

## **PREFACE**

How can San Diego realize the benefits of the new communications technology and the technologies now on the drawing boards?

Why should the community seek to create a modernized communications infrastructure? Will it, indeed, benefit by so doing? How?

What can it do, given its limitations, and with major policy and regulatory control largely exercised on the state and federal levels, to enter the Information Age in a significant way? Should it attempt to do so? What are its real-world options?

This report, the National Overview, represents Phase One of a three-phase effort to answer those questions. It is based on study of the growing professional literature, reports of the Federal Communications Commission, the National Telecommunications and Information Administration, the Congress, the trade press; interviews with representatives of the telecommunications and related fields, and the political sector.

The report looks at the infrastructure question from an overall point of view, noting technological and policy trends as they affect prospects for a universally accessible high-capacity publicly switched network, which can carry vast amounts of information, such as video services, as opposed to the current narrowband, or telephone service.

In addition, it looks at current policy trends as they appear in various regions of the country, the plans of several states which are in the vanguard, and touches upon the actions and attitudes of various cities in the telecommunications area. We do not include San Diego in this phase, that being the province of Phase II, in which we will examine the state of the communications art as reflected in San Diego's industries, education and health services, and city and county operations, noting the area's telecommunications strengths, weaknesses and needs.

Phase III will contain our conclusions and recommendations, along with possible scenarios for development.

## **SAN DIEGO AND THE GLOBAL VILLAGE**

The much-heralded Information Age is a worldwide phenomenon. Perceptive governments and industry leaders in other countries have seen and understood the promise of advanced communications for their economic and social development. And they have acted to make it part of their reality within time-frames that pose a serious challenge to this country.

What makes this situation potentially serious is the freedom of location that advanced communications makes possible for corporate operation. A company that is communications-

intensive can locate virtually anywhere on the globe, if the combination of skills and costs is attractive enough.

Which means that San Diego must compete globally, must be able to offer to industry (industries that it wishes to retain or attract), communications opportunities equal to, or better than, locations elsewhere in the world. It is no accident that as San Diego considers the prospects of becoming a vital communications hub for the Pacific Region, it must confront the ambitions, not only of the cities and states of the West, but Japan and Singapore, as well.

### **The Japanese Target: A Fibered Nation by 2015**

Japan's telecommunications industry has undergone significant changes in the last seven years. In 1985, the industry was deregulated, in order to foster competition, reduce rates, and liberalize services. This meant privatization of Nippon Telegraph and Telephone (NTT), which formerly held a monopoly on domestic service in Japan, and Kokusai Denshin Denwa (KDD), the country's former monopoly for international telecommunications services. In 1990 the Ministry of Posts and Telecommunications, which regulates NTT and KDD as special corporations operating in the public interest, reviewed the laws concerning deregulation and considered the possibility of breaking up NTT, but decided to postpone any decision until 1995. <sup>1</sup>

Japan has been aggressively pushing the boundaries of the possible with telecommunications technology for more than 25 years, making it a formidable competitor. It gains an even sharper edge because of the coordination of activity between the business sector and the government's Ministry of International Trade and Investment. Decades ago the Japanese were experimenting with the potential of wired communities. They built Tama, a town located about 50 miles outside of Tokyo. Taking a suburb of Tokyo, they cleared it, built new homes, and wired them with coaxial cable. Every home was wired for cable — the kitchens even had a television, a keyboard, and a fax machine — and similar equipment was found throughout the home. The Japanese had no idea they were so far ahead of the U.S. in cable applications and stopped experimenting because there was no market to export to. <sup>2</sup>

In the past, Japanese vendors, perhaps hoping to set world standards, made little effort to ensure compatibility with equipment sold by other vendors. In more recent times, however, they have realized the potential opportunities of the global marketplace and are joining international standards committees in order to make a greater impact in the international marketplace and promote export of Japanese technologies and products.

By the end of the decade they intend to have the multimedia advantages of Integrated Services

Digital Network (ISDN) provided to every business and home, with high-capacity fiber to every business and home by the the year 2015. Inaugurated by NTT, the program is named Optical Fiber Loop for the 21st Century (OFL-21). By 2005, NTT expects to begin offering such services as high definition visual communications, voice recognition and voice synthesis capabilities, and portable phones via this broadband network. Commercial ISDN was introduced in Japan in 1988. There may be up to 750,000 ISDN-compatible lines installed in Japan for residential and business users. KDD, in cooperation with AT&T and British Telecom has set up the world's first international ISDN services between Japan, the U.S., and Great Britain, and work is currently under way to expand these services to France, Canada, and other countries.<sup>3</sup>

Technopolis, a \$150 billion program to support development of "smart cities," is now underway. Information will be transmitted over a fiber-optic network domestically, and over satellite internationally. A \$13 billion teleport in Tokyo is part of this initiative. The government has built roads with optical fiber ducts and cable boxes pursuant to its "smart cities" initiative.<sup>4</sup>

Just as impressive is a program called Teletopia, undertaken by the Ministry of Posts and Telecommunications. Designed to create regional information hubs that will serve as administrative centers and platforms for

economic growth, Teletopia is financed through incentives which encourage investment and will position Japan to compete aggressively in the international economic arena in coming decades.<sup>5</sup>

### **Singapore Becomes A Pacific Hub**

In 1991, Singapore's Prime Minister, Goh Chok Tong, endorsed a new strategic plan to build a national information infrastructure: Information Technology 2000:

*In our vision, some 15 years from now, Singapore, the Intelligent Island, will be among the first countries in the world with an advanced nation-wide information infrastructure. It will interconnect computers in virtually every home, office, school, and factory. The computer will evolve into an information appliance, combining the functions of the telephone, computer, TV and more. It will provide a wide range of communication modes and access to services. Text, sound, pictures, video, documents, designs and other forms of media can be transferred and shared through this broadband information infrastructure made up of fiber optic cables reaching to all homes and offices, and a pervasive wireless network working in tandem. The information infrastructure will also permeate our physical infrastructure making mobile telecommuting possible, and our homes, workplaces, airport, seaport and surface transportation systems 'smarter.' A wide range of new infrastructural services, linking government, business and the people, will be created to take advantage of the new broadband and tetherless network technology.<sup>6</sup>*

This small country, with only 240 square miles of land area, a population of just over 2.7 million, and no natural resources to speak of, has already made substantial progress in

building an information infrastructure that is enabling it to compete internationally. Air, land, and water travel authorities, traders and government trade agencies are connected by the country's nationwide electronic data interchange (EDI) system, TradeNet. It has added a satellite facility to link several countries, an undersea cable that creates a telecommunications link, a national ISDN, and two AT&T international digital-switching gateways. These advances have enabled Singapore to attract many regional headquarters. Many U.S. companies use Singapore as a hub. Singapore spends \$400-500 million annually to upgrade the infrastructure. <sup>7</sup>

### **Europe Moves To Modernize**

Tremendous changes are also taking place throughout Europe. In 1985, the Single European Act was adopted by the 12 member nations of the European Community. Plans were formulated to remove any barriers (physical, technical, or fiscal) within the EC by the end of 1992. Telecommunications technology is an important component of these plans. Formerly a conglomeration of mostly state-run monopolies, countries throughout the EC are deregulating and privatizing their telecommunications industries. In 1988, ETSI, the European Telecommunications Standards Institute, was formed to improve the speed and quality of the standards-making process in Europe. This coordination of efforts has strengthened the impact of European input on

standard setting in such international bodies as the International Telegraph and Telephone Consultative Committee (CCITT) and the International Organization for Standardization (ISO).<sup>8</sup>

### **Great Britain Deregulates**

The telecommunications industry in Great Britain reflects this altered environment. In the last 10 years it has changed from a stagnating state-run monopoly to a dynamic marketplace of new technologies. During the 1980s the British government pursued deregulation to achieve advances in telecommunications services and facilities. British Telecom was partially privatized, Cable & Wireless was totally privatized, OFTEL (an independent growth-oriented regulatory agency directed toward promoting modernization) was created, price-cap regulation versus rate-of-return regulation was adopted, and competition for basic telecommunications services accompanied by the promotion of competition in enhanced services was introduced. These efforts resulted in increased investment in network modernization. <sup>8</sup>

### **Germany: "Telekom 2000" Program**

Deutsche Bundespost Telekom was once a government monopoly. Actions by the EC and mounting pressure both from within Germany and from the international front, forced the German government to allow competition in the telecommunications equipment and advanced-services markets. Deutsche Bundespost

Telekom, the largest telecommunications organization in Europe, is now a public corporation and is undertaking the modernization of the telecommunications infrastructure of the former East Germany with a program known as "Telekom 2000". As part of this program cable television, ISDN, and additional high tech services were offered by Deutsche Bundespost Telekom in a seven-city trial of fiber to the home during 1991.<sup>10</sup>

### **French Goal: the Information Society**

In 1976 French President Phillipe Giscard D'Estaing announced the "The Computerization of Society" or "Informatique," as it came to be known, developed by his Minister of Economics. It was a bold, forward-looking plan designed to put France in the communications forefront. Behind "Informatique" lay a strategy seeking to take maximum advantage of the new understanding that information is wealth. Since information was being automated, it followed that those who automated first would be in the best position to capitalize on these basic shifts in the economy.

As part of this program, France Telecom, the government communications monopoly, was charged with creating a huge teleport in Paris. This positioned the city to serve as the telecommunications hub for the rest of Europe. The French also marketed the teleport aggressively in the United States, with the aim of routing trans-Atlantic calls through Paris. A

large portion of such calls are now downloaded in Paris before being shipped off to other places.

At the same time, France Telecom was attempting to revamp the national network and extend coverage of the telephone, with the goal of achieving one of the highest telephone penetration rates in the world. Minitel followed, a small terminal in the home or office capable of sending or receiving text, used as an extension of the telephone system. First deployed as an electronic phone book, it rapidly spawned many additional text services, generally known as videotex. The Minitel units were supplied free to the consumer by the government. From a modest start as an electronic directory, whose widespread use, it was claimed, could lead to such environmental benefits as the savings of trees, Minitel usage has expanded to the point where over five million terminals have access to over 13,500 information services.<sup>11</sup>

### **The American Response**

The United States is not organized for head-to-head competition with Japan or other countries with a centrally directed undertaking. Instead, it is a battleground of contesting industries and companies, and a great variety of initiatives, technological and political, generally moving in the direction of a universal, publicly switched broadband network. Whether that end will ever be fully reached, or reached in enough time to be meaningful in an internationally competitive

sense, given the present free-for-all approach that is characteristic of the American scene, remains a question at this point in time.

Two members of the U.S. Senate have taken the lead in an attempt to organize support behind a legislative initiative designed to make the broadband network a reality, with the foreign challenge very much a motivating factor. As stated in the *Communications Competitiveness and Infrastructure Modernization Act of 1991* (Senate Bill S1200) by Senators Conrad Burns, R-Montana; and Al Gore, D-Tennessee:

*Foreign competitors in the Pacific Rim and European Community are marshalling their resources and pushing ahead aggressively with communications infrastructure modernization, with the expectation that their massive investments will be recovered by selling the related technology abroad.*

*By the year 2015, the Japanese Government plans to have every Japanese business, home and institution served by broadband technology, whereas in the United States--given current public policy--it is estimated that it will take until 2030 or 2040 to achieve the same result.*

*The Japanese Government estimates that by the year 2020 fully one-third of Japan's Gross national Product will be generated through its broadband communications infrastructure.*

*The more rapid deployment of a broadband communications infrastructure will stimulate the development of American technology for domestic use and for export abroad and will help insure that the United States is not forced to import broadband communications systems and related technology and export*

*the jobs to develop and manufacture these systems.* <sup>12</sup>

Although it is too early to forecast with any degree of certainty a legislative outcome of the Senatorial effort, early passage would be surprising; a more likely prospect is reintroduction of the bill in future Congressional sessions. Companion legislation, the Boucher/Oxley bill (H.R. 2546) has been introduced in the House.

At its July 16th meeting, the Federal Communications Commission took what some regard as an historic step toward freeing the telephone industry from the legal shackles which it alleges have been standing in the way of its full participation in the building of the broadband infrastructure: the Commission modified its rules to enable local telephone companies to enter the video marketplace through a video dialtone service and to obtain a financial interest of up to 5% in video programming ventures. Along with bringing the benefits of competition to the field of cable, the Commission believes that these actions "will advance the FCC's goals of creating opportunities and incentives to develop an advanced telecommunications infrastructure..." <sup>13</sup>

The term "video dialtone" refers to a common carrier-based service which would permit the telephone companies to present on-screen menus of services being offered by non-

telephone company suppliers, including cable television. The viewer would dial up the desired service in much the same manner as when making a telephone call.

Whether video dialtone will prove to be the key to new investment, or whether the 5% programmer participation will provide the telephone companies with financial incentives sufficient to promote full embrace of the broadband infrastructure, are, of course, the critical questions.

The Commission also recommended to the Congress that it repeal the telco-cable cross-ownership prohibition contained in the Cable Act of 1984.

Through the efforts of the Commerce Department's National Telecommunications and Information Administration, the Administration has been attempting to educate the public on the need to keep up with, even surpass, those countries now firmly embarked on the broadband network course. In October, 1991, the NTIA issued a major report, based on an 18-month inquiry: *The NTIA Infrastructure Report: Telecommunications in the Age of Information*, in which it stresses the importance of such a network to the future economic and social welfare of the United States.

The Commission has also adopted price cap regulation, which allows the Bell Companies

and GTE to enjoy greater earnings derived through efficiencies and technological advances, but limits the charges that can be passed on to the customer.

### **THE GROWING IMPORTANCE OF TELECOMMUNICATIONS TO ECONOMIC DEVELOPMENT**

Today, the U.S. is moving away from a manufacturing-based economy and toward a service-based economy. Increasingly, the ability to access and transport information is critical to success. A recent study shows that the importance of telecommunications in the production process has expanded in virtually every industry and that most industries experience greater efficiency gains because of increased use of telecommunications. The Economic Strategy Institute attempts to quantify the impact that increased private sector investment in broadband communications can have on economic growth throughout the United States.

*Economic growth in the United States would be greatly accelerated by increased private sector investment in broadband communications. Creating a more favorable environment for such investment could enable U.S. industries to create as much as \$321 billion in net new GNP growth and add 0.4 percent to annual U.S. productivity growth over the next 16 years — about the time currently needed for two cycles of investment in the new communications infrastructure. These gains would come on top of the gain of \$191 billion in U.S. output that already is expected if present trends in broadband investment continue. These additional benefits, however, can be realized only if broadband communications become*

*an attractive investment for the private sector, and if national broadband systems become more ubiquitous and "user friendly."*

*Although many industries would benefit from broadband-generated productivity gains, the most important improvements would come in the following industries: computers, electronic components, communications equipment, radio and TV equipment, business services, printing and publishing, wholesale trade, plastics, electrical appliances, finance, insurance, and real estate.<sup>14</sup>*

Major findings of a DRI/McGraw Hill study of telecommunications modernization and the New Jersey economy point out graphically the impact of these technologies on economic development:

*Telecommunications network modernization under a business-as-usual program, would support 70,000 man-years of employment in New Jersey and \$554 million in state tax revenue over the 1992 to 1999 period.*

*Under an accelerated modernization plan, the direct and indirect effects of the construction activity would create an average of 2,000 jobs per year, for a total of 16,000 man-years of employment and \$141 million in state tax revenues, in addition to the benefits associated with the business-as-usual plan.*

*Using a conservative "lower bound" estimate of telecommunications usage, productive efficiencies induced by the enhanced telecommunications network under the accelerated plan would generate a further addition of 21,600 man-years of employment and nearly \$184 million in state tax revenues. A more aggressive "upper bound" estimate yields an addition of 60,000 job years and \$497 million in tax revenues.*

*The combined construction and efficiency effects of the accelerated program will result in an overall increase of nearly 38,000 man-*

*years of employment and \$325.7 million in tax revenues, above and beyond the benefits associated with the business-as-usual plan.<sup>15</sup>*

The study of New Jersey's telecommunication infrastructure by Deloitte & Touche/Braxton Associates supports the conclusion that telecommunications plays an important role in economic development, a role that will increase in the future. The report traces the increasing role of telecommunications in business to fundamental forces in the business environment, including the increasing intensity with which businesses use information and communications and the increasing importance of telecommunications-intensive industries in New Jersey and the nation's economy. It finds that telecommunications can be expected to become even more critical to a company's ability to compete in the future. Moreover, telecommunications is a significant consideration in the business relocation process. As such, telecommunications has clear ramifications for economic development initiatives seeking to attract/retain business in New Jersey.<sup>16</sup>

This impact is not unique to New Jersey. A study conducted by DRI/McGraw Hill for Maryland contained similar findings:

*Over the 1991 through 2005 period, the construction and related activities associated with C & P's telecommunications network enhancement plans will support — directly or indirectly — an average of 11,000 jobs annually.*

*The economic activity fostered by network enhancement will generate an additional \$1.5 billion in state revenue, or an average of \$107 million per year.*

*The enhanced telecommunications capabilities afforded by the modernization plan will induce productivity gains in Maryland industries, contributing further to job creation. Our analysis shows that the enhancement would create 25,600 man-years of employment through 2005.*

*Telecommunications-induced productivity gains will also likely contribute to higher personal income and tax revenues. We estimate that \$220 million of additional tax revenue could be generated.*<sup>17</sup>

The U.S. Department of Commerce's National Telecommunications and Information Administration has noted that "...individual states quite properly view telecommunications as a potential source of advantage when competing against each other for jobs and investments..."<sup>18</sup> This is not to indicate that telecommunications infrastructure is the primary — or the only — reason that a company will locate in a specific area. A Tennessee study found that telecommunications infrastructure is an indirect rather than a primary influence on the site location process: "Telecommunications can, however, sometimes be cited as a negative factor in removing a location from the candidate list. The presence of a digital (or stored program control) switch was mentioned several times as an absolute requirement . . . Being ahead in Telecommunications technology deployment rarely produces competitive advantage in

recruiting businesses, but being behind can be a significant liability." <sup>19</sup>

A variety of factors may enter into site decisions, such as the available skills in an area, taxes, the regulatory environment, labor costs, educational facilities, assessments, climate, and cultural opportunities.

Still, Tennessee's Public Service Commission has publicly stated that the state has been able to attract a number of companies on the basis of its announced communications infrastructure plan. In the year following announcement of its 10-year Plan of infrastructure development, at least 11 telecommunications-intensive businesses visited Tennessee and selected various areas of the state for new site locations. The company executives pointed to Tennessee's aggressive push to get advanced technology and fiber optics in place at an accelerated pace during the 1990's as an influential factor in their location decisions. The companies include:

*Message Corporation of America, which will bring 1,000 jobs to Tennessee during the next three years; Whirlpool, 300 jobs; Traveler's Insurance, 250 jobs; Colonial Insurance, 40 jobs; Sears, which will bring 220 jobs to a new location in Knoxville — it has already hired 2,200 part-time employees for a catalogue center in Northeast Tennessee; Marine Midland, a division of Ford, 300 jobs; Caterpillar Financial Services (division headquarters), 200 jobs; Advanced Services, Inc., 150 jobs; National Federation of Independent Business, 80 jobs; Telecommunications Marketing Corporation, 300 jobs during its first year; and a Canadian*

*manufacturing company that will employ 100 by the end of 1992.* <sup>20</sup>

According to the Commission, existing businesses are pleased, as well, because of the broad range of services and technological capabilities the new infrastructure being created makes possible.

### **Eliminating Geographic Barriers**

There are a number of practical examples of telecommunications reducing unnecessary geographic barriers to competition and providing business with the incentive to locate in a specific area.

Rosenbluth Travel, a Philadelphia-based firm, located a branch office in Linton, North Dakota. Eighty-two people are employed in the office and \$1,000,000 annually is paid out in salaries. This carries quite an impact in a town with a total population of less than 1500. Rosenbluth Travel benefits because operating costs at the Linton Office are 20% lower than the cost of its other offices. The company is so pleased with its Linton experience that it is building a \$1 million corporate retreat and farm just out of town. <sup>21</sup>

In Peru, Nebraska, a small town of 1000 people, the Peru Center for Telecommunications Marketing, Inc., was founded in 1986. A joint venture between the small teaching college Peru State University and Texas-based telemarketing firm

Telecommunications Marketing, Inc., the center employs over 100 people and adds more than \$1 million annually in salaries to the town's economy. In order to get TMI to locate in the town, Peru State convinced Lincoln Telephone and Telegraph, the area's local phone company, to install new switching equipment and 20 miles of fiber optic cable at a cost of \$130,000. <sup>22</sup>

Installation of a new digital switch convinced TRW-Koyo Steering Systems to locate a manufacturing plant in Tellico plains, an East Tennessee rural community. As a result of investing in a \$500,000 switch, the local phone company contributed to the eventual employment of approximately 600 people — more than 10% of its entire subscriber base. <sup>23</sup>

In the Watts area of Los Angeles, the JobLink program serves as an example of how telecommunications can be used to provide job opportunities to disadvantaged regions and populations. Operated by a consortium of non-profit community agencies and Pacific Bell, the program is a project that provides computer training and jobs to people in the community. Instead of having to travel to employer locations, participants carry out data entry and word processing work in neighborhood employment centers and send finished work to clients over the public network. <sup>24</sup>

The advanced telecommunications infrastructure in Heathrow, Florida,

contributed to the decision of the American Automobile Association to relocate its headquarters from Fairfax, Virginia to Heathrow. <sup>25</sup>

### **Use of Telecommunications by Cities, Counties and States**

Realizing the importance of telecommunications infrastructure in a region's ability to flourish both socially and economically, a number of cities and states are taking aggressive measures to improve such infrastructure and turn it into an asset for the area's future.

#### **Charlotte, N.C.**

Here are a few examples of how Charlotte, N.C. is aggressively integrating communications and making use of new technologies:

- 1) *The implementation of a 900 Megahertz radio area network (RAN). The network uses radio waves to send and receive data to and from outlying city departments. It is replacing the many leased phone lines, at a current total savings of \$3,000+ per month.*
- 2) *The fiber optic cable loop that will connect the Government Plaza buildings will be able to carry voice, data, and video transmissions and will connect the Charlotte-Mecklenburg Government Center, Old City Hall, Fire Station #1, the Law Enforcement Center and the County Court Building.*
- 3) *The Institutional Network (INET) provided to the City by ATC CableVision through the franchise agreement will connect the government plaza buildings with the Main Library, Hall Marshall Center, ATC CableVision and the*

*Fire/Police Training Academy. It will replace leased phone lines, allow for transmission of training information to and from remote locations, and carry data transmissions. <sup>26</sup>*

The city funded a study by Ernst and Young, which sought to determine the problems, redundancies, duplication of efforts, confusions, and highest priorities in its telecommunications operations. Following the recommendations of the study, the city created a new Internal Consulting Division whose mission is to keep the city abreast of new technologies, so that they can be deployed internally. This division also concerns itself with "down-sizing" the system, making it more efficient from a personnel standpoint. Everything is examined (computer setups, data links, etc.). At its recommendation, a task force was set up, containing representatives of the user departments (such as fire, police, and emergency services) and a survey of other cities was undertaken, to see how these cities handled problems encountered as telecommunications users. The task force report concluded that communications should be consolidated in the city to better manage and facilitate communications. Responsibility for cable television, radio, and telephone was taken out of the General Services Department and combined with responsibility for Management Information Services. The plan was implemented in October 1991.

This communications and information services department is responsible for planning, acquisition and maintenance. There are five divisions: 1) Systems Support Services; 2) Operation and Maintenance (new buildings and work stations); 3) Radio Systems and Telephone Systems; 4) Technical Support Services Division; and 5) Project Teams. The project teams are made up of representatives of 26 departments. They are organized into Special Project Teams for such things as a new law enforcement center, fire, emergency services, and planning. There is also a committee for Technical Evaluation and Planning, made up of Division heads. There is a CIS Department, and a Steering Committee composed of department heads and the City Manager's Office. This steering committee reviews policies.

Active input is also received from a user task force representing the private sector. Membership changes every year.

A City Council Oversight Committee oversees the City's Access Channels. Formation of a Public Access Committee is currently being considered. The access channels are supplied by the two cable operators serving the City. There are also two channels for the County.

The City of Charlotte has its own video production facilities and a satellite link with downlink and uplink capabilities. New satellite dishes will soon be provided by Vision Cable

as part of its franchising agreement. Charlotte currently receives federal programming on management and training from Raleigh, which has a public television office. This programming is then carried on the City's cable access channels. In addition, microwave is utilized to send the programs to the police, the fire training academy and the smaller counties. There are 15 microwave sites, operating at 800 megahertz. These microwave links are also used for data transmission. Charlotte is considering building a teleport for its new convention center. It would also position the city to offer video and teleconferencing services to industry.<sup>27</sup>

### **St. Petersburg, FL**

St. Petersburg, Florida, is using fiber to connect the major components of city government operations. Its fiber network connects City Hall, the police, the fire administration center, emergency services, and three office buildings. A multipurpose network, it provides a data and video link 24 hours a day. All these network services were implemented at no increase in cost, because of fiber's high speed and capacity. The city has saved thousands on net expenses, packing increasing amounts of information on the system. The investment in fiber was \$400,000 in the ground (the fiber was all located downtown) and the interface equipment cost approximately \$250,000-\$300,000. Figured over seven and a half years, the investment was inexpensive compared to leasing a similar

communications system, according to Gene Webb, Assistant Director of Information and Communications Services for the city of St. Petersburg. He reports that fiber has proven to be very reliable, exhibiting high flexibility, affording tremendous system security and rejecting electrical interference, even from Florida's severe electrical storms.<sup>28</sup>

### **Oakland, CA**

On December 4, 1990 Oakland City Council passed Resolution 67651 which set forth 5 policy goals for the planning, implementation, and use of information in the City of Oakland, California.

*Goal 1: to build a state of the art communications network that supports the city's business functions, provides appropriate community access, and contributes to the community's economic development goals.*

*Goal 2: the City shall define corporate information (data) and integrate that information on the network for all to share. In doing so, City staff shall define and establish data administration standards for the storage, access, security, and retention of electronic information. One of the guiding principles will be that data will be stored once, in only one place, and shared as necessary with all authorized users. Further, City staff shall explore and evaluate opportunities to serve as a "value added" re-seller of information to the private sector.*

*Goal 3: The city shall establish standards and guidelines that will insure future*

*hardware and software interoperability and ease of use.*

*Goal 4: A partnership shall be defined and developed between City departments, the Office of Corporate Information Services, and the private sector to provide support for the City's information resource environment and to exploit those resources to the greatest extent possible in providing business functions*

*Goal 5: Recommendations in the Strategic Business Systems Plan for acquisition of information technology and resources must be based upon the overall cost/benefit and the proposed project's contribution to City Council's goals.*  
29

In response to these goals, the Oakland On-line concept and implementation was developed. It is comprised of CityNet, the city's internal network; Info/Fax, which uses phones, computers, and fax technology to provide citizens and businesses with improved access to City information and standard forms; Info/Access - the first publicly sponsored community computer bulletin board in the East Bay. It provides information about City programs, services, and public meetings via a dial-up computer system. The system is interfaced to CityNet for easy transfer of information.<sup>30</sup>

### **Montgomery County**

Located outside Washington D.C., Montgomery County, has a government network serving 34 sites in the county (coaxial

and microwave) and a local coaxial network in the County seat of Rockville. The primary users are county agencies, although the school district was added recently. The two networks were built by the cable company as part of the original cable franchise. The county invested in both networks to cut its use of leased lines and T-1 circuits (a basic high capacity phone line - 1.544 gigabits). It uses both networks for data and voice and uses some capacity for video (court arraignment and bulletin boards). The school district uses the network for video only. The two networks are managed by the Department of Information Systems and Telecommunications.<sup>31</sup>

### **Metro Dade County, FL**

In Metro Dade County, Fl., the Dade County fiber network was initiated by the County Administrator. The County initiated a pilot program providing public access to government information for a fee using the fiber and microwave system deployed to carry its 911 system, (The county had to go to the legislature to obtain permission to re-sell value added public information). The County had already installed an extensive conduit system for its traffic lights. In exchange for the rights of way to the County's conduits (and \$200,000 a year) Intermedia (a local cable operator) built out the County's fiber system. In 1987 the Office of Computer Services and Information Systems developed a 5-year strategic plan for information technology and

telecommunications with input from many county departments.<sup>32</sup>

### **Seattle, WA**

The City of Seattle has its own fiber optic network, having installed a fiber cable backbone loop between its downtown offices, and maintains its own telephone system. It is anticipated that this system will meet the voice and data communications needs of the city for the next 40 years. Also a part of the city's telecommunications system are three microwave links to suburban and outlying offices. These tie together the voice side of the telecommunicaitons system: six radio systems (for public works, etc.) and a telephone network of 17 switches tied to the local switched network. The creation of this system resulted from the city's belief that it had to become more competitive, reduce costs, and consider the economics of advanced telecommunications. The city believed that the system could be a tool for enabling its departments to better accomplish their tasks. The Administrative Services Department implements and administers the system, but does not push the various departments to hook up to it, waiting, instead, for the department to recognize a need that can be met. The Seattle Police Department maintains its own network for reasons of confidentiality.<sup>33</sup>

### **Connecticut**

The state of Connecticut, in order to meet the specific needs of government agencies to

communicate with each other, to administer programs more efficiently, to increase productivity, and to reduce costs, has opted for a state-of-the-art telecommunications network (StateNet) for its own use. StateNet will use 336 miles of fiber optic cable and seven digital cross connect systems to support voice, image, and high-speed data applications. The University of Connecticut will be integrated into the network. Eventually, the network will be expanded to include all state agencies and access by municipal governments.<sup>34</sup>

### **Kentucky**

Kentucky moved in 1990 to investigate telecommunications as a tool to promote economic development by holding a conference that was attended by over 250 business, industry and government representatives. Louisville is home to a telecommunications research center (a partnership of South Central Bell, the University of Louisville, and the state of Kentucky). An element of recent education reform legislation was funding for telephone lines into all classrooms — a move to position education to exploit new communication technologies.<sup>35</sup>

### **Michigan**

In Michigan, a state taskforce identified superior telecommunications technology as the key to the future economic success of the state. Michigan commissioned a study to identify the state's telecommunications resources and services. Key recommendations dealt with

deployment of fiber optic and other digitally switched broadband technologies throughout the state.<sup>36</sup>

### **Minnesota**

Minnesota carried out a study to establish goals for telecommunications and concluded that the state should actively promote a statewide broadband telecommunications system. The state hopes to provide fiber optic technology in all homes in the next 15 years and is seeking to position itself as a supplier of equipment, programming and services to other states and countries.<sup>37</sup>

### **Nebraska**

Nebraska, capitalizing on extensive deregulation in the late 1980's, has positioned itself as a center for telemarketing. Omaha alone is home to over 300 telemarketing companies.<sup>38</sup>

### **New York**

New York is benefiting from the synergies of public/private partnerships. An example of this type of joint effort is Metro-Tech, a \$500 million, 16-acre urban research and office park being developed at Brooklyn Polytechnic University's campus in conjunction with the state of New York. Incorporating the current facilities of Polytechnic with a new CATT building and a state of the art technological and science library, it is projected that Metro-Tech will create 14,500 new jobs, while retaining more than 500 existing jobs. New York

Telephone and the Teleport, the largest satellite facility in New York, support Metro-Tech's high-speed communications needs with fiber optic networks. Immediate, direct access to optical fiber led the Securities Industry Automation Corporation to locate in the park. Its presence led Morgan-Stanley and Goldman Sachs to move to downtown Brooklyn just blocks from the site.<sup>39</sup>

### **Ohio**

Ohio is home to S.O.N.I.C. (State of Ohio Network for Integrated Communication), one of the most advanced private networks in the U.S. The network is comprised primarily of microwave transmission but includes fiber optics and analog and digital switching. Its use is restricted to state and university personnel.<sup>40</sup>

### **Tennessee**

Tennessee recently completed a major study of its telecommunications technology and has formulated a 10-year master plan of development. Under this plan, the network will be upgraded in a fiscally constrained way. Older switches will be replaced and intelligent features added, county by county. The plan was implemented in 1991 and is on track. The plan recommended an infrastructure calendar of three phases:

- 1. Fully deploy intelligent network capability (CCS#7) in the five urban counties by 1991, and in the rest of the State by 1993.*
- 2. Begin deployment of ISDN in 1991 in the urban areas, moving to full deployment by*

*1998. In the suburban counties, deployment should start in 1993 with rapid initial buildup and full development by the year 2000. Similarly, deployment should start in rural counties in 1994 with a rapid initial buildup, leading to full deployment in the year 2000.*

- 3. Offer broadband capability in the urban counties starting in 1995, in the suburban counties starting in 1997, and in the rural counties starting in 1999. In all cases, broadband is planned to grow slowly at first, reaching 10% penetration in the urban areas, 5% in the suburbs and 2% in the rural areas by the year 2000.<sup>41</sup>*

The planners estimate that total cost for the modernization over the ten-year period will be just under \$400M. The cost increases "represent an approximate 11.5% increase in capital expenses and 4.74% increase in revenue requirements over the life of the Plan."

In the consultant's opinion, "if implemented, this Plan will put Tennessee at the forefront among the States in the United States in terms of telecommunications infrastructure deployment."

### **New Jersey**

Industry eyes are focused on New Jersey, where a potentially significant scenario seems to be working its way to a conclusion. In January, 1992, the state legislature passed the Telecommunications Act of 1992, signed by the Governor the same month, authorizing the New Jersey Board of Public Utilities to adopt a flexible policy of rate regulation, with the aim of encouraging investment in a state-wide

broadband network. The stimulant was a major study for the Board financed by the three telephone companies that serve the state, which exhaustively reports the economic and social benefits of such a state-wide network, and strongly recommends that regulatory policy be directed toward providing incentives for its development. Under the legislation the telecommunications supplier files a plan with the Board explaining how it wishes to be regulated, presenting its view of the balance between incentives and protection of the public. The Board is required to respond by a given date. If the Board accepts the plan, it serves as the basis of future regulation.

Along with its proposed rate plan, New Jersey Bell, which serves approximately 95% of the state, submitted its planned scenario of development.<sup>42</sup> The goal: to modernize the network quickly with advanced switching and transmission technologies, and to complete a publicly switched broadband fiber-to-the-curb network by the year 2010. Cost of the future technologies is estimated as above \$1 billion from 1992 through 1999.

*Advanced Intelligent Network: Digital switching and signaling systems deployed to provide call routing and database access service. Enables "follow me" type services, for example, that allow customers to program the public switched network to forward their calls automatically to different locations depending on the time of day. Initial availability in 1992--target is 100% deployment in 1998.*

*NarrowBand Digital Services: Switching technologies matched with transmission capabilities to support data rates up to 144,000 bits per second ("144 kilobits"). Enables services...that will meet requirements of customers who use any combination of work stations, personal computers, FAX machines and telephone. Initial availability in 1992--target is 100% deployment in 1998.*

*WideBand Digital Services: Switching technologies matched with transmission capabilities to support data rates up to 1,500,000 bits per second ("1.5 megabits"). Enables services, for example, that will allow students to remotely access multimedia information, including video, from home or school. Initial availability in 1994--approximately 95% deployment in 2000.*

*Broadband Digital Services: Switching technologies matched with transmission capabilities to support data rates up to 45,000,000 bits per second and higher ("45 megabits"). Enables services, for example, that will allow residential and business customers to receive high definition video and to send and receive interactive (i.e., two way) video signals. Initial availability of switched broadband digital services in 1996--approximately 35% deployment in 2000--complete deployment expected in 2010.<sup>43</sup>*

A Board response to New Jersey Bell's rate regulation plan is scheduled for November 25, 1992, While legislative and executive branch approval suggest a positive outcome, it should be noted that cable and newspaper industries are opposed to the project.

The analysts reviewing the 10-year business plans of New Jersey's three telephone companies note:

*The required percentage increases in overall revenues annually under the moderate and aggressive scenarios never exceed 7.5% per year, even in the peak years of infrastructure investment over the ten-year period under review. This represents the overall percentage increases required to accelerate the rate of technology deployment. In fact, except for the peak year, the percentage increase in revenues per year is considerably below this level and more in the range of approximately 5% or less...*

*Thus, the acceleration of telecommunications infrastructure deployment could be achieved with nominal annual revenue increases. The annual increases in required revenues under the moderate and aggressive scenarios approximate the anticipated inflation rate (i.e., 4% to 6%) during the ten-year period.<sup>44</sup>*

## **THE PROMISE OF ADVANCED TELECOMMUNICATIONS**

Telecommunication technology can play an integral role in many arenas outside of business. It can enhance social welfare by improving the delivery of critical services, such as education, health care, and emergency services, and cut down on congestion and pollution by facilitating home or neighborhood based workplaces via telecommuting.

### **Government Operation and Services**

Today's city and state governments are routine consumers of telecommunications. Most cities and states own, rent, or purchase a variety of telecommunications equipment and services: PBX or Centrex, inside wiring, telephone instruments, fax machines, data networks, traffic signal wiring, government cable channels, cable production equipment, public

safety dispatch, voice mail boxes, paging devices, and cellular telephones. Areas in which telecommunications can play a significant role include:

- \* increasing administrative efficiency*
- \* helping to balance budgets*
- \* improving democratic governance*
- \* ensuring delivery of municipal services, especially to low and moderate income constituencies*
- \* reducing air pollution, traffic congestion and energy consumption*
- \* encouraging economic development within environmental constraints.<sup>45</sup>*

Crime and law enforcement are consistently listed as major concerns of individuals in polls taken in this election year. Telecommunication technology can significantly enhance the ability of law enforcement and public safety entities to provide timely and effective service. The city of Los Angeles is a good example of a comprehensive approach to integrating telecommunications into the provision of public safety services. In the November 1988 election, voters in Los Angeles approved a \$67 million bond for a fire department systems upgrading, including a citywide microwave system designed to serve as the backbone of a disaster response system, to improve computer-assisted dispatch, and to allow the fire department to simulcast information. LA's Emergency Command and Control Communications System is comprised of an

emergency radio system that allows communications with almost any area in the region, by tying together 35 different radio sites throughout the LA area; a Mobil Digital Terminal located in the police squad car which provides access to central police databases, allows car-to-car communication, and enables officers to request help with buttons that provide the car's identification and location; a computer-aided dispatching system that provides field officers with updated information on address verification and incident histories in an area; and ROVER, the Remote Out-of-Vehicle Emergency Radio, which allows officers to communicate with the dispatch center and obtain information while away from the car, communicate with others officers, or digitally call for help when voice communication wouldn't be prudent.<sup>46</sup>

Los Angeles is not the only city to integrate advanced telecommunications technology into its public safety services. Tracking criminals is made easier in Seattle, Washington, because the police department maintains its own network, controlling access to computerized files and maintaining connections with other police databases and InterPol. The department is also in the process of installing a computer-aided dispatch system in its cars and Seattle's fire department is following suit.<sup>47</sup>

Continuing education is an important part of any professional career. It may not be CBS or NBC, but in Beaverton, Oregon, the fire and

rescue department uses the city's institutional network (I-NET) - a private video network - to deliver programs produced at the department's own studio, that can help save peoples' lives. These programs include EMT recertification, in-service programming for paramedics and special programs on various subjects such as hazardous waste clean-up. They are shown for all three shifts and use the city's own fire and rescue personnel whenever possible. Thirty different stations receive programs originated at the studio. Its full time staff of five (which includes three paid student interns) is looking into interactive training for use in the near future.<sup>48</sup>

Every year people die senselessly, caught in raging floodwaters that descend seemingly without warning on unsuspecting innocents. In Kentucky, telecommunications technology provides advanced warnings of these and other disasters. The state's microwave radio system is linked to about 100 funnel-topped rain gauges throughout the eastern part of the state. As soon as one centimeter of rain water collects in a funnel, a signal containing its location and water quantity is transmitted to one of the state's microwave receivers, which relays those data to the central computer in Frankfort. These same microwave facilities are used to warn people in the affected areas to evacuate their homes. The state also has a microwave-based earthquake-warning system. Seismic instruments implanted throughout the state are connected by microwave radio to the

University of Kentucky's Department of Geology. The data received is monitored around the clock by university technicians.<sup>49</sup>

Not all use of telecommunications technology is so dramatic. It can also be incorporated in more mundane, but fiscally important, ways to help maximize resources, reduce cost, and improve efficiency. Utah's Department of Transportation uses the state telecommunications network to keep track of supply inventories at various offices around the state as well as to transmit central designs for roadway repairs. North Carolina implemented its own long-distance credit card service, allowing the state to save on administrative and billing expenses that normally would be incurred by using commercial carriers' cards. And in Wyoming, the long arm of the tax man moves a little more quickly now that the state's 23 tax officials use the state network to transmit their assessments to the central computer in Cheyenne. This means that licensing and property tax assessments can be entered more quickly and more accurately and therefore improve the revenue cash flow.<sup>50</sup>

Sometimes, simple solutions can put a more human face on services provided by the state, allowing improved responsiveness to the needs of the constituency served, and at the same time lead to substantial financial savings. In Georgia, in order to foster closer ties between its social services employees and their clients, the state provided Department of Family-

Children Service workers with pagers that can display both letters and numbers. The state-owned and operated paging system provides Georgia-wide coverage for social workers out in the field. They can receive the names and telephone numbers of clients who called them. According to George Christenberry Jr., director of the Georgia Telecommunications Division, the paging system also saves the state money. They have a number of social workers on call during weekends and their time off, and if they cannot be provided with some way to be reached, without restricting their movements, they are paid overtime. With the pagers, they only have to be paid for the time they are called out.<sup>51</sup>

### **Expanding Educational Horizons**

Telecommunications can be a powerful tool for delivering educational services to people in all walks of life. It can allow educators to reach out to non-traditional learners, using telecommunications to shorten the distance between individuals or communities in remote areas, to bridge the gap between those who have access to teachers and information and those whose access is limited. Technologies can link students in remote areas to the location where the educational resources are located.

Many studies indicate that education using various forms of telecommunications technology is as effective as classroom teaching. Elderly people, the disabled, working parents, all of whom might be unable

to attend classes in the traditional educational environment (classes conducted during the day at a centrally located campus) can avail themselves of the benefits of learning in the new electronic classroom. It can also allow educators to better utilize their resources. In these times of economic uncertainty and budget constraints, telecommunications technology can be integrated into the traditional educational setting so that students at multiple sites can benefit from the same, shared educational experience.

Two examples of this are the Satellite Telecommunications Education Programing (STEP) Network and the Panhandle Shar-ED Video Network Cooperative. STEP was created to deliver high school credit courses to 13 schools where the district couldn't provide qualified teaching personnel. It has grown to the point where students in more than 100 high schools in 12 states, receive the courses via satellite and are connected with a teacher by an 800 number.<sup>52</sup> In Beaver County, Oklahoma, the Panhandle Shar-Ed Video Network Cooperative installed 52 miles of fiber optic cable to connect the county's four public high schools. The network transmits 2-way, full-motion video between and among the four schools. This allows students in any one classroom to communicate with classmates in every other location, and enables the schools to pool their limited faculty resources and offer courses that none could offer on a stand-alone basis.<sup>53</sup>

Another type of shared-resources program is the Jason Project, which uses satellite technology to make it possible for students to explore the mysteries of the deep and to expose them to the process of scientific discovery. Invented by a scientist at Woods Hole Oceanographic institute in Massachusetts, Jason is a remotely operated robot vehicle that travels along the ocean floor sending data via fiber optic cable to scientists on a ship on the surface. The pictures are then sent, along with the scientists' commentary, via satellite to students in 12 museum sites in the U.S. and Canada.<sup>54</sup>

Telecommunications technology can be particularly useful, indeed play a critical role, in helping to meet the needs of traditionally underserved and difficult to reach populations. As illustrated above, it can allow the pooling of resources and the consolidation of targeted populations, to make outreach feasible.

Migrant students and students in economically disadvantaged areas will be the beneficiaries of a grant received by The Educational School District, located in Spokane, Washington. ESD has been awarded \$5 million for a satellite-based project geared toward these students. The organization will use the Satellite Telecommunications Education Program to provide mathematics, science, and career awareness programming. Five states will

participate and 40 sites will be provided with satellite downlinks.<sup>55</sup>

African-American students will be the beneficiaries of efforts by the Black College Satellite Network (BCSN), located in Washington, D.C. BCSN will provide math, science, and foreign language to 65 urban high schools across 12 states, the District of Columbia, and the Virgin Islands.<sup>56</sup>

The Los Angeles County Office of Education is leading a national team which has been awarded \$3.45 million to deliver bilingual math, science, and other program to "at-risk" students in primarily urban districts, including Boston, Detroit, Los Angeles, and Washington, D.C. The program is called TEAMS (Telecommunications Education for the Advances in Mathematics and Science) and will equip two sites in each district with widescreen TVs, computers, and other hardware. In addition, satellite downlinks will be provided to as many Chapter 1 schools (schools where at least 10 students live below the poverty line) systems as possible.<sup>57</sup>

The Los Angeles Office of Education also owns and operates the Educational Telecommunications Network (ETN). ETN is designed to provide staff for development for teachers via satellite. Programming is provided at no charge to 62 LA County school districts, and at an annual fee of \$2,000 plus \$0.15 per student to 25 other subscribing counties.

Curriculum reform as well as social issues (e.g. AIDS, suicide prevention, child abuse) have been the focus of programming.<sup>58</sup>

Extensive use of telecommunications is being made in institutions of higher education throughout the country. Perhaps the most well known example of this is the "Internet". The Internet is a collection of computer networks, each serving the individual needs of a particular government agency, university research institution, or industry laboratory. The Internet evolved in the late 1980s through the gradual interconnection of various existing networks which occurred out of a need to share information in an environment unhindered by artificial institutional boundaries. Internet has tremendous potential for all aspects of the pursuit of knowledge: computing, information retrieval from databases, and information sharing via communication.

Professor Jones studies a particularly exotic species of cricket. There are subspecies found around the world and his passion in life is to track down new examples. Professor Smith is trying to unlock the mystery of a particular process that occurs in heart muscle.

Via the Internet, Professor Jones can speak with colleagues in New Zealand and track down clues on a new type of cricket. He could do this by mail, but that is tremendously time-consuming and a great disincentive to pursue this particular line of questioning. He could

communicate by telephone, but the time difference and the cost make that impractical. Via the Internet he is not bound by geography or time, and when his research gets to the appropriate point, he can then travel to New Zealand to do his collecting, by now very familiar with conditions there, or he can supervise the collection over thousands of miles via the computer network.

Professor Smith is one a few individuals working on this particular question of heart-muscle physiology. The colleague that he would most like to work with and who is pursuing a similar line of research lives and works in Italy. The Internet forms an open line of communication that allows them to work together. Experiments can be jointly planned and then executed in one laboratory or another. Data can be shared on almost a real-time basis. Physical, face-to-face interaction may be limited to one or two visits a year. And out of the synergy of the interaction of these two minds, important questions could be answered.<sup>59</sup>

Not only professors or industry researchers benefit from computer networking. Campus-based computer networks allow students to have greater access to off-campus resources, enable them to communicate better with each other and with their instructors, and to utilize on-campus services more effectively.

Northwest Missouri State University has successfully boosted enrollment by offering the first "electronic campus" in the U.S. By placing a computer in every dorm room and faculty office, the school offers numerous capabilities, including word-processing, status of library books, schedule of activities, E-mail, and facilities for turning in papers electronically.<sup>60</sup>

Northern Kentucky University telecomputing allows students to communicate with instructors as well as turn in assignments using the TriState Online service from Cincinnati Bell Telephone. The courses are presented over cable TV, using a combination of TV and telecommunications to bring the classroom into the home. Students need only a "dumb terminal" and a modem from which to dial into the TriState Online free public service gateway. This allows students to ask questions during or after the program via E-mail. Instructors can post tests and grades using a computerized bulletin board.<sup>61</sup>

"PennNet" at the University of Pennsylvania is one of the largest campus-based data communications networks in the country, allowing electronic information exchange by faculty, students and administrators between locations of the University's West Philadelphia campus. Over 100 miles of fiber optic cable connects computing devices in nearly all of the 116 university buildings. AT&T's Information Systems Network LAN, using high-speed

packet-switching technology, serves as the basis for the system which allows users to transmit voice, data, video, and images, and allows access to PennLIN (an on-line library card catalog), local area networking, and Ethernet communications.<sup>62</sup>

Not all applications are computer-based. Traditionally, integration of telecommunications into the higher education process has been first audio, and then video-based. TI-IN United Star Network (based in San Antonio) involves 10 states and 328 schools and more than 3,200 students. TI-IN USN is a one-way video, two-way audio satellite-based system. The TI-IN USN Consortium includes three state education agencies, four universities, a regional state education agency, and private, for profit TI-IN network. TI-IN reaches about 6,000 students in 1,000 schools in over 30 states.<sup>63</sup>

The Midlands Consortium, comprised of 278 schools over five states and serving approximately 2,500 students, is comprised of Oklahoma State University, University of Kansas, Kansas State University, University of Missouri, Missouri School Board Association, and University of Alabama at Birmingham and is built upon the Oklahoma State University Arts and Sciences Telecommunications Service (ASTS). Subjects offered through the consortium include English, Spanish, Russian, German, Civics, Calculus, Genetics, Chemistry, Physics,

Economics, and Trigonometry. Staff development programming is also offered to instructors in areas such as distance learning, designing learning environments, and the role of parents in the educational process.<sup>64</sup>

The state of Oregon is pursuing an integrated approach, administered by the Oregon State System of Higher Education, and utilizing Ed-Net, which is made up of three statewide networks: one consisting of two channels of full-motion conventional video, one-way outbound with two-way audio, which will eventually serve 700 receive sites; a second consisting of 30 channels of compressed video, designed for fully interactive video and audio, which will eventually have 39 send/receive sites; and a third data network that will provide resources for library access, student support services, and course delivery. OSSHE, which consists of the state universities and colleges located in the state, is attempting to "make higher education available to all its citizens, in spite of [the] geographic and demographic problems and the difficulties facing virtually all areas of the American economy today." It is extending three existing programs, a B.S. in Agricultural Business Management (a joint program of Oregon State University and Eastern Oregon State College), a B.A./B.S. in Liberal Studies (Oregon State University), and a B.S. in Nursing (a joint program between Oregon Health Sciences University and Eastern Oregon State College) from their universities of

origin to other students at remote locations throughout the state.<sup>65</sup>

In the face of these examples of telecommunications integration into the educational process, some may wonder why any additional effort should be undertaken to further expand such services. It is important to note that the level of integration is miniscule and that these undertakings are largely trials, patchwork solutions to problems that pervade the educational system: e.g. scarce resources, and numerous sub-populations with significant, individualized needs. Under current conditions, students in some areas benefit from integration of telecommunications into their educational experience, gaining access to resources they would never otherwise enjoy and becoming computer literate and able to function in an increasingly telecommunications-based environment. Many more suffer from needs which might have been addressed through pooling of resources made possible via telecommunications or by access to resources not available within the geographic area of the school or university attended.

### **Health**

Telecommunications use is largely undeveloped in the area of health care. Spiraling health care costs and increasing demands on the health care system are leading to a serious investigation of how telecommunications can be used to reduce administrative costs and improve the quality and cost-effectiveness of health care.

In July 1990, Bell of Pennsylvania announced plans to conduct the first U.S. trial of a metropolitan area network (MAN) based on the IEEE 802.6 draft standard with Temple University. The trial sought to link local area networks and a data center at Temple with LANs at its health and science campus. The MAN was intended to support molecular modeling and medical imaging, both of which require large data transfers, and would reduce the time needed to transfer a medical image from over 30 minutes to only 3 minutes, making the transfer of images (now done largely without electronic transfer) a more rapid and efficient process.<sup>66</sup>

Health care is made easier and more effective for both providers and patients in rural or medically underserved areas because of KARENET (Kellogg Affiliated Remote Environments Network). Funded by the W.K. Kellogg Foundation and AT&T and developed by Texas Tech University Health Sciences Center, KARENET centers on a computer software system designed to provide health care information. KARENET provides several software products over conventional phone links: automated health care records, continuing education programs, patient care management protocols, patient education programs, on-line computer interaction to facilitate conferencing, and patient education programs.<sup>67</sup>

Health care for the homeless was made more effective by the introduction of personal computers in a community health project in Georgia. The Atlanta Community Health Project for the Homeless was organized in 1984 and currently has 20 clinics serving the health care needs of the disadvantaged. Personal computers were installed at 20 clinics and applications were installed that include basic demographic information, diagnoses, treatment location, and the results of the visit for each patient. The information is input at the clinic site and uploaded to a central computer associated with St. Joseph Hospital. Prior medical records can also be downloaded to the PCs at the clinics from the central computer. This allows clinics to streamline the processing of patients by getting rid of data gathering requirements for each visit, and provides a case history file for the doctor to review.<sup>68</sup>

Four Boston hospitals are currently testing various data transfer applications over high-speed fiber optic transmission lines. These projects (called Media Broadband Service) are being developed in conjunction with New England Telephone and NYNEX. Principal applications include telecardiology, which allows referring physicians from suburban hospitals to view moving images of a patient's heart catheterization simultaneously with cardiologists from the New England Medical Center — after consultation, the specialists from both locations will jointly decide on appropriate treatment for the patient;

Teleradiology, which allows Massachusetts General Hospital to transmit patient data and medical images between Boston, Charlestown, and Somerville, the site of its film library; and Electronic Medical Records, multimedia patient records consisting of data, text, and voice which will be created by the Children's Hospital in Boston — the reports can be packaged and sent to referring and consulting physicians and imaging specialists using electronic mail.<sup>69</sup>

Outpatient care is also being affected by the introduction of telecommunications technology. A home health care trial is underway at Boston University which utilizes a system designed to increase compliance of geriatric hypertension patients to their medication/treatment regimens through weekly calls to a voice synthesizing computer. The computer is programmed with each patient's specific treatment requirements and requests a series of responses from the patient using a touch tone phone. This results in the generation of a report for examination by the physician which highlights any irregularities in the patient's treatment.<sup>70</sup>

### **Telecommuting**

Telecommuting, the use of telecommunications services to enable people to work at home, is already making a difference in many lives, and as the results of studies of its effectiveness are analyzed, it becomes clear that telecommuting is a valuable tool in addressing many problems

currently facing, employees, employers, and society at large.

The value of telecommuting is quantified by a study conducted by Arthur D. Little,<sup>71</sup> which found that a reasonable level (10-20%) of telecommunications substitution would allow:

- \* *6 million automobile commuters to work at home*
- \* *replace approximately 3 billion shopping trips annually (via electronic shopping)*
- \* *eliminate almost 13 million business trips annually through teleconferencing*
- \* *eliminate over 600 million truck and airplane delivery miles annually through electronic transfer of paper documents.*

It was determined that, conservatively, this level of telecommuting would provide \$23 billion in annual benefits (in 1988 dollars).

Cost reductions would result from:

- \* *elimination of pollutants produced by vehicles*
- \* *savings on gasoline used (about 3.5 billion gallons less)*
- \* *freeing of time from reduced highway congestion and elimination of commuting, shopping, and business trips (about 3.1 billion hours)*
- \* *reduction of maintenance costs for the existing transportation infrastructure (an impressive \$500,000,000).*

Some of the benefits of telecommuting realized by employees, include reduction in daily commuting time (which averages about one

hour per day), and savings on money spent on work-related transportation, food and clothing. Telecommuting can help parents balance work with child or elderly care and can create opportunities for persons with disabilities, the elderly, and residents of rural areas.

Employers benefit because, by permitting employees to work at home, a firm can retain skilled, highly valued workers who want to change their work schedules to accommodate changes in life situations. It can enable companies to reach highly qualified workers (a parent with small children or individuals with disabilities), who otherwise would not be available because they will not or cannot readily commute to work. This becomes important because today's work force will grow only slowly over the next few years.

It can help firms reduce operating costs.

Companies can reduce overhead expenditures for office space, furniture, and electricity.

Businesses can employ home-based workers to handle work during peak periods of activity and avoid the expense of a larger permanent staff.

### **State Telecommuting Trials**

The California Department of General Services recently completed a 2-year trial telecommuting project. One hundred fifty employees from several state agencies participated. Some agencies required their workers to buy personal computers; others supplied that equipment if

the employee agreed to work at home three or more days per week. When the results of the trial came in, telecommuting had proven beneficial in several respects. The agency found that implementation of an effective telecommuting program did not require major capital investments, the productivity of the home-based employees exceeded that of a non-telecommuting control group, telecommuting improved the quality of employees' lives, lowered costs for office and parking spaces, and showed significant potential for reducing traffic congestion, air pollution, and energy usage.<sup>72</sup>

In Arizona, AT&T and the State of Arizona conducted a six-month telecommuting experiment with 134 employees and four state agencies. Participants telecommuted about one day a week. These employees drove about 97,000 fewer miles, avoiding 1.9 tons of air pollutants, and saving about \$10,000 in traveling expenses, as well as 3,705 hours of driving time. The Arizona Energy Office estimates that telecommuting by only 1% of the employed in Maricopa County one day a week would save an equivalent of 41 years of rush hour traffic.<sup>73</sup>

Other states are investigating the promise of telecommuting, as well. The Washington State Energy Office is now conducting a Telecommuting Demonstration Project involving 23 public and private employers and some 250 commuters and the Hawaii

legislature has appropriated \$125,000 (to be matched by private funds) to establish the Hawaii Telework Center, a centralized facility from which public and private sector employees are linked via telecommunications to their offices.<sup>74</sup>

### **Business Telecommuting Trials**

Telecommuting experiments are not just restricted to the public sector. More than a decade ago, IBM saw telecommuting as a way to attract and retain qualified workers and help the company deal with anticipated future shortages of computer scientists and electrical engineers. A trial involving 300 computer programmers established that home-based workers were more productive and that IBM could manage logistics and security. The company ultimately paid telephone line, modem, and terminal equipment costs for more than 8,000 employees working at home.

Ciba-Geigy, an international chemical company with offices in the U.S., has a telecommuting program, primarily for its information systems personnel. The program allowed employees to remain with the company even after it had relocated to the District of Columbia and Florida. The program has also produced substantial dividends for Ciba-Geigy in the form of increased employee loyalty and productivity.<sup>75</sup>

It is important to note that currently only 2-3% of the population works at home, and that to

achieve the level of telecommuting examined in the Little study, a fiber-to-the-home telecommunications network is assumed to be necessary. If such a network *is* necessary, the total cost has to be considered. In addition, telecommuting may not have the desirable characteristics of the traditional office environment, such as interaction among co-workers, socialization of new workers into the company culture, and mechanisms for allocating time. None of these considerations, however, obviates the substantial promise of this evolving new work situation.

### **THE ROAD TO BROADBAND CAPABILITY**

"Fiber Optics" is currently one of the "hot" phrases bandied about when talking about telecommunications technologies. This is largely because universal broadband capability will be achieved only with the deployment of fiber optic cable. Fiber optic technology has changed the face of communications systems, enabling tremendous amounts of information to be transmitted at high speed. What is truly remarkable is that all this information can be transmitted over a fiber the thickness of a human hair. Instead of using electricity traveling through copper wire (the way it's done with conventional telephone wires), fiber optics uses light pulses traveling through the glass fibers. These pulses are generated by a laser flashing on and off at high speeds and are converted to electrical signals at the receiving end. A typical fiber optics communications system consists of an optical transmitter (light

source), optical fiber, and an optical receiver (detector).

The capability of any communication system depends upon two key variables: transmission rates and distances that signals can travel before they need amplification. Fiber optic capability is doubling every year as a result of increasing data rates and decreasing fiber losses. This pace of improvement can be expected to continue for the next twenty years before the known physical limits are reached. In practical terms that means a thousandfold improvement in capability of the most advanced lightwave systems. The difference in transmission capability between fiber optic cable and conventional technologies is truly amazing. Three inch-thick conventional cable can carry 10,800 conversations on 1,800 copper wires. A half-inch thick fiber-optic cable can transmit 1.35 million conversations on just 144 glass fibers.

Much is currently being said about the evolution of our communications infrastructure. An interstate highway system serves as an analogy to the current development of fiber optic delivery systems. These systems are a means of getting product (movies, information stored in databases, video, home shopping services, multiple phone services, business data, etc.) to the end user. How the information is delivered is important only in as much as it affects the flow of information to the people who want access to it. Most people

don't particularly notice the freeway that they drive on to get to work unless they are stuck on it in a morning traffic jam that happens because the current infrastructure is insufficient for the amount of traffic it is asked to bear.

Fiber optic cable, because of its tremendous signal carrying capacity and low signal loss, is clearly the medium of choice to meet the developing needs for transmission of information. The major weakness of coaxial cable, the wire-based cable currently serving as the work horse of cable TV companies, is that, over long distances, it is not very efficient in delivering electronic signals. As these signals travel along several hundred feet of coaxial cable they grow weaker by half. This makes it necessary to use to use signal amplifiers extensively throughout the system to restore signal levels — about every quarter of a mile, almost like having to stop for gas every few blocks when you drive your car. These amplifiers create electronic noise, a kind of electrical smog that impairs the quality of the transmission.

This is not to write-off coaxial cable as a valuable link in the signal transmission pathway. To the contrary, over short distances of 300 feet or less into the home, coaxial cable requires no amplifiers. This positions it to be an important component in the most immediately promising configuration of the evolving communications infrastructure. Furthermore, the cost of installing fiber *to the*

*home* today is simply too great. Its installed cost is about three times that of existing copper links to the home. For this reason, the fiber optic network will initially extend only *to the curb*, a few hundred feet or closer from the home or office.

However, the next step in the network's evolution to broadband services will be to extend fiber to the home. Extension of a fiber optic distribution system to the end user has been spurred on by the the desire to deliver video programming and high speed data services to the home and office. Traditional coaxial cable is not feasible to use as the sole delivery medium because only fiber optic cable has the bandwidth necessary to carry all the data, interactive database, telephony and video services - delivered via very high bandwidth signals - over *extended* distances without the need for signal boosters and the consequent introduction of noise.

For the short journey from the curb into the living room, coaxial cable will carry the load. The advantage of this configuration is that, by sharing the fiber and optoelectric circuits among many homes and completing the final drop from the curb with coaxial cable, the cost is dropped considerably. Widespread deployment is projected to be economical in builds within the next few years.

The telephone industry currently estimates that the economic crossover point of fiber to the

curb versus copper for POTS (plain old telephone service) will occur in 1992. The crossover of fiber to the home versus copper for POTS is expected to occur in 1994-95.<sup>76</sup> A common view among telcos has been that if service providers are not allowed to provide new services, broadband fiber to the home will remain stalled, but that if they are allowed to provide multiple broadband video services, the deployment of narrowband and broadband fiber optic technologies, "will be expedited and the process of cost reduction will be hastened."<sup>77</sup>

However, cable companies are making rapid progress in the provision of broadband services to the home and are considered by many to be in the lead in the race between the telephone and cable industries to provide such services. This is largely due to the nature of cable's deployment of physical plant.

While the telcos have installed a greater amount of fiber optic cable than the cable companies, the cable companies are increasing their base more rapidly. Fiber mileage installed by cable companies will hit 22,000 miles by the end of 1992, having doubled each year since 1988.

A cable system's signals run from the headend (the heart of the system where the customers' signal is generated), out to the subscribers' homes. The traditional structure of cable deployment for the cable company is a *tree-and-branch* configuration. A simple coaxial

trunk is laid from the headend and tributary cables run off from this trunk into neighborhoods. Trials are underway in which the *tree-and-branch* configuration is being changed into a *star* configuration, a configuration widely in use by telephone companies. In this new set up, separate fiber optic lines are installed from the headend into a neighborhood. At that point, the fiber optic cable connects into the existing coaxial pipes serving the individual homes in the area. This allows the cable operator to upgrade the system (and finance that upgrade) one section at a time. This configuration also eliminates the need for extensive use of signal amplifiers, since fiber optic cable does not need them, and frees up the network for two-way traffic that can be switched at the headend, in much the same manner as a telephone system.

Queens, New York, is the site of the most ambitious fiber trial yet undertaken.

Approximately 10,000 households are served by new fiber trunk lines in this first phase of the experiment. One hundred fifty channels are offered by Time-Warner. These include 90 conventional channels and 60 pay-per-view movie channels. The cost of this greatly expanded service is \$23.95 per month, and the cost for PPV movies ranges from \$1.95 to 4.95 each. This is only the beginning, so far as ATC is concerned. The next step will be to offer compressed digital video services, and it appears that this will be possible within the next three to five years. According to James

Chiddix, senior vice president, Engineering & Technology, American Television & Communications Corporation,

*We see a logical migration path from today's all coaxial systems with their limitations in reliability, signal quality, and channel capacity, to an entertainment delivery system capable of delivering any program to any home. We do not believe that that is the end of the story, however.... We can see that the establishment of an extensive fiber infrastructure in the community now allows us to provide fiber drops to business users and to provide them with very high speed computer communications, either between businesses within our own service area, or through long distance fiber carriers, to businesses in other areas. In addition, we believe that this kind of broadband network provides the ideal interconnection infrastructure for the PCN, or personal communications network, business. This successor to cellular telephone will make very efficient use of the radio spectrum for wireless communications. However, in order to make that possible, each cell will cover an area only a few hundred yards in radius. In order to provide cost-effective interconnection of those "microcells" a broadband network of the kind which we are building to support our entertainment business appears to be ideal.*<sup>78</sup>

To catch up with cable, telephone companies would have to make the same investment in fiber trunk lines and also invest in replacing their twisted copper pair wires into the customers' homes with something that could handle much more than 4 kilohertz, the bandwidth of a phone call. Upgrading the fiber trunk lines and leaving the twisted copper pair wires would be like trying to fit the same

volume of rush hour traffic down a freeway with all the lanes closed except one.

Total cost (in constant 1990 dollars) of local-access network construction for fiber-in-the-loop architecture being pursued by the telcos is estimated at \$230 billion, though the final figure may easily turn out to be considerably higher.<sup>79</sup>

It may seem that the telephone industry has been left at the starting gate in the race to provide a broadband fiber network. These companies, however, have tremendous resources at their disposal, and should Congress decide to loosen the regulatory reins, they could rapidly make up lost ground. In addition, the regulatory picture for cable is far from certain. There has been a concerted effort in Congress to bring about reregulation of cable. So, while cable has made tremendous strides in providing a broadband communications network, the final character of the broadband network of the future will ultimately be shaped by the decisions made by regulators and legislators.

## **PUBLIC POLICY CONSIDERATIONS**

How, if, and when the United States achieves universal broadband capability, is very much an open question; the future shape of American communications is now being forged in the crucible of fierce political turf wars between competing industries. On the one side stands the telephone industry, which argues that it is

time to remove archaic regulatory barriers and free it to make its full contribution to the building of the infrastructure which will truly usher in the Information Age and put us in an internationally competitive position. As this industry sees it, the major barriers are represented by the restrictions of the so-called Modified Final Judgment, under which the Bell operating companies, following divestiture, which saw them split off from the AT&T empire, were enjoined from going into the business of providing information services directly to the consumer or manufacturing communications equipment. The most restrictive of the barriers, the industry insists, is the prohibition that prevents it from offering cable television services.

In projecting future costs and revenues, the industry maintains that the only way it can justify the huge financial investments required to build the ubiquitous broadband network is by tapping the revenue lode represented by cable television service to the consumer; and so it has urged lifting of the restrictions in the Modified Final Judgment (MFJ), under which the breakup of the Bell System took place, the Cable Act of 1984 and the rules of the Federal Communications Commission. Recently, Judge Harold Greene, who has been administering the MFJ, lifted the information services restrictions, but the Congressional and FCC prohibitions are still in force.

The public stands to gain from telephone company entry into the cable business, proponents of this point of view maintain, because such entry would mean finally bringing significant competition into the cable scene, thus tempering the price-gouging proclivities of the de facto cable monopoly, increasing choice for the consumer, and hastening the day of the full-fledged universally accessible public switched network.

Cable fiercely opposes telco entry, arguing that choice already exists through the available competing electronic and print media, and that the sheer size of the Bell companies and their long history as monopolistic institutions point to an inevitable crushing of the cable industry that now exists should they be permitted to offer cable television service in their local areas. Ultimately, cable maintains, regulatory efforts will prove ineffective and there will be only one supplier of information — the telephone industry: the prohibitions should be maintained.

The newspaper industry joins the cable industry in urging that information restrictions be kept. It fears the telcos, eager to move strongly into information services, will utilize their monopoly position to discriminate against competitive services, thus making it difficult for the newspapers to compete. At stake is not only the fate of information services, but the income from classified advertising, whose loss or diminution could seriously hurt newspapers

financially. The telephone response is that legal constraints can be devised which virtually rule out any significant anticompetitive misbehavior.

Like the cable and newspaper interests, the broadcasters find the prospect of telephone company involvement in content threatening. Potentially, the national Association of Broadcasters argues, the monopoly position of the telco puts it in the position to favor itself in the acquisition and distribution of programming, thus acting to undermine the over-the-air industry in the long run. There is no objection, however, to the telephone company as common carrier, carrying the programming services of other entities.

Ironically, though in this instance seeming to side with cable, it was the NAB which led the lobbying charge that resulted in passage of the cable re-regulation bill in 1992.

The competing concerns are reflected in the Congressional infighting over various bills that have been introduced, even passed by one chamber or another in recent years, and in what appears to be some discernible movement of the FCC toward eventual elimination of the telco restriction. As noted in the first section of this report, Senate bill S1200, introduced by a Republican Senator from Montana, Conrad Burns, and a Democratic Senator from Tennessee, Al Gore, would set a national goal of building the nation's broadband network,

with the year 2015 as completion date, the same date as that chosen by Japan for completion of its broadband system. The bill enthusiastically espouses the cause of telco entry into cable.<sup>80</sup> In May, 1992, the Administration strongly supported this position in a letter from President Bush's chief domestic advisor, Clayton Yeutter, to Senators Bob Dole (R-Kansas) and Senator Burns endorsing S1200. Already passed and signed by the President is the Senator Gore-spearheaded bill which sets in motion the creation of a national high-speed computer network, the High Performance Computing Act of 1991.

Complicating life for the phone companies, however, is a Congressional effort to delay telephone entry into information services led by Texas Democratic Congressman Jack Brooks, Chairman of the House Judiciary Committee. His bill, H.R. 5096, would keep the telcos out of information services for three years, after which they would have to pass a strict antitrust test.

In the middle of all this, the battle to re-regulate cable continues, with both the Senate and House having passed bills — S12 and H.R.4850 — which bring back price regulation to the cable field. There remains much uncertainty over a possible Presidential veto of what is widely viewed as a consumer issue and over the ability of the Congress to override the veto if it occurs.

## **The Coming Struggle For Control of Tomorrow's Communications**

From the standpoint of a community concerned with its communications future, the struggle between industries has already been productive of new possibilities. Until recently, creating the ubiquitous broadband network was seen as part of the natural evolution of the telephone industry. Few foresaw that a cable industry, beset by the telco and potential DBS threats and responding to its own internal pressures to find new avenues for growth, would move with such speed into new technological areas, that it is now considered by many in the field as a serious contender for the communications role long enjoyed as a virtual natural right by the telephone industry.<sup>81</sup> Cable spokesmen are already pointing to tomorrow's cable industry as a fully developed *communications* service, competing directly with the Bell companies. It is no accident that the first dramatic test of the promising new Personal Communications Service (PCS) to gain national attention was the Cox demonstration in February, 1992, in which the chairman of that company talked to the Chairman of the FCC via a PCS instrument, the voices fed by cable to the long distance carrier.<sup>82</sup>

The 1992 convention of the National Cable Television Association in Dallas was noteworthy for its focus on cable's technological promise:

*Already reaching the most U.S. homes with the greatest bandwidth, cable operators can prepare to carry mobile and landline*

*telephone services and high-speed interactive data-as well as digital PPV (Pay Per View) and HDTV (High Definition Television)-at little more than standard upgrade costs and, here and there, the purchase of local, alternate access routes to and from long-distance carriers.*

*With no additional burden on its core video business, TCI President John Malone told the show's opening panel, cable can enhance its position as 'the most cost-effective highway to the home' for every imaginable communications service.<sup>83</sup>*

The report goes on to quote NCTA's President, James Mooney, "The biggest telecommunications story of the decade may turn out to be not telcos creating broadband networks, but cable technology and architecture proving to be the most efficient means of delivering the next generation of communications services."<sup>84</sup>

The New York Times reports:

*Cable companies have also been buying small companies that compete head-to-head with local telephone companies by providing high-speed communications to big corporate customers. Last month, for example, Cox and Tele-Communications acquired the largest of these companies, the Teleport Communications Group of Staten Island.*

*Teleport has built networks in a dozen large cities, including New York, Los Angeles and Chicago, and is eager to expand from central business districts to other parts of each city and the suburbs. Executives of Cox and Tele-Communications say they anticipate linking their cable systems to these networks, raising the possibility of an extremely rapid expansion to suburban office parks, hospitals, hotels and eventually, perhaps, to residential telephone customers as well.*

*Given that plan, a collision between industries is inevitable-and imminent.*<sup>85</sup>

It may be worth noting, too, that the Time Warner upgrade in Queens, New York system with fiber optic trunk facilities is expected to enable the system to carry high definition, widescreen TV, voice interactivity, and linkages with computers, fax machines and PCS. This is a 150-channel system, whose promise of abundance may not fully come into own until compression techniques now being developed make several hundred channels possible.<sup>86</sup>

### **Telco-Cable Cooperation Begins**

At the same time that cable is voicing the theme of competition with the telephone companies, both industries have entered into a period of tentative cooperation, as indicated by a number of experiments under way or being planned. U.S. West, TeleCommunications Inc., the country's largest cable operator, and AT&T, have joined forces in an 18-month market test in the Denver area of new services made possible by the new technology. TCI will provide the cable system and the programming services; AT&T is building the central office equipment; U.S. West is conducting the marketing research.

U.S. West's President, Richard McCormick, advocates telco-cable cooperation, to cut costs and improve efficiency. He considers the prospect of two fiber lines to the home as

essentially wasteful. For his company alone to put fiber to the curb throughout the system would cost \$13 billion in 1990 dollars.

Predicting that sooner or later the fiber network will come into being because of quality and cost factors, he would like to accelerate the process through working together with cable.

*Fiber is getting cheaper, the ability to place it is getting cheaper. If we can look for ways that we can cooperate with the cable companies, maybe we can move faster than we are.*<sup>87</sup>

He argues in favor of what he calls a "condominium" approach to the building of a fiber optic network.

*For me it (shared facilities) means ownership on a condominium basis, of a facility where the use of that facility is at the discretion of the owner. In other words, we're not sharing it with joint services, but there actually is a division within the facility itself.*

*Think about a common sheath that has several fibers in it. My view is we could own half of that sheath, the cable company could own the other half. As in a condominium, we could make sure the sidewalks are shoveled-in other words, that the sheath is maintained and the right of way is protected. But the cable company would have complete discretion and control over what goes over its fibers within that sheath, and the telephone company would have complete discretion and control over what information is transmitted over its sheath.*<sup>88</sup>

An ambitious long-range cooperative project was announced at the end of March by Pacific Bell: a plan "to link for the first time a fiber-optic telecommunications network and a cable

television system," in a to-be-built, master-planned community. When fully built out, the new Sutter Bay community, which is 15 miles north of Sacramento, will comprise 55,000 homes, housing a population of approximately 140,000, and commercial operations that are expected to provide some 96,000 jobs. The contemplated communications model will serve the development's first 3,000 homes and 130 acres devoted to retail, business park and office uses.<sup>89</sup>

Unlike the U.S. West-proposed single sheath approach, the Sutter Bay project calls for construction of two separate, parallel systems are to be constructed. Eventually, they are to be connected in the user's premises. As envisioned by developer and cable system operator Sutter Bay Associates and South Sutter Cable, what will be built is an "electronic highway system connecting homes, schools, hospitals, government offices and businesses capable of supporting a wide variety of applications, such as telecommuting, in which pressing buttons on a telephone key pad or computer keyboard replaces an automobile trip. The environment, citizens and commerce will all benefit."<sup>90</sup> South Sutter Cable will build the cable system; Pacific Bell, a fiber-to-the curb system. Most important, from the Pacific Bell standpoint, is the coordination of the construction of both networks that will characterize the joint venture from the outset.

With the television and telecommunications networks interconnected, in the customer's home, the customer will be able to interact with a televised program via the telecommunications network. For example, during a two-way educational broadcast, a student would receive video and audio over his television cable system and respond, either by voice or computer, via his fiber-optic telephone line, although this bandwidth requirement doesn't need fiber.

In realistic prospect, according to Pacific Bell, once the first phase becomes operative, will be telecommuting, video-conferencing, remote energy management, security monitoring, video-on-demand, video-catalogue shopping via computer or telephone key pads, and interconnecting with computers and local area networks (LANs) at schools and businesses.

To move forward, the project needs approval from both the FCC and the California Public Utilities Commission.

Similar approval was required to conduct the pioneering test, still under way, by GTE in Cerritos, California so that it could provide cable television programming through Apollo Cablevision. The Cerritos test is designed primarily to obtain technical and operational data from a field comparison between three technologies: standard copper telephone wire, coaxial cable, and fiber optics, in carrying voice, data and video signals. Tested services

include voice and data, cable television, interactive video services, video-on-demand, home banking, and shopping security, and education. An important commercial application under trial is MainStreet, which focuses on a variety of shopping and information gathering opportunities that are made available on the television screen, rather than on a computer. The system is operated by a conventional-style remote, hand control unit.

Another potentially significant aspect of the Cerritos trial involves an educational effort in which two local elementary schools are participating. Three teachers in each school representing five sixth-grade and one combination second/third grade class, use the service as part of their everyday classroom activities.

The Cerritos experiment is based on GTE's 2480 fiber-mile network and prototype broadband technology issuing from GTE Laboratories. GTE built the coaxial cable plant, over which Apollo CableVision continues to provide basic and premium cable TV, while GTE provides near-video-on-demand movies and special events, as well as the MainStreet videotex service.

Plans for 1992 include adding a fiber-to-the-curb trial and a test of interactive video services with approximately 50 homes using interactive video disc players located at the headend.<sup>91</sup>

From the beginning, the Cerritos experiment has been opposed by cable, which argues that the FCC waiver allowing GTE to provide cable television service through Apollo Cable is illegal. In July the National Cable Television Association and the California Cable Television Association urged the Commission to rescind the "good cause" waiver which allows the GTE-Apollo Cable combination. The FCC is considering the issue in response to a September 1990 ruling by the U.S. Court of Appeals that criticized the Commission for granting the waiver. The Court asked why GTE could not conduct its tests without the prohibited affiliation with the cable franchisee. As expected, GTE's response was to urge the FCC to reaffirm the five-year waiver.<sup>92</sup>

Cable's rapid technological progress and entrepreneurial thrusts are explained in part by the industry freedom, for the most part, from the kind of regulation that hampers the movement of the Bell companies. It may be worth noting that overseas, where the regulatory climate is favorable, the same phone companies that are slow to act in this country have been taking aggressive steps to launch new joint ventures. Pacific Bell, for example, which has yet to propose publicly a plan to build a fiber network throughout California, is actively engaged in a cable venture in Great Britain.

While to some it may appear that cable has the competitive advantage owing to the historic fact

of its present national configuration, which, theoretically, should permit it to modernize its systems more economically than is possible for the telephone industry, Washington developments could alter the competitive positions of the two industries substantially. The Congress and the FCC may decide to remove the prohibitions on telco entry into cable television; in which case, the telephone industry would have increased incentives to take aggressive steps in pursuing its fiber hopes.

Finally, in the midst of a turbulent political year, there is no predicting the the legislative-regulatory fallout of a possible change in administrations.

### **THE CHANGING REGULATORY SCENE**

The telecommunications field is gradually moving to a condition of decreasing regulation. Rate of return regulation, which means straightforward approval of telephone rates by the state public service or utilities commission, sets the profit level of the telephone company in terms of a fixed cost-price ratio. Under the newer approach, which is being adopted by an increasing number of states, the rate-setting philosophy is geared to providing incentives to cut costs and improve efficiency-presumably this course should lead to an intensified search for technological innovations. Growing in popularity is the belief that there is an incentive inherent in permitting the provider to share in earnings greater than expected that results from

efficiency and technological innovation. In California, the Public Utility Commission introduced a regulatory scheme on October 12, 1989 which allows Pacific Bell and GTE, the two largest service providers in the state, to share earnings with the public when they rise above the amount stipulated for the given year as the estimated market rate of return. The 50-50 split comes into play at the earnings range of 13-16.5%, after which 100% goes to the rate payer. These rules come into play only after the companies have achieved a productivity factor 4.5% above the national average. Monopoly service prices are frozen; competitive services are free from price regulation, but are subject to price floors and price caps.<sup>93</sup>

### **The Idea of Competition**

The 80s saw an intensification of commitment and activity toward the goal of competition at the Federal Communications Commission during the reigns of Chairmen Mark Fowler and Dennis Patrick. The commitment continues under the current Chairman, Alfred Sikes. Chairman Fowler, easily the most radical exponent of deregulation ever to serve in the FCC Chairman's post, proposed a test in selected metropolitan markets which would introduce competition into the local loop. He argued against the monopoly status enjoyed by the Bell Operating Companies, maintaining that local competition would result in improved service and lower cost.<sup>94</sup> Local competition seemed far off in that period— before cellular

telephone had established itself as a substantial industry and before the appearance of the Personal Communication Service (PCS)— but its day may have been closer at hand than was recognized by many in the field.

An indicator of just how swiftly the concept of local competition has taken hold is the conference convened in Chicago on March 30, 1992 by the Washington Annenburg Program under the title "Telecommunications Free Trade Zones: A Model For Local Exchange Competition."

The present administration is firmly wedded to the concept of competition as the supreme regulator of the marketplace, locally as well as nationally:

*As in other areas of telecommunications, technological developments are increasing the potential for competitive entry into local exchange services. Deployment of digital technology may soon enable cellular radio systems to carry 10 times as many calls on the same frequencies as is the case today, thus substantially alleviating at least the capacity constraints that have limited cellular radio's ability to compete with local exchange telephone service. Future development of radio-based PCS may also increase opportunities for new entrants to offer service in competition with the now-dominant LECs (Local Exchange Carriers—the local telephone companies as we know them, such as Pac Bell).<sup>95</sup>*

Commenting on the above-mentioned activities of Cox and Time Warner, the NTIA says:

*These and other developments are rapidly increasing the likelihood that cable firms will be able to offer local exchange services in competition with the LECs, either by leasing distribution facilities to other local service providers or by providing service directly to customers.<sup>96</sup>*

The NTIA conclusion is that it is time to permit competition for local exchange services.

The over-arching question remains: can the free play of an unencumbered marketplace be relied on to produce the ubiquitous broadband network? Or is it so important to the welfare of the country that we cannot afford to leave its creation to the uncertainties of a laissez-faire policy?

The Burns-Gore bill seeks to make infrastructure development a national goal.

Indeed one of the justifications for this approach is the Congressional finding that "Communications infrastructure will be as important in the future to the information economy as the transportation infrastructure has been to the industrial economy."

Historically, the government has been an active player, along with the private sector, in building the transportation infrastructure.

Although it agrees with the aims of the Burns-Gore bill, the Administration stops just short of embracing what it sees as an industrial policy. Its strategy is to help shape the technological and business environment so as to unleash the forces of competition and innovation to make

their greatest contributions to the building of the new communications infrastructure. Whether this variation of the bully-pulpit role is enough to insure that the infrastructure will be fully built out, is, of course, the question.

Even if one accepts the argument that the marketplace contains enough economic motivations to insure the eventual building of a ubiquitous broadband network, the question remains whether the poorer residential, or isolated users, such as those living in rural areas, will be adequately served, or whether the needs of small business will be met. The role of small business grows in significance as a source of job creation, and product and service innovation. Without the availability of a telephone capability that permits small business to compete with large industry in a basic communications sense, one can only speculate as to the fate of that sector of our national life. Such capability is made possible now through a common carrier system built around the technology of a public switched telephone network. Just as anyone can travel a public road, but may be restricted from using a private road, such a network allows members of the public to have unrestricted access to place phone calls or send data to each other.

*Many of the services can be provided using a variety of telecommunications networks. However, a crucial part of the telecommunications infrastructure is the public switched telephone network (PSTN), a common carrier network which is available to nearly every citizen, as opposed to private networks which are available to a limited*

*group of users. The PSTN is a ubiquitous, uniform and universal common carrier network and its continuing modernization is vital to capitalizing upon three ongoing economic trends, namely: (1) the continuing transition from a manufacturing-based to a service-based economy; (2) the increasing importance of small business as a source of future economic growth; and (3) an increasing gap in equal access between urban and rural areas...<sup>97</sup>*

### **The Inevitability of Convergence**

The turf conflicts between the involved industries may become even more tangled in the years ahead, simply because technology is, as we have seen, causing the boundaries between disciplines and industries to fade and vanish. Thus cable moves into telecommunications services, and the telephone companies struggle to enter cable television; the newspapers become electronic publishers, and telco initiatives spur a war over the fate of classified advertising. Digital electronics appears in more and more guises, blurring distinctions between the television set and the computer. A Wall Street Journal report notes:

*All this illustrates how the lines are blurring among four huge industries: computers, consumer electronics, communications and entertainment. The relentless spread of digital electronics--converting information, sound, video, text and images into a single stream of ones and zeros that can be decoded by similar electronic hardware--is stepping up competition, forcing strange alliances and undermining once-lucrative businesses. Consumers seem sure to get new services and lower prices.*

*Operators of telephone, television, cellular and satellite systems like digital because it vastly increases clarity and capacity and can*

*improve security. Creators of music, movies, books and pictures benefit because digital allows their product to be transferred readily to a variety of packages and reproduced more cheaply. Makers of consumer-electronic equipment find digital saves money by providing a common underlying technology.*<sup>98</sup>

Looming large in tomorrow's media picture is the single, integrated instrument that functions as combination audio-visual delivery system and computer providing high fidelity and direct and interactive services limited only by human imagination. This day may be far off, given the technical and economic problems yet to be solved. Still, even under current technologies, approximations of what may be possible with the mature broadband system are sure to be realized, given the technological momentum already attained.

### **Protecting the Ratepayer**

Universal service has long been a cornerstone of U.S. communications policy, although the mechanism in place to finance it is fairly new. In the beginning, because of its Bell telephone patent, American Bell operated as a de facto monopoly, charging high prices for its services and targeting the business districts of major cities. Rural America, for the most part, was ignored. Expiration of its patents in the 1890's found Bell facing a host of independent competitors. Hundreds of small telephone companies sprang up in rural areas. Bell faced competition for the first time as entrepreneurs sought to carve out a niche in the urban

telephone market as well. What resulted was a form of chaos. If a city was served by telephone companies A, B, and C, and a customer of company A wanted to speak with a customer of company C, he was out of luck. Tremendous duplication of services meant in practical terms that customers would have multiple telephones on their desks because duplicative phone services lacked the ability to interconnect.

Out of this chaotic environment emerged a growing chorus of protest. By 1907 there were calls for state utilities commissions to regulate a single company that would provide end-to-end service to all who requested it within a given area. AT&T came out in favor of such laws, arguing that a regulated monopoly would provide better and less expensive service than could be achieved under competition or government ownership. It was soon joined in its call by independent telephone companies. In 1910, Congress had amended the Interstate Commerce Commission Act to extend the Commission's jurisdiction to include interstate telephony and charge it with the authority to review the reasonableness of telephone rates. By 1912, 30 states had established Public Utility Commissions. Among their oversight responsibilities was scrutiny of local telephone company activities.

With passage of the Communications Act of 1934, which replaced the Federal Radio Commission with the Federal Communications

Commission, the national goal was identified: "to make available, so far as possible, to all the people of the United States, a rapid, efficient, nationwide and worldwide wire and radio communications service, with adequate facilities, at reasonable cost."

Two rationales for universal service are equity and economic development — the underlying belief that all people should be able to communicate with each other via telephone at reasonable prices on an equal basis and that the value of the network to everyone increases as the number of people on the network increases.

Prior to divestiture, the cost of local telephone service was subsidized by profits made from artificially high long-distance calling costs. Following divestiture, there was concern about the practical survival of universal service. There was worry that with the removal of long distance cross subsidization of local service, the cost would increase to such an extent that it would be unaffordable for low income individuals.

A number of calling plans were created in response to this concern. Local measured service and two low-income assistance programs, Lifeline and Link-Up America are examples. Link-Up America was the result of a study conducted by the Consumer Federation of America, the American Association of Retired Persons and AT&T. As the marketplace opens up to competition, efforts

are underway to reconcile current subsidy structures with competition. The New York PSC will allow competition by alternative providers with LECs (Local Exchange Carriers) on condition that a fund be established to meet universal service needs. In May of 1991, the New York PSC approved a "Universal Service" rate element included in an "actual collocation" tariff filed by New York Telephone. This element causes interconnectors with certain LEC private line service components to pay an access charge designed to offset the loss of contributions resulting from these interconnection arrangements.

Massachusetts and California are pondering a similar question: whether or not to require competitors to LECs, as part of arrangements for interconnection to LEC facilities, to contribute funds for universal service.

As more services have become available over the public network, the definition of what constitutes basic service and what the nature of the public network is has begun to be contested. The lines have become fairly clearly drawn.<sup>99</sup>

Consumer groups, whose position is typified by that of the AARP and the Consumer Federation of America, argue in favor of POTS, plain old telephone service, and argue against rate increases, such as the subscriber line charge, favoring instead lowered rates for

consumers. The government's position, articulated by the NTIA in its recent infrastructure report, is that,

*The promised benefits of even better telecommunications technology mean that provision of traditional voice services through government-sanctioned monopolies can no longer suffice as the goal for universal service. Rather, universal access to the myriad services available in the competitive telecommunications marketplace should become the new standard.*<sup>100</sup>

While the fiber-centered arguments continue, in the face of formidable financial challenges, a pragmatic view has begun to emerge that argues for transitional, step-by-step investment based on technology that is currently available. Talking to an audience of communications professionals at a September Business Week Conference, Mitchell Kapur, founder of the Lotus Development Corporation and co-founder and president of the Electronic Frontier Foundation, called for the creation of "platforms" which would parallel in telecommunications terms the mass-marketing achievements of the computer industry. Just as the computer manufacturers opened the industry to outside software providers, thereby releasing an industry's creative powers, so should the telecommunications focus turn to the challenge of fashioning a mass market based on the technologies currently available that can be deployed at a fraction of the cost of the fully developed broadband service. Utilizing currently deployable technologies, Kapur maintains, it is possible to build a mass market

around the concept of a narrowband ISDN, thereby laying the base for an eruption of new and innovative services which can be expected to meet the mass market challenge.

This point of view is developed by Dr. Mark N. Cooper, Director of Research for the Consumer Federation of America:

*From an economic perspective, a Widespread Integrated Narrowband Network would deliver 80 percent of the functionality of a UBN (Ubiquitous Broadband Network) in the near term at 10 percent of the cost. Its cost is \$30 billion to \$60 billion compared to \$200 billion to \$400 billion for a broadband network.*<sup>101</sup>

This approach relies on existing distribution facilities. It has the social advantage, Dr. Cooper holds, of building on the "backbone" of computer literacy and open interactive communications. The narrowband deployment calls for no special relaxation of regulatory oversight over the telecommunications sector. Rather:

*It requires mass market, consumer-oriented tariffing, distribution policies that allow full utilization of increasingly widespread technologies like personal computers, and open access policies that ensure that the most vigorous decentralized information industries, like the personal computer and customer premise equipment sectors, can develop and market consumer-oriented services.*<sup>102</sup>

Clearly, major national issues await resolution. In the meantime, technological advance will continue unabated; of that there can be little

doubt, given the creative and entrepreneurial energies striving to find their way in a changing world. What is less clear, is how effectively our communities will cope with the challenges posed by the new technologies.

## CONCLUSIONS

- \* Telecommunications and information technology will be major factors in defining tomorrow's world.*
- \* The world is moving swiftly toward global interconnectivity. Economic and social rewards will go to the cities and regions that organize themselves to participate effectively in the information-led economy that is emerging. Those areas that do not choose to follow this path will be left behind.*
- \* There is a tendency to see communications issues in national and state terms, to the neglect of the pivotal role of the city or region, where responsibility for the whole community is finally lodged. The city's purview encompasses all elements of the community: not only industry at large, but small business, the farmer, the average citizen and family, as well--to assure access to the business, professional, educational, health and social benefits that are the promise of a universally accessible, advanced communications infrastructure.*

*\* San Diego has a choice: to let the future arrive as it will, shaped by events and circumstance, or to take on a leadership role and focus its public and private sector energies on the challenge of building its segment of the Information Highway in its own corner of the Global Village.*