceptance as expected in spite of millions of dollars spent in technical development and marketing. It appears that DBS service is headed in the same direction.

Every marketplace is unique and must be addressed with its own unique character in mind. Failure to recognize that the Houston, Gulf Coast market may differ drastically from New York City would produce a planning disaster. Therefore, the Houston marketplace will be described to illustrate the point.

Real estate developers in Houston have been slow to react to the rapid development of communications technology. Houston has only one smart building, and it has achieved only moderate notoriety. There are a few industrial companies with very sophisticated communications staffs and capability, but they are very few in comparison with the total market. One major real estate developer executive told this writer, "All we know about communications is that we always provide a telephone equipment room and a vertical chase through the building, call the phone company, and they do the rest. But they won't do that anymore." Many companies have communications managers whose historical job function was to call the local telephone company to order telephone service, either new or changes. One major national company communications manager recently acknowledged he had never heard of broadband networking. Many potential users of teleport services think 9,600 bps is high-speed data transmission. This seeming lack of sophistication is largely due to the fact that for most users, 9,600 pbs or slower was the only service available in dedicated circuits from the local telephone service company.

Gulf Teleport market research revealed a need to address both markets, the very sophisticated and the unsophisticated. However, the techniques for sale of the service and for technical delivery of the service are radically different. Teleport planners must also recognize that many of the more sophisticated users may very well proceed with private networks and may not even become customers.

Another problem facing the real estate/teleport developer, especially the developer of smart buildings for teleport interconnect, is the difficulty of being all things to all people.

Management Information Systems Week reported on Tabor Center by Williams Brothers Realty Developments, Inc. of Tulsa, Oklahoma. This project apparently plans a fiber optic network in 3.1 million square feet of office space connected to an in-house computer. The company was said to be holding off a decision on computer selection until the last minute to see which system was the "most sophisticated." Certain questions become obvious: Will the most sophisticated system available translate to sellable economics? How many potential clients really need the most sophisticated system? Can the building provide a savings to its tenants, or must they pay a premium for the most sophisticated system? Can individual building owners and operators provide technical support for such systems? Each project must find the answer to these questions if it is to succeed.

MEETING MARKET NEEDS

It is therefore suggested that a properly designed teleport facility should provide communication services to the broadest possible market. The communications links used—whether fibre optic, microwave, or some other medium—should be as nearly as possible a transparent conduit for the users' signals. Whatever is sent must be delivered to the other end of the pipe (conduit) in the same form as transmitted. Gulf Teleport market research provided one overriding feature of potential customers. They said in effect, "We want to keep on doing what we are doing, do it better, and do it cheaper." Any project that cannot meet that objective may well be doomed to failure in the marketplace. Only after that immediate objective is met can the project planner expect to be a force in gradually moving the customer to more sophisticated and more expensive communications systems. The entire teleport concept has been based on the concept that by shared service, the customers could achieve greater levels of service at lower cost. Technical brilliance must serve that goal to be a success.

In many cases less sophisticated techniques are more than adequate to meet the customer's needs. Fibre optics is the new buzzword in communications, but in many cases coaxial cable or twisted pair technology may meet the needs of the marketplace with better economics to the end user. Trade journals and newspapers frequently report on exotic, sophisticated functions being planned for smart buildings. Again the marketplace must be examined carefully by real estate and communications planners to avoid indulging their own space-age technological fantasy.

Prospective users of teleport or communication-enhanced properties are limitless. Any company with a computer in one location communicating with a computer in another location is a potential customer, assuming that the teleport can provide superior communications capability at competitive rates. Do not be fooled, however, into believing that users will flock to a new service in a frivolous manner. Data communication is serious business to any potential customer. Unless a teleport marketer can show both quality of service and savings, the market will not respond. No matter how poor the current service, customers know what they have. No corporate communications manager will risk his/her job by recommending a new and unproven carrier, unless there is great motivation; and that motivation must be both service and cost. When those requirements are met, the market will respond.

Leaving the data world behind, voice and video users are next to be considered. Gulf Teleport planners were pleasantly surprised at the large number of dedicated leased voice circuits reported in market research. In most cases, dedicated voice circuits were in use paralleling data circuits.

Gulf Teleport anticipates that leased voice circuits will total approximately 30 percent of its total traffic. The buyers of those circuits are expected to be the same buyers as for data circuits. Video conferencing is such an insignificant part of the market that it has been totally ignored as a planned revenue base. The marketplace has yet to determine what real videoconferencing is, and many services sold as videoconferencing do not deliver true two-way video and audio. The most common form of videoconferencing is a video and audio program in one direction only. Conference attendees are congregated in meeting rooms equipped with TVRO earth stations. The conference attendees may address questions to the program distributors over 800 WATS lines.

Industry has a need and a legitimate use for true two-way videoconferencing on an occasional basis, so that both executive, management, and technical meetings can be conducted as needed. The cost savings for a large company would be significant if managers scattered across the country could confer on a real time basis without traveling to a central site. Very few companies can afford to install such a system for their private use, though that market may grow as the cost of technology continues to decrease. Teleports could make real-time videoconferencing a reality on a shared basis if compatible equipment were used in numerous teleports. The teleports would then become a vehicle for the growth of the true videoconferencing market. It is very difficult to believe that videoconferencing can be a successful industry without some shared service medium, such as teleports. Gulf Teleport, Inc., in its technical planning, expects to make such service available on a very carefully planned basis—to avoid great capital expenditure with very little return. Commitment of capital must parallel the growth of the market.

Real estate planners may find a marketable commodity by providing videoconferencing facilities in a development, connected to a teleport. Careful market and cost evaluations would be needed to ensure the economic success of such a facility. Not to be ignored is the possibility that such a facility may never be self-supporting, but its existence could enhance the real estate project to such a degree that it becomes desirable.

In order for teleports to succeed, satellite uplink capability must be combined with the terrestrial link that delivers service to the customer. There is no reason to believe that any teleport operator could build a facility providing one or more satellite uplinks and downlinks, advertise the satellite capability, and expect the market to respond. The problem is one of accessing the uplink and the downlink with good economics and good reliability. There are numerous earth stations in operation and available at the present time. Most are operating at significantly less than full capacity. The marketplace has no need for additional uplinks and downlinks. What is needed and that which will ensure the success of the teleport concept is the up/downlink tied to the terrestrial network for access to customer premises. Therefore, the terrestrial link becomes the real key, rather than satellite capability. From a marketing viewpoint, the positioning of the terrestrial link becomes the key, so that it accesses market concentrations sufficient to produce a sustaining revenue stream. Remember, teleports have an economic advantage by the very nature of the business. The teleport is not a service provided to every home or even to every business in its service area. The target market is leased line users, and the teleport planner enjoys the luxury of accessing only selected geographic areas where adequate business potential is identifiable. Therefore, with proper planning, capital is placed only where the return is assured.

The cost of a teleport is not a small item; but in terms of continuous operation, the cost of transponder rental can overshadow the cost of capital equipment. More than one uplink operator has gone broke because the revenue base would not support the cost of transponder rental.

Once a local teleport network is in place, be it on the Gulf Coast or anywhere else in the world, the part that is missing is the other end of the link. One telephone handset with no one to talk to is worthless. Therefore, a teleport operator must be able to deliver end-to-end service. The customer will not respond to and will not buy half a circuit. Therefore, growth of the teleport industry becomes important to the success of individual teleports. This is not to say that teleports will communicate only with other teleports. The teleport and its customers could communicate with another teleport and its customer base, with individual companies who have up- and downlink capability, or with other common carriers who may distribute service within a region by other means. However, in order to make the end-to-end connection, teleport operators must have working relationships with the other half of the circuit. Again, we highlight the marketing aspects. It would be impossible to sell service to a customer in Houston or New York and only deliver the service to the satellite and tell the customer to arrange the other half of the circuit. It is hoped that the American Teleport Association will prove to be a vehicle or mechanism whereby the various teleport operators can exchange information, both technical and marketing. The sales representative in Houston must be able to price and coordinate the service hookup end-to-end, whether within the local loop or around the world. Without a cooperative effort among teleport operators, the overall concept cannot succeed.

The specifics of the terrestrial link—whether it is fiber optics, microwave, cable TV, or other means—are secondary to service integrity. In many cases economics will dictate the exact medium. Gulf Teleport is planning a combination of both digital and analog microwave, allowing the needs of individual market areas to dictate the specifics. It is very possible, indeed probable, that certain locations may have both digital and analog capabilities. The objective is to provide the highest possible service capability at a reduced cost to the user.

FIRST MILE/LAST MILE

Still another issue to be resolved in teleport planning is commonly referred to as the first mile/last mile problem. As can be observed in Figures 29–1 and 29–2, which show the Gulf Teleport service network, the teleport will bring service into business areas. This is typically the case with all the teleports planned as regional gateway systems. Teleport developers often state their intention of providing service to the end users end-to-end, but what they really mean is making the service available in a specific business community. The various microwave links or fibre optic links will have head-end points or nodes scattered throughout the service area whereby individual users can make interconnects to the teleport network. How service is carried from the head-end node to individual customers is an open-ended problem requiring many solutions. There are various technologies available to solve that problem: short-range microwave, radio telemetry, broadband cable, or leased telephone circuits. Individual teleport planners must examine their individual markets and identify the most reliable and economically sound methods of individual customer access. It is very possible and even probable that some combination of all the above methods, and possibly others not even listed, can be used. As with any chain, it is only as strong as its weakest link. Therefore, teleport operators may in some cases find themselves dependent on other service providers for the first mile/last mile hookup. This dependency can certainly be increasingly important and serious to the future potential of teleports. Only if this problem can be successfully resolved so that the customer is provided the transparent pipe, end-to-end, can service integrity be ensured.

Gulf Teleport is considering the regional, or geographic, arrangement to the business community as it addresses this problem, and the problem is less severe to Gulf Teleport than it might be to other teleports because of the way the business community is concentrated in several independent and remote blocks or groups. Therefore, each node that terminates in a business

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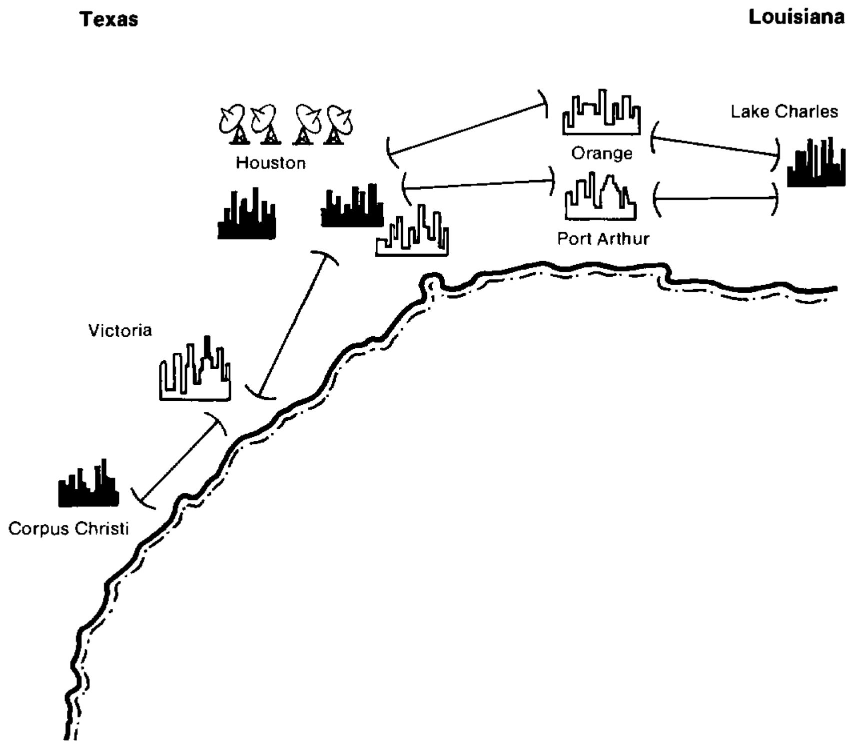
FIGURE 29–2



area can access a significantly large business community with little difficulty. The local telephone company (BOC) could be a help or a hindrance in solving the first mile/last mile problem. The service capabilities of the phone company could be integrated for short-range leased circuits to solve the first mile/ last mile problem if the level of service integrity could be maintained through the Bell loop. The question must be resolved on a local basis. Another question is whether or not the BOC will view the teleport as a competitor and refuse to be cooperative and helpful, or view it as an opportunity to participate at the local level in the growing demand for digital circuits. Perhaps the BOC will choose the latter view and will benefit from the growth of the teleport industry and will at the same time provide a reliable and economically viable solution to first mile/last mile problems. It would be advisable for any teleport planners faced with first mile/last mile problems to attempt to involve the local BOC on a favorable basis as early as possible. For the teleport that addresses only a building or a captive real estate development, the first mile/last mile problem is insignificant, since they could typically make direct interconnect through cable networks or fiber optic networks.

■ CONCLUSION ■

In summation, it should be fairly obvious that there is no pat definition of a teleport. There may be several. A teleport can be what the planners and developers want it to be within the guidelines and the needs of the marketplace that it is intended to service. The objective must be to deliver satellite communication capability to the marketplace on a cost-effective basis that will prompt a satisfactory and successful market response. One teleport cannot be a financial success without other teleports being equally successful.

Certain teleports have received a great deal of publicity through the efforts of the entrepreneurs involved. Great claims have been made concerning the importance of the teleport for local future economic development, and there is little doubt that communications capability is becoming more and more important to business planners. As new businesses come into existence and older businesses expand or relocate for various reasons, communications will be increasingly important in planning. In the past, local economic development groups have advertised such things as lifestyle, transportation capabilities, labor resources, shipping facilities, airports, harbors, and even recreational facilities. Communication capability will become a part of the evaluation criteria for business planning. It would be overly optimistic to believe that teleport capability will be the overriding factor to a business planner, but certainly the existence of a successful teleport is a valid tool for local and regional development proponents. Local Chambers of Commerce, if astute, should move quickly to embrace the teleport as an economic development tool. Once again, marketing becomes the key. Only through a balanced marketing program can the teleport concept be a valid tool for regional developers. It is also reasonable to assume that if a company were evaluating potential sites for a new factory and all other things were equal, the teleport could easily be the deciding factor. Certainly the city with teleport capabilities would have a decided advantage over the city with none. This is not to say that the teleport must be in every case a full regional teleport. Teleports can take many forms, and the form of each teleport depends on the needs of its unique marketplace.

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Chapter 30

Teleports: The Staten Island Teleport

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High Tech Real Estate Dow Jones-Irwin 1985
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Outline

THE CONCEPT

The Staten Island Teleport is a prototype office park for the 21st century with the integration of enhanced office facilities, communications access to satellites and terrestrial networks, and a regional communication distribution system for flexible and real-time communication service requirements.

The information explosion that started in the 1970s has accelerated significantly and is changing the way we live and conduct business. Statistics have shown that 46 percent of the nation's work force is employed in the information industries, and 26 percent in service functions. In the New York metropolitan area, 50 percent of all business is generated from information industries. By 1990 an estimated $100 billion will be expended annually for business communication services. Our information economy is driven by this communications explosion. Over the next 10 years, there will be a substantial increase in the number and types of communications satellites, a major increase in the optical fiber network distribution throughout the world, and the evolution of more and more sophisticated intelligent premise switches/PBXs, all of which will serve our information-dependent societies.

Integration of this communication technology explosion with information processing and the need for enhanced real estate is the basis for the Staten Island Teleport. The Teleport addresses the business needs of all corporations for:

Communications facility access within the New York/New Jersey region for satellite and terrestrial services.

Rate stability and predictability for communication services and real estate for controlling long-term expenses.

Enhanced office facilities for controlling building energy consumption; intra-office communications and gateway access to satellites and a regional fiber network.

Secured building office space.

Fail-safe power for protection of computers and information systems from loss of data and sabotage.

THE TELEPORT CONCEPT

As we approach the new century, it is becoming more apparent that the concept of a "port" with all its implications—exchange of goods, commercial transactions, and so on—must be expanded to include communications access as the critical ingredient for continued viability.

The Port Authority of New York and New Jersey, with its broad mandate to ensure the vitality of trade and commerce in its post district, has an important stake in expanding the port concept to ensure that communications can find a safe harbor in this region as did the great ocean-going vessels at the dawn of this century, or as aviation does today. It was to this end that the Teleport concept was developed by the Port Authority of New York and New Jersey. The idea was developed after reviewing the business needs in the New York metropolitan area and because of the particular concern with the egress of businesses from this region.

COMSAT, Arthur D. Little, and other consultants were retained to review and define this project. After much analysis, it was determined that an enhanced suburban office communications facility with distribution to the business district of New York City and the surrounding area would be viable.

Because New York City is one of the most microwave congested urban areas in the country, any large installation of C-band earth stations and even limited use of additional microwave facilities for distribution would be very difficult. A regional site search was conducted reviewing 29 locations for satellite access to domestic and international satellite arcs. Staten Island was chosen as the best location with the least radio frequency interference. It was decided that distribution from the Staten Island site to and throughout the region was designed to employ fiber optics. Fiber optics was desired because it would avoid the microwave congestion within New York City and because of its potential capacity, which is limited only by technology advances and security of transmission.

Thus development of the Teleport, to be located on 350 acres on Staten Island, was announced. The principal partners in this endeavor are (a) the Port Authority of New York and New Jersey, who is responsible for the teleport-site land development, including infrastructure and enhanced real estate; (b) Teleport Communications, a joint venture between Merrill Lynch Telecommunications, Inc., and Western Union Communications Services, who are responsible for the communication management of the satellite earth station access facilities, enhanced office park communications services, and fiber optic distribution throughout the region; and, (c) the City of New York, which owns the land.

ENHANCED REAL ESTATE "MASTER PLAN"

The Teleport's master plan (Figure 30–1) illustrates the basic physical design. This plan carefully balances the suburban office park setting with a natural wetland preserve. The development has been divided into phases: Phase I is for the development of 100 acres, and Phase II is for the development of an additional 100 acres. The 150 acres will remain as an undeveloped wetland preserve. The Teleport office park will be composed of office buildings of three to four stories (80,000 to 100,000 square feet); the buildings will be clustered throughout the site and have ample parking. The entire location is fenced for security with one main entrance. The communication center,

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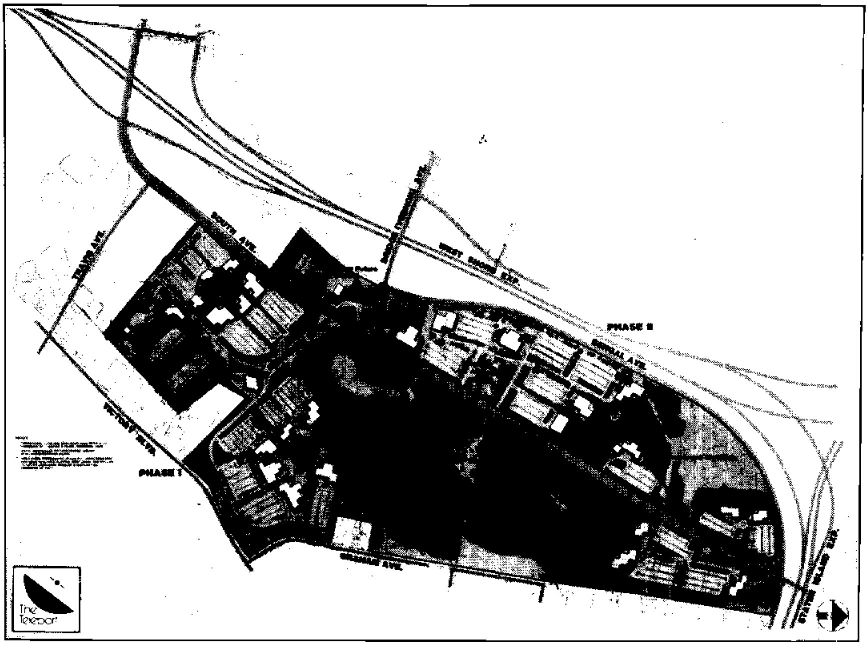
FIGURE 30–1



or Telecenter building, will accommodate the communications switching, monitoring, and control of the earth stations within the "earth station shield" area and the fiber optic network.

Enhanced office buildings will typically be used for back-office and computer services. Computer-controlled environments with remote sensing monitors and raised floors are typical.

A unique fail-safe power system will be employed at the Teleport. The primary power will be from Power Authority of the State of New York (PASNY) on the northeast power grid, but a second contingency system will be available throughout the park. This second system is an extension of the mid-Atlantic power grid from New Jersey and is provided over the Goethals Bridge (operated by the Port Authority) into the Teleport. This system provides the fail-safe power many companies are seeking.

Security will be provided by the Port Authority police, who have state police powers. There will be 24-hour coverage, seven days a week, with trained personnel for fire and emergency medical services.

Demographics surrounding the Teleport are important to ensure a proper labor force available for business at the site. Staten Island itself has approximately 150,000 residents with the skills, education, and training to support back-office and high tech operations envisioned at the Teleport. Within one hour of mass transportation, the same labor profile is increased to 750,000; within a half-hour automobile drive, it is expanded to 1.5 million workers.

Accessing the Teleport was another critical area of concern. The site provides an excellent location. It is surrounded by an excellent highway system. From the site Newark airport is only 12 minutes away. Further, it is an easy 30-minute drive to Manhattan.

To meet the needs of the region, various land and real estate options will be made available to potential corporate tenants. Private developers will be encouraged to lease land and rent office space. Private corporations will also be offered the opportunity to lease land, and the Port Authority will finance and/or build to suit. The Port Authority makes available long-term lease arrangements, depreciation allowances, secures local community and city approvals, and potential city tax abatements.

COMMUNICATION SERVICES

A teleport provides three essential telecommunications services: multisatellite access, regional distribution network, and an enhanced office park tenant services. From a communication point of view, a teleport is a network to cluster multiple satellite access facilities away from congested microwave airwaves in central cities. It also supplements the present earth station access facilities, which will be insufficient to meet the growing needs for satellite communications. Finally, a teleport provides the need for a tenant office park requiring enhanced telecommunications enriched office facilities and ease of access to all types of communication facilities. The expansion and forecast of satellites and number of transponders is increasing rapidly. Forecasts indicate that C band (4 to 6 Gigahertz) transponders will rise from an estimate of 240 in 1983 to 672 by 1987. The emerging Ku band (12 to 14 Gigahertz) transponder growth is exemplified with a use of 20 transponders in 1983, growing to 410 by 1987.

SATELLITE ACCESSIBILITY

With the ever-increasing number of transponders available for communication, the underlying issue in the New York region is access to these transponders. The need is not just the access to a limited number of transponders but the access to all satellites and transponders.

Staten Island was selected because it is capable of accessing the full U.S. domestic satellite arc as well as the Atlantic international arc. This site not only proved to provide appropriate access, but there were other important criteria used in its selection.

Proximity

Proximity to the metropolitan business district was one of these criteria. The Teleport is 11 airline miles away from Manhattan. This provides significant terrestrial communication cost savings for businesses and residents of the New York City region. There are approximately four common carriers that utilize C band satellites for their communications offering in the New York region. Their satellite earth station facilities to access the domestic arc are more than 50 miles from New York City. This increase in terrestrial facility access of 50 miles versus the Teleport's 11 miles causes the cost to the user or common carrier an estimated increase of 300 percent.

An even more dramatic impact of proximity and satellite access is with international satellite services. Today, all satellite international access from the New York region utilizes earth stations located at Etam, West Virginia, or Andover, Maine. Both of these locations are more than *300 miles* from New York City.

Ease of Access

Ease of access to various satellites, domestic or international, is another key element of Teleport. Common carriers in the New York region operate their earth station facilities each utilizing the earth station to access only their own satellites. This restriction of satellite earth station access to only the common carrier's satellite places a burden on the corporate user. A user must incur charges for more than 50 miles of terrestrial lines to access a common carrier earth station and satellite in one part of the country and, then may need to incur the same charges to access another common carrier facility located in a different part of the country. A Teleport user will have access to many common carrier satellites. This will reduce the need to access multiple terrestrial facilities and will provide significant savings to the user—be it a private corporation or a common carrier. In addition, this same terrestrial link will have access to international earth stations.

SATELLITE SERVICES

The Teleport will offer unique satellite earth station services. These services are flexibly designed to meet the needs of business. They range from protected environments for earth stations to RF port sharing services, which provide voice, data, facsimile, and video communication services. Initially, approximately 10 acres will be utilized to house 17 earth stations, of maximum size of 13 meters, with room for expansion to an estimated 36 earth stations. The initial earth stations will be protected from stray radio frequencies with the construction of a shield wall. This shield will be 50 feet high with steel siding on the exterior and concrete on the interior of the wall. The construction, placement of earth station, and maintenance of this area will be controlled by Teleport Communications. A one-of-a-kind radio frequency and structure blockage computer program has been designed to ensure proper placement and operation of all earth stations within the shield wall.

Figure 30–2 depicts the teleport shield wall with the integration of the Telecenter building and strategically located equipment shelters along the perimeter of the shield. The shield also is equipped to distribute communication facilities throughout the infield and along the wall to the equipment shelter. In addition, each equipment shelter will have access to the Teleport fail-safe power system and Telecenter uninterruptable power supply and generator backup. The shield is designed to accommodate all environmental considerations required for installation and operation of earth stations and communication facilities. To meet the various needs of the region and industry, the Teleport will accommodate shared or dedicated earth stations. Options are available to permit a private corporation or common carrier to install and operate its own earth station facilities. Shared earth station options are available from Teleport Communications earth stations providing satellite access for users at the Teleport park, or within the region.

A unique offering and significant satellite communications reason for teleports is the port-sharing concept. This concept encourages earth station opera-

FIGURE 30–2

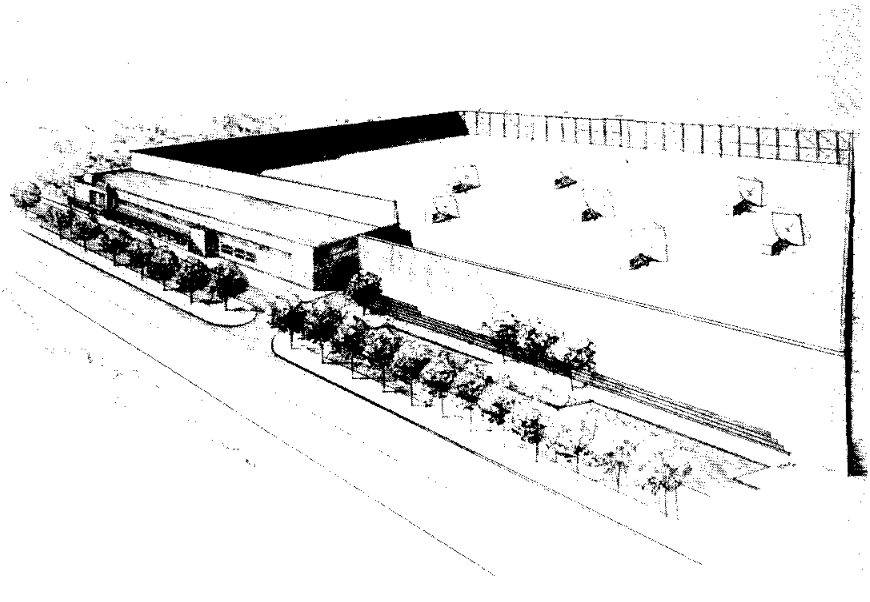


FIGURE 30–3

tors to contribute two RF ports from their earth stations to the Teleport. These ports increase the access to multiple satellites utilized by all users at the Teleport and throughout the region.

OPTICAL FIBER NETWORK

The transmission and receipt of satellite communications does not involve only the satellite earth station. Paramount to a teleport is the regional distribution network of high-capacity communication facilities. This system provides satellite users end-to-end service at various transmission speeds. The Teleport will be utilizing fiber optical cable throughout the region. The system will enable satellite services to be distributed from the Teleport to the business districts within the region. Initial installation costs are more expensive than those for microwave, but the many superior attributes of optical fiber far outweigh the initial costs. First, the microwave congestion issue is resolved. Moreover, the ever-increasing improvements in optical fiber technology proceed at a great pace. Originally a single pair of hair-thin fibers could transmit 672 simultaneous voice conversations. Further, technology has improved the quality of the fiber material and electronic terminal capacity. Today, the

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transmission capacity of those hair-thin fibers is 405 Mbps, which is an equivalent of more than 6,000 voice conversations, by a conservative estimate. Improvements and advancements are expected to provide for even greater capacities, providing 565 Mbps to 1.2 Gbps capacity.

The Teleport regional network will span the New York and New Jersey region with interconnection to the Teleport. The network provides for full redundancy of electronics and standby optical fiber pairs to ensure continued service to its users. Full physical diverse routes will be employed from Manhattan to the Teleport site. An optical fiber ring network in Manhattan is designed to handle the potential of cable outages between the strategically located optical fiber network operation centers. The initial network interconnects the Teleport with Manhattan, Brooklyn, and Queens of New York and Newark and Princeton of New Jersey.

To meet the demand of users, the Teleport will construct optical fiber links from the fiber network operation centers to a user location. This will ensure user service from premise to satellite earth station at teleport and to other locations within the region.

Teleport optical fiber services are offered at a basic DS-1, 1.544 Mbps and DS-3 Mbps transmission speeds. The services are offered to users any-

FIGURE 30–4

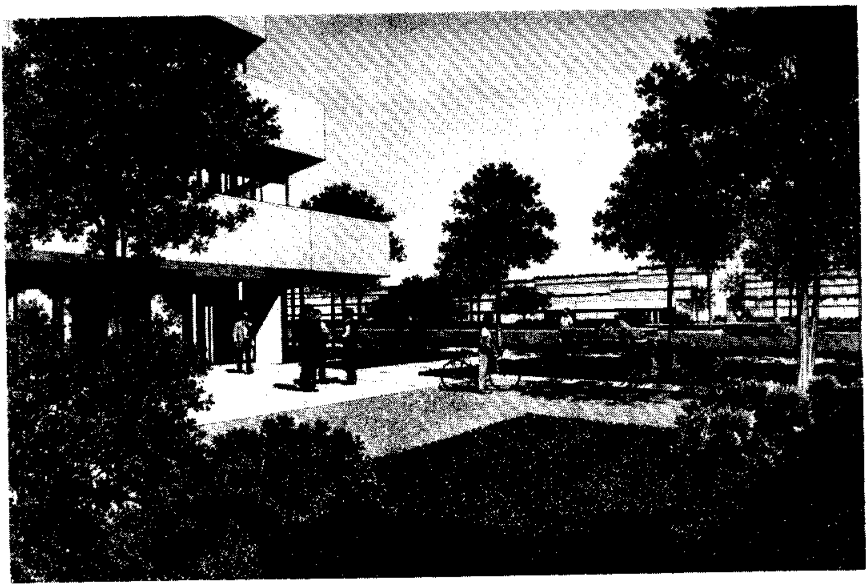
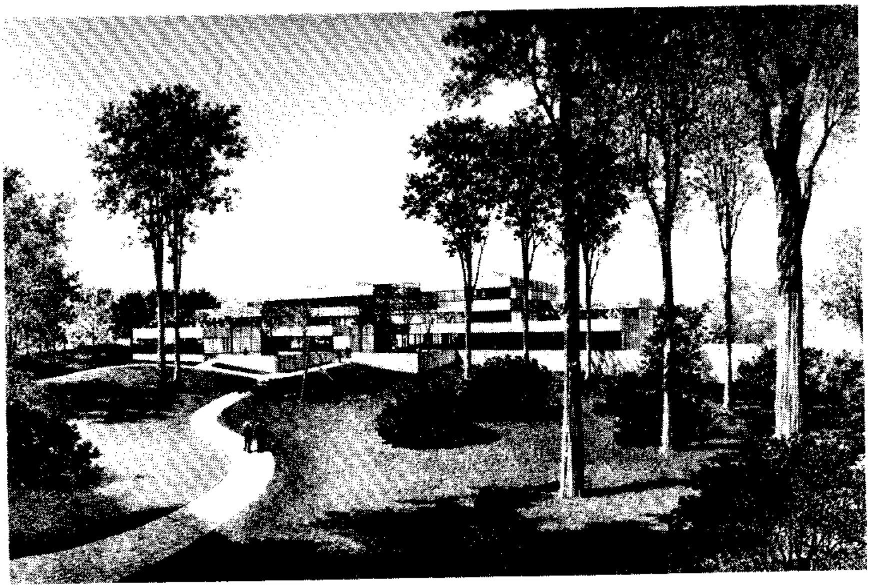


FIGURE 30–5



where in the region to Teleport for domestic and international earth station access; from user premise to user premise; and from user premise to interstate and/or international common carrier's point of presence in the region. The optical fiber network flexibility provides the exact options that today's common carriers and businesses require to control their business communications and provides the diversity essential to ensure reliable communication services.

Today's communications environment is in disarray. With the many interstate and international common carrier services to choose from, businesses require high capacity, and direct access to these companies. Direct access from the business office or real estate development to the common carrier permits cost savings and flexibility not only to the corporate user or developer utilizing communications, but also to the common carrier. Common carriers can streamline network designs and thus prefer direct access to their clients via the present dominant local telephone company or an alternate supplier of local facilities.

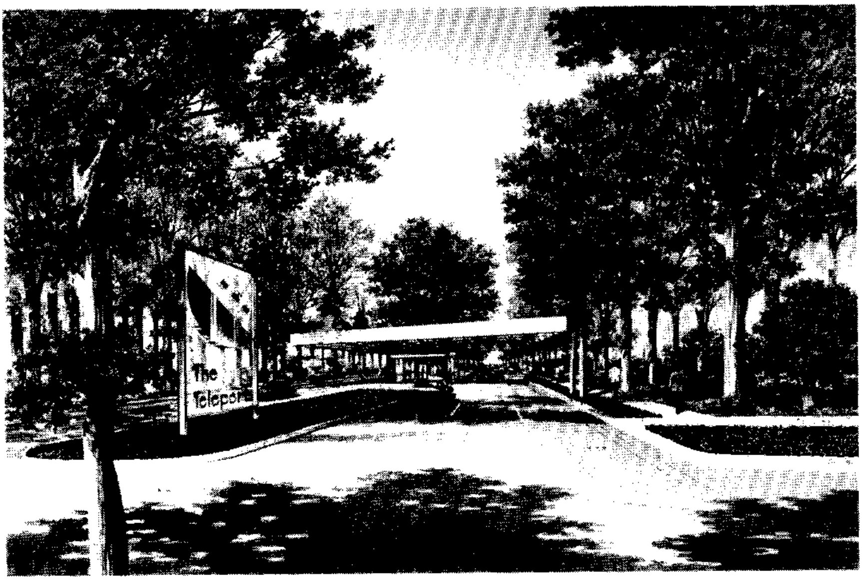
Direct access also provides a type of client control for the interstate/international common carrier to its clients by virtue of the large capacity service commitment. Direct access along with today's technology utilizing plug-in electronics reduces installation intervals, provides communication capacities required for various services ranging from low-speed data, voice, to video conferencing and economy due to streamlined installation and network design.

TELEPORT PARK SERVICES

A significant response to industry needs is the teleport-enhanced suburban office park. Shared multi-tenant communication services will be offered to all tenants of the teleport. Teleport tenants can avail themselves of the latest technologies now and in the future to supplement their office facilities. The Telecenter building functions as the control and monitoring center for all earth station facilities, teleport optical fiber systems, and the premises to house the intelligent systems for park services.

As many people know, the shared multi-tenant system concept benefits all users by the sharing of capital costs and by achieving high-price performance. Utilizing this system will save users office floor space and the costs of preparing this space for electric, heating, ventilation, and air conditioning use by a communication system. The teleport office park will be prewired

FIGURE 30–6



from the Telecenter building to each park building and within the building. The prewiring plan allows for the most flexibility and is designed to provide each station user access to many voice, data, and video services. A combination of optical fiber and copper cable distribution will be utilized. Of the many park services offered, three basic systems can be described as offerings for the multi-tenant: voice management, data management, and building services management.

Voice management systems will provide basic voice communication switching service. The system will allow intelligent terminals to be connected to this system provided by the Teleport or the user. Standard enhanced features such as conference calling and detailed accounting for recording of station user calls will be provided. Of significance to the voice management system will be the economic call routing program. This program will pool all multi-tenant calling requirements and provide for the most economical medium for call completion over a variety of interstate and international carriers. The combining of the many tenant calling needs will clearly save all tenants communication costs over subscribing directly for communications from interstate/international carriers directly.

Data management systems at the Teleport will permit a tenant to again save communications costs with utilization of modem pooling and the sharing of access lines and facilities to sophisticated data networks for switched 56 kbps and 1.544 Mbps service. With the utilization of adjunct processors, terminal emulation will be performed to allow various communications terminals and word processors to interact with other devices on the park premises or even in other cities.

Clearly the Building Management system will be of significance to all tenants at the Teleport. This system will utilize a protected processor for such services as central message center—electronic mailbox, electronic directory, and security alarm services. Security services will employ various devices, such as employee ID readers and sensor technology for monitoring of security entrances and doors. Security monitoring or alarms may be transmitted to internal local building security desks or to the Port Authority police monitoring location for immediate attention of the situation. Another large application of sensor-based technology will be the centralized energy control system. This centrally protected system will save tenants from separate system installations and provide for reductions in energy consumption by controlling and monitoring lighting, fans, motors, and other electrical consumption devices throughout their premises.

Each system is designed for ease of use by individual tenants and is basically partitioned in the main system to simulate a separate control system for each user. The shared systems for tenants at the Teleport optimizes economies of scale and compliments the enhanced real estate requirements of today's business community.

THE TELEPORT—COMMUNICATIONS GATEWAY TO THE WORLD

The integration of high tech communication and enhanced real estate is the Teleport's response to the New York region's businesses and economic developmental needs:

Accessibility

The Teleport site provides easy access for businesses within the region and from the regional airports. There is unparalled access to an experienced work force on Staten Island and throughout the region. Teleport provides access to domestic and international satellites, and its distribution systems span the region and the globe by connecting users to interstate and international common carriers.

Flexibility

To meet the many varied financial and operational needs of the region, the Teleport offers a variety of service options. These services are customized building designs, various communications services and—with the utilization of high-capacity transmission services—the quick provisioning within the region.

Reliability

The Teleport provides a secure environment with Port Authority police protection and a communication radio frequency-free shield. The unique fail-safe power system combining the North Atlantic and Mid-Atlantic power systems is the only one of its kind. The optical fiber network with redundant systems and physical diversity provides the insurance required for continuing communication systems.

Economy

Port Authority options of financing, tax advantages (and potential tax abatements), and attractive real estate prices provide for business utilization of the first New York City suburban office park. Telecommunications will be competitively priced for park services and regional distribution by offering rate stability and the predictability required by all businesses. The basic philosophy of systems and satellite earth station port sharing ensures cost savings for all.

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Dependability

Besides the physical and protected systems employed, the Teleport was developed in response to regional needs by reliable, qualified organizations. The project has great staying power and the commitment for success from the Port Authority of New York and New Jersey, Merrill Lynch, Western Union, and the City of New York.

An analogy can be drawn between a teleport and an airport. The essence of a teleport is that it is an interstate/international access facility that services the telecommunications industry and other communication users in a manner very similar to the way an airport services the airline industry. In both cases, there is a sharing of common facilities at a specially developed site where the shared costs would be lower than if each user created its own site. Further, the presence of many airlines at an airport facilitates connecting flights for its passengers in the same way that the presence of many satellite earth stations at a teleport facilitates interconnections of telecommunication services. Finally, airport users share common highways into a metropolitan business district and region, and teleport users share a high-speed optical fiber network into Manhattan and throughout the metropolitan region.

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Robert Annunziata is chief operating officer of Merrill Lynch Telecommunications Inc. He is also senior vice president of Teleport Communications, a joint venture between Merrill Lynch Telecommunications, Inc. and Western Union Communications Systems, Inc.

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Stanley Welland is accountable for the establishment and direction of a technology planning group that provides technical planning, guidance, and assistance to corporate systems and management to maintain consistency of planning and implementation with the overall objectives of Merrill Lynch. The group constantly reviews and assesses the industry developments for potential impact on the company's information processing systems. Welland works with Merrill's venture capital organization and participates in the identification and recommendation of investments in technology that will not only yield capital growth but will also provide the firm with technological leadership in providing financial services. This covers hardware, software, and services—including satellite, cable, and related technologies. Welland joined Merrill Lynch in March 1981, when he initiated Merrill's development of The Teleport project.

For 11 years Welland held assignments in the following Exxon organizations: Exxon Office Systems Company; The Mathematics, Computers, and Systems Department; the Office of Management Information Coordination; the Headquarter's Administrative Services Department; and Exxon Enterprises (Information Systems Division). His work experience encompassed the management of a broad range of projects involving the solution of technical and business problems encountered in many of the functional areas of the Exxon Corporation and its worldwide affiliates. He was the Qyx product manager assigned to Exxon Office Systems Company and a senior adviser for the Exxon Enterprises Information Systems Division, where he was responsible for developing, evaluating, and recommending strategic and tactical plans for the growth of Exxon Enterprises' business activities in the communications systems area.

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