I. EXECUTIVE AND PROJECT SUMMARY

I-1. EXECUTIVE SUMMARY

BACKGROUND

In recognition of the potential impact that telecommunications can have on New Jersey's changing economy, the New Jersey Board of Public Utilities (NJBPU) commissioned this study of the telecommunications infrastructure in the state. As the state's economy has shifted from a strong manufacturing base to more of a service-based economy, the telecommunications infrastructure has grown in importance to the economic development and overall vitality of the state. Innovations in telecommunications technology can be harnessed by local exchange carriers to help meet the increasing need for the state's growth industries to access "Information Age" resources. Similarly, trends in the use of information technology and video communications in the home indicate the need for the citizenry of the state to have access to new telecommunications capabilities. This study provides a framework to better understand the various impacts of telecommunications on the state, both now and in the future.

In addition to exploring the relationship between telecommunications and the state's economy, the scope of the study included an assessment of whether the state's traditional regulatory policies governing telecommunications should be modified to reflect the evolution of the role of telecommunications in New Jersey. Historically, the NJBPU's overall goal in regulating this industry has been the achievement of universal service - the extension of telephone service to every home and business in New Jersey. Since New Jersey residents already enjoy the lowest rates for basic telephone services in the country and approximately 96% of the residences in New Jersey have basic telephone service, the traditional goal of the universal service concept has been effectively achieved in New Jersey. In view of the increasing importance of telecommunications to the state and emerging trends in the demand for more advanced telecommunications capabilities from all consumers, the study was structured to provide additional perspective on whether changes in the universal service concept might be advantageous for the state of New Jersey and its citizens. Thus, the study provides the foundation to assess and modify, as appropriate, telecommunications regulatory policy to reflect the changing communications needs of the state as well as the demands for telecommunications services and capabilities in the "Information Age," and the opportunities presented by communications technology.

The consulting firm of Deloitte & Touche and its strategy consulting division, Braxton Associates, were engaged by the NJBPU to perform the study. The study was funded by the state's three local exchange carriers (LECs) - New Jersey Bell, United Telephone of New Jersey, and Warwick Valley Telephone Company - the companies charged with providing universal service in New Jersey.

OBJECTIVES

The specific objectives of the study, as developed by the NJBPU, were structured to identify what would be required for the state's policymakers to chart a new course for telecommunications regulatory policy. More specifically, these objectives included the following:

- Assess the current telecommunications network in the state.

- Analyze the sources of future demand for more advanced telecommunications services.

- Identify opportunities to improve access to telecommunications-based educational programs.

- Identify opportunities to strengthen the quality and cost-effectiveness of health care services that employ telecommunications.

- Evaluate the linkage between the telecommunications infrastructure and economic growth in New Jersey.

- Evaluate the relationship between progressive regulatory policy and the development of the telecommunications infrastructure.

- Evaluate the financial implications of accelerating investment in the state's telecommunications infrastructure.

- Identify the overall policy implications of evolving the universal service concept of simply providing low-cost basic services to a broader concept of providing universal access to "Information Age" services.

STUDY APPROACH AND METHODOLOGY

The approach used to meet the objectives of the study included obtaining direct input from managers of economic and business retention programs, businesses that have been involved in relocation decision-making, education and health care professionals, and representatives of various state agencies. In addition, each interviewee/respondent provided their perspectives on the current and future importance of telecommunications infrastructure in New Jersey. The study team also contacted numerous telecommunications and computer equipment manufacturers and research institutions. This comprehensive process involved obtaining input from several hundred parties through interviews and/or surveys. Data was also gathered from a variety of sources to provide comparative "benchmarks" of telecommunications infrastructure issues in New Jersey as compared with other areas of the country. Furthermore, input was solicited from the Office of Rate Counsel within the Department of the Public Advocate, which has traditionally been very active in representing consumer interests in telecommunications matters before the NJBPU.

SUMMARY OF CONCLUSIONS

The following summarizes the significant findings of the study. Each conclusion is addressed further in the subsequent section of the Executive Summary and in detail in Volumes II and III of the report:

- Regulatory policies in New Jersey have essentially achieved the universal service objective of statewide availability of affordable telephone service. Along with the lowest rates for basic exchange services in the country, the state has a relatively sophisticated local exchange network capable of supporting not only high-quality basic service but also many enhanced voice and data services.

- As New Jersey continues to move toward an information/services-based economy, today's local exchange carrier network will increasingly constrain users' (especially residential and small business users) ability to fully participate in the "Information Age."

- The key telecommunications policy issue is the degree to which public policymakers and regulators should encourage LECs to accelerate the deployment of advanced telecommunications technology to support broad-based availability of higher bandwidth services.

- A significant opportunity exists to advance the public agenda for excellence in education through improvements to the telecommunications infrastructure.

- Strong motivation, especially in the areas of improved quality of care and cost reduction, exists for increasing the use of telecommunications and information technologies in the health care industry in New Jersey.

- Public policies that encourage deployment of an advanced telecommunications infrastructure are essential for New Jersey to achieve the level of employment and job creation expected in the state.

- Regulatory philosophy across the country is supportive of the deployment of an advanced telecommunications infrastructure in LEC networks; the regulatory framework in New Jersey can help enhance the state's competitive position in the "Information Age."

- The deployment of advanced telecommunications capabilities can be significantly accelerated at minimal cost relative to the intrastate revenue base of New Jersey's LECs.

- In conclusion, a significant strategic opportunity exists to advance the public agenda in New Jersey through the accelerated deployment of a reasonably priced, advanced telecommunications network in the state.

CONCLUSIONS AND PUBLIC POLICY IMPLICATIONS

Regulatory policies in New Jersey have effectively achieved the historical universal service objective of statewide availability of affordable telephone service. Along with the lowest rates for basic exchange service in the country, New Jersey has a relatively sophisticated local exchange network capable of supporting not only high-quality basic service but also many enhanced voice and data services.

New Jersey Bell (NJB), which serves 97% of the access lines in the state, has the lowest rates for basic exchange services and intraLATA toll calls among the former Bell Operating Companies in the country. The other local exchange telephone companies in the state, United Telephone of New Jersey and Warwick Valley Telephone Company, have comparable or lower rates than the rates of NJB. Coupled with its low rates, the state can claim a high rate of telecommunications technology deployment and the widespread availability of advanced telecommunications products and services, such as enhanced voice services and basic data services. This speaks well of the state's regulatory policies, which to date have been focused on achieving universal service. As evidence of that achievement, it is notable that there is a 95.5% penetration level of basic telephone service among New Jersey's residences, a level above the national average. New Jersey's current telecommunications infrastructure, capital expenditures, and quality of services are comparable to other states and, in the case of international comparisons, highly developed foreign countries.

The study compared the quality of service statistics provided by the larger local exchange carriers in New Jersey to applicable regulatory standards in the state as well as to the quality of service performance of other large telephone companies across the country. The performance statistics indicate that both NJB and United Telephone of New Jersey are performing at or above the quality of service standards adopted by the NJBPU. Additionally, the statistics demonstrate that the overall quality of service has improved in New Jersey in recent years. Furthermore, the state's performance is on par with, or exceeds, the quality of service performance achieved by other Bell Operating Companies across the United States.

As New Jersey continues to move toward an information/services-based economy, today's local exchange carrier network will increasingly constrain users' (especially small business and residential users) ability to fully participate in the "Information Age."

Technological developments in the telecommunications industry will open the door to the "Information Age," especially in the areas of video communications. "Information Age" services generally require high bandwidth capabilities in the network. The term "bandwidth" refers to the capacity of the telecommunications network to transmit large quantities of information in a short period of time. Today's local exchange carrier networks constrain users' ability to transfer high bandwidth information, such as images, and restrict real-time or interactive video communication. Investment in the telecommunications infrastructure (i.e., in digital switching systems and fiber optic cabling) could result in widely available, high bandwidth network capabilities. Through such investment, the benefits of the visual evolution in telecommunications will not be limited to large business and institutional users, but will be extended to small businesses and, importantly, to residential users.

Over the next ten years, technological advances in computing power, digital video systems, and information compression techniques will enable communications with visual information in much the commonplace manner used today to communicate with voice and data.

The personal computer has been a part of the office and home environment for only a decade, but advances in desktop computer power in the 1990s will permit individual workstations to process and display ever-increasing amounts of image and video (moving images) information. Images, and particularly full-motion video, contain far more information than text or data and, therefore, require a higher bandwidth capability in order to transmit information between users. Thus, transmitting today's color television signals in a digital format could require almost 20,000 times the bandwidth used to access today's on-line information services (e.g., Prodigy). Fortunately, developments in image and video transmission technology are decreasing both the bandwidth and the cost required to transport information. The net effect of compression technology will be to dramatically increase and broaden the demand for high bandwidth services.

At the same time, consumer video equipment will increasingly incorporate computer-like capabilities.

Trends in home computers and entertainment video will create a need for increasing bandwidth. At the same time that computers are incorporating video technology, television sets are incorporating "computer-like" features. Today, at-home users likely have separate devices for entertainment video and computers. These devices could, however, share components such as video chips, monitors, and high bandwidth communications circuits. The integration of these technologies is expected to result in significant cost reductions which in turn will increase the demand for high bandwidth capabilities in the network.

Home video technology should be available in the 1990s to support on-demand entertainment and interactive educational and information services. Mass market residential video applications will create demand for widespread, higher bandwidth network capability.

Today's telephone network can transmit information at speeds that have generally proved adequate for today's information transfer needs. But while today's network has essentially reached the limits of its ability to support high bandwidth, interactive communications, technology will continue to advance the information processing capabilities available to the individual (e.g., computer processing, local computer networking, and consumer video equipment). The existing network will increasingly constrain the ability of individual users unless its capabilities to handle higher bandwidth traffic are increased.

Larger businesses are already demonstrating a demand for higher bandwidth services. Smaller business - a significant element of New Jersey's economy - will require equivalent capabilities in the public network if they are to remain competitive.

The large business marketplace is already demonstrating a demand for increasingly higher-power personal computers and workstations, for videoconferencing, and for the telecommunications capability to support them. Small businesses, including at-home businesses, could increasingly find themselves at a competitive disadvantage as larger users make bandwidth video/image applications an integral part of their business success.

The U.S. Small Business Administration has identified an increasing role for small business as "partners" of larger businesses, based in part on information-processing technologies which facilitate efficient small business specialization. Therefore, small businesses that increasingly employ advanced information/telecommunications technology can exploit these opportunities and retain a market advantage over other firms that do not employ such technology. Given the state's dependence on small business for economic growth and job creation, New Jersey's economy runs a significant risk if the future telecommunications needs of smaller businesses are not met by New Jersey's telephone network.

The demand for higher bandwidth residential access can be expected to grow. Residential needs could be diverse and may range from business-like telecommuting applications to interactive educational programming to switched video entertainment services.

The Cable TV Act of 1984 prohibits telephone companies from providing "video programming," that is, video transmission equivalent to broadcast video services. Consequently, higher bandwidth transport targeted at residential users may need to rely on applications other than today's "video programming."

But the success of cable television has demonstrated consumer willingness to pay for video services. Higher bandwidth network capabilities will be required to support most, if not all, other consumer video applications. These applications are likely to include the following:

- Residential units may serve as home base for small businesses or telecommuters. Businesses are increasingly relying on computers and telecommunications technology to allow employees to perform their jobs at locations other than the traditional job site.

Advanced telecommunications, including interactive video capabilities, would significantly facilitate the telecommuting process. In addition to obvious employee and employer benefits, New Jersey's economy as a whole would benefit as well:

- Commuting costs and auto pollution should be reduced
- There would be a better matching between employer and employee locations
- The opportunities for nonambulatory individuals would be increased

Furthermore, our economic development survey found that transportation considerations influenced New Jersey corporate relocation decisions. If the telecommunications infrastructure substitutes to some extent for the transportation infrastructure, there may be significant benefits to New Jersey taxpayers as well.

- Other demand for interactive video applications is likely to develop as well. Several marketing studies have indicated significant residential demand for services such as on-demand entertainment or other features as well as access to educational programs. Bell Atlantic estimates that 50% of residences would subscribe to on-demand entertainment programming within several years of their offering and 30% would subscribe to interactive video offerings.

- Higher bandwidth network capability would also permit the introduction of more visually oriented, user-friendly information services, including camcorder-like "televisits."

- Once equipment and higher bandwidth transport links are obtained for entertainment, business, or educational purposes, they will be available for other uses. As libraries and information services increasingly place both text and image information into on-line data bases, a variety of additional services would become available to New Jersey's residents.

As today's video-oriented, computer-literate students become the consumers of the next decade, the demand for interactive entertainment/educational services can be expected to increase sharply. The examples set out above represent a 1990 view of year 2000 technology. Industry observers expect that information technology and applications will unfold in ways that are far more dramatic and innovative than anticipated today.

The key telecommunications policy issue is the degree to which public policymakers and regulators should encourage LECs to accelerate the deployment of advanced telecommunications technology to support broad-based availability of higher bandwidth services.

Encouraging development of the telecommunications infrastructure that will permit New Jersey's citizens to obtain interactive access to the visual communication world may be one of the most important policy decisions of this decade.

The issue of how fast advanced telecommunications technology should be deployed to meet potential demand is complicated by the fact that widespread deployment of new technology in the public-switched network requires not only significant financial resources but also significant lead time. The provision of advanced telecommunications technologies at an accelerated rate and in a broad-based manner cannot be achieved without increased investments and, at least in the near term, increases in network efficiencies and revenues from new services phase-in. This translates into potentially higher costs to those who would benefit from these public network enhancements; namely, the LECs, businesses and residential ratepayers, and governmental entities using the public network. Furthermore, the financial ramifications of accelerated

technology deployment are a major issue for public policymakers charged with evaluating the trade-offs between the various costs and benefits of accelerated telecommunications technology deployment.

In charting a new course for telecommunications regulatory policy, the criteria used for evaluating potential change should extend well beyond the question of financial impact or rate treatment for the LECs in the state; many of the perceived benefits of accelerated telecommunications technology deployment cannot be measured in terms of their effects on the LECs. For example, if advanced telecommunications capabilities can serve as a competitive advantage in attracting business and/or retaining business in the state, the real benefits will materialize through increased employment opportunities for the citizens of New Jersey, maintenance of the tax base in local communities, and support of the overall economic welfare of the state. Similarly, to the extent that advanced telecommunications capabilities help to improve educational instruction or the quality or the cost-effectiveness of health care services delivery, the benefits realized from these capabilities cannot be measured from their impact on LEC revenues or earnings levels. Neither can the potential benefits of these new technologies and applications be fully realized without advanced telecommunications capabilities. Therefore, it is important to maintain a broad perspective in evaluating the impacts of accelerated telecommunications infrastructure deployment in New Jersey. The costs of infrastructure acceleration are much easier to estimate than the potential benefits to New Jersey.

(1) **A significant opportunity exists to advance the public agenda for excellence in education through improvements to the telecommunications infrastructure.**

In New Jersey, as in the nation overall, educators and public officials are seeking to raise the level of students' performance in basic skill areas such as language, mathematics, and the sciences. At the same time, our educational system is attempting to address operating and capital budget problems and the shrinking supply of highly qualified teachers.

An advanced telecommunications infrastructure presents an opportunity to help address these pressing social issues. By providing schools in the state with generally available cost-efficient access to an advanced telecommunications network, educators would have the opportunity to take advantage of distance learning opportunities in advancing instruction in all subject areas. This could foster equity in education and a more diverse curriculum, and help address the problem of an ever-decreasing pool of qualified teachers. In doing so, the agenda for raising New Jersey's education system to a world-class level of performance could be more readily realized.

Distance learning using telecommunications could help address some of the major problems facing educational institutions today and can enhance the learning process.

By implementing a high bandwidth telecommunications network, New Jersey would be better able to provide superior quality education experiences to the most disadvantaged inner cities, the most remote rural areas, as well as the most affluent suburbs. The resources, experiences, and information sharing made possible through a statewide high bandwidth network could help break down traditional barriers to achievement and growth. The experience of Bergen County Schools in New Jersey highlights the potential opportunities for telecommunications to significantly enhance the educational process. The interactive video network implemented by Bergen County Schools is a leading edge application of distance learning using fiber optic-based telecommunications technology. This network, when completed, will link the county's 47 high schools and two colleges.

Distance learning can help improve educational quality by eliminating the geographic constraints that have traditionally prevented students from obtaining highly specialized instruction. In Bergen County, for example, students now have improved access to courses such as Latin, stenography, and world geology. Telecommunications can be used to expand the breadth of instruction in New Jersey's schools, not only increasing the value and diversity of the education, but also increasing student interest and participation. Finally, distance learning can help bridge the gap between educational "haves" and "have nots." Any school or student can have access to the same teaching expertise and curriculum diversity.

A wide range of agencies are involved in New Jersey educational telecommunications, but no central planning process currently exists. Increased emphasis on planning and cooperation between the various parties interested in improving education is needed to integrate telecommunications into education.

To date, New Jersey's success in implementing pilot distance education programs has been the result of the ad hoc initiatives and informal cooperation between a number of different state and local agencies. For example, the essence of the Bergen County interactive video network success lies in the extraordinary coordination and cooperation between the county's Board of Chosen Freeholders and the various school boards, administrators, teachers, and students involved.

Similar initiatives can be found in other areas. For example, the New Jersey Intercampus Network (NJIN) in cooperation with the Department of Higher Education is attempting to develop a statewide interactive video network to link all of the state's colleges and universities. Similarly, program administrators for the New Jersey node of the National Science Foundation Network have collaborated with NJIN in planning to link all state institutions for higher learning with a high-speed data network. These two initiatives may offer the New Jersey Intercampus Network, until now funded only for planning, educational, and design initiatives, the opportunity for centralized coordination, which would improve efficiency and better meet the telecommunications needs of the colleges and universities in the state.

Those states that have emphasized cooperation between state agencies, local municipalities, school districts, and universities have been the most successful in producing a telecommunications plan for education. These groups comprise more than just public agencies and regulatory bodies. The private sector - in the form of hardware designers, network operators, and curriculum developers - must also be part of the dialogue. Only by working together will the benefits of a long-term vision of distance learning be realized.

New Jersey has several activities under way that use advanced telecommunications to enhance education. New Jersey has played a lead role and benefited from the federal STAR Schools Program, a program which employs satellite downlinks in the state's schools. The state has also been involved in the development of two-way interactive video systems, Instructional Television Fixed Service (ITFS) technologies, and data communications networks. These experiences will clearly benefit New Jersey as it continues to develop telecommunications policy for education, since it has gained valuable experience in systems implementation.

Strong motivation, especially in the areas of improved quality of care and cost reduction, exists for increasing the use of telecommunications and information technologies in the health care industry in New Jersey.

(2) health

Information technologies have great potential for improving quality of health care services while reducing delivery costs. An advanced telecommunications network is essential to the effective deployment of these technologies, allowing hospitals and other health care providers to extend the benefits of information across a large number of institutions and individuals. Some of the efficiencies gained from such a system could be used by health care providers to address more far-reaching issues, such as to help offset the cost of health care services to the uninsured citizens of the state.

The demand for more complex and costly health care services will increase. This situation is complicated by the rapid rise of health care costs overall, which are growing at a rate far above that of the Consumer Price Index. Additionally, pressure on the revenue stream of doctors and hospitals brought on by prospective payment and managed care plans and increases in the average age of the population all contribute to this problem. Compounding these pressures are the rising ranks of uninsured in the state, whose inability to pay places increased pressures not only on taxpayers but on those that can pay for health care services.

Within hospitals, health care information systems allow hospital administrators and physicians to more efficiently manage patient care schedules, maintain more accurate and complete medical records, effectively operate hospital subunits, keep tighter control of materials, facilitate medical decision-making, and provide strict financial control and reporting. In-hospital networks and bedside terminals can make the information generated by these systems more readily available for medical and operational decision-making, leading to more, well-informed patient care decisions.

Together with these information-based technologies, image-based technologies can improve health care efficiency and effectiveness. Specifically, electronic imaging systems, which convert x-rays and other medical images into digitized form, could be effectively disseminated among a number of experts over a high bandwidth telecommunications network. These advanced imaging systems are already being used at leading medical institutions. Where personal visits are either too costly or logistically impractical, conferences between these experts and practitioners employing videoconferencing and diagnostic imaging applications can help to bring the highest level of medical care to a greater number of individuals.

These image-based technologies also offer opportunities for New Jersey to greatly improve its health care service delivery system. Through teleradiology (the transmission of x-ray and similar imaging over the telecommunications network), hospitals in the major urban centers could share their most experienced medical personnel in the diagnosis of patient conditions. The use of such "remote diagnostics" could be used to raise the quality of care offered to all citizens in the state, not only those with access to the most advanced institutions. Similarly, the remote diagnostic concept could be extended to the rural areas of the state, eliminating unnecessary travel by patients to urban hospitals and improving health care in the state's more remote areas.

(3) **Statewide availability of advanced telecommunications network technology could help reduce disparities in the delivery of health care services.**

Internal computing and information transfer capabilities are already being enhanced in hospitals in New Jersey. As these systems continue to evolve and interrelationships between health care providers develop further, New Jersey hospitals will increasingly look to the telecommunications network to satisfy their more extensive telecommunications demands.

health

By making advanced telecommunications services available through a widespread high bandwidth network, these benefits can be brought to patients everywhere, from those using the most advanced research hospitals to the smallest community health centers.

Public policies that encourage deployment of an advanced telecommunications infrastructure are essential for New Jersey to achieve the level of employment and job growth expected in the state.

Advanced telecommunications capabilities are expected to be particularly important for the attraction and retention of business in New Jersey. The focus of future economic development efforts in the state will be on the services-producing sectors of the economy, such as the finance, insurance, and real estate industries. Many states will be targeting such businesses because of their rapid growth, low-asset intensity, and job creation. Furthermore, these sectors have also been identified as among the most telecommunications-intensive sectors of the economy. Therefore, it will be essential for the state's telecommunications network to be able to support the capabilities required by these types of businesses.

The increasing role of telecommunications in business can be traced 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. Advanced telecommunications capabilities are now widely recognized as a "competitive weapon" in economic development and business retention.

This reflects the overwhelming recognition of the study participants that business is rapidly becoming much more information- and telecommunications-intensive. The growth in information intensity will contribute to rapidly increasing demand for information technology and data transport capabilities, including the demand for higher bandwidth data transport through the public telecommunications infrastructure.

Advanced telecommunications capabilities can be a significant factor in the location decision-making process, especially for companies in the service-producing sector. Thus, telecommunications can serve as a "lever" to enhance the attractiveness of a state for business in the service-producing sector of the economy. As an ancillary benefit, to the extent that an increasing proportion of the state's new businesses is in the services-producing sector, which typically does not generate environmental hazards, this will also provide an indirect benefit to the state by helping to mitigate the impact of additional environmental/pollutant concerns.

The capabilities of the infrastructure must evolve in a manner to satisfy the increasingly sophisticated and more complex needs of business users. Additionally, because of the wide dispersion of businesses throughout the state, the telecommunications network must have these new capabilities widely available rather than focused in a few major metropolitan business centers as is the case in many states. As a result, it will be essential for New Jersey to have a statewide advanced telecommunications infrastructure to enhance the future economic climate of the state.

Small business enterprises are extremely important to the overall growth in employment and job growth in New Jersey. Over one-half of the employees of all businesses within New Jersey work at locations with fewer than 100 employees. Thus, small business operations are a major component of the state's and the nation's economic fabric. The needs of these businesses are as important, if not more so, to the state's long-term well being as the needs of large companies with more employees per location.

The combination of these observations suggests an explicit policy role for telecommunications in economic development and business retention.

(5) Future public policy directions should consider the "risk" of not achieving the employment growth and job creation expected in telecommunications-intensive industries.

The state's economic initiatives should encourage employment in those sectors which are telecommunications-intensive. The development of the telecommunications network within the state must, at a minimum, keep pace with the demands of businesses in these sectors. Many of the businesses in these telecommunications-intensive industries are "innovators" in the use of information technology. Consequently, the deployment of new telecommunications technology must stay ahead of emerging transport requirements if advanced telecommunications capabilities are going to be effectively used as a competitive tool to support economic development and business retention efforts in New Jersey.

Employment growth in telecommunications-intensive sectors are forecast to significantly exceed the growth rate of other industries. Eighty-five percent of New Jersey's employment growth between 1988 and 2000 is expected to come from the services-producing sectors of the economy. The services-producing sectors, many of which have also been identified as telecommunications-intensive, will be the drivers behind the earnings capacity of employees in New Jersey in the future.

The state's ability to realize anticipated economic growth is "at risk" if the job growth in telecommunications-intensive industries is not achieved. Future public policies geared to stimulate economic activity and job growth should recognize telecommunications-intensive industries as a major component of New Jersey's expected future growth.

Therefore, because telecommunications services will play a critical role in economic growth and business attraction, the development of the state's telecommunications infrastructure should be encouraged and supported. The availability of advanced telecommunications services within the state should be particularly attractive to telecommunications-intensive industries and would provide a "competitive edge" to attract and retain these businesses.

Regulatory philosophy across the country is supportive of the deployment of an advanced telecommunications infrastructure in LEC networks; the regulatory framework in New Jersey can help enhance the state's competitive position in the "Information Age."

Representatives of state regulatory authorities around the country indicate increasing support for the role telecommunications play in economic development and business retention initiatives. They recognize that there is a competitive advantage to having advanced telecommunications technology employed in their state's networks. Similarly, when evaluating local exchange carrier investment plans, a shift has occurred from a focus on questioning why a particular technology is being deployed to one of questioning why a particular technology is not being deployed more quickly and on a broader basis. Clearly, regulatory philosophy has changed to an environment where the availability and quality of the telecommunications services offered are significant concerns.

Additionally, there has been a significant trend in recent years for regulators to adopt alternative forms of regulation. Relaxed regulatory policies have become more commonplace than traditional rate base/rate of return regulatory philosophy. These relaxed regulatory policies are in response to the rapid evolution of telecommunications technology and the emergence of competitive alternatives for various telecommunications products and services. Consequently, these

regulatory models have been structured to provide additional incentives for local exchange carriers to develop new products and services, aggressively pursue operating cost-efficiencies, and encourage the deployment of new technology.

While representatives of the regulatory agencies surveyed indicated that their primary objective is to avoid increases in residential telephone rates, they also seemed willing to consider an increase in local exchange rates to support telecommunications infrastructure development under certain conditions. For example, the majority of respondents would support an increase in basic exchange rates to promote economic development or to make more advanced services available to residences and small businesses in the state as part of a long-term upgrade program. Thus, the survey results demonstrate that, while skeptical of basic rate increases, regulators recognize the increasing importance of advanced telecommunications in the "Information Age" and are becoming more receptive to strategic investments needed to deliver the advanced telecommunications service capabilities expected by customers in the future.

The New Jersey regulatory environment has already responded to several of the issues being evaluated by regulators in other jurisdictions across the country. For example, the Rate Stability Plan (RSP), which currently governs New Jersey Bell, is an effective combination of the various forms of alternative regulatory models. The RSP caps the rates for essentially all existing services. Service offerings have been separated into competitive and noncompetitive components. The rate capping element of the plan provides price stability for NJB customers. Should the RSP continue through 1993 as expected, NJB basic exchange and intraLATA toll rates will not have increased for more than eight years. It also provides an incentive for NJB to optimize earnings by introducing new products and services, pursuing cost containment and operating efficiencies, and continuing to deploy new technology.

However, the survey of regulatory practices in other states identified one comparative shortcoming of the existing regulatory framework and model in New Jersey. Approximately two-thirds of the other jurisdictions are empowered to establish pricing flexibility or banded rates for individual services, many without the need for traditional regulatory review. Under present statutes in New Jersey, the NJBPU cannot approve a price increase for any LEC service without a comprehensive review of all revenues, expenses, and investment (i.e., a traditional rate base/rate of return rate case). This statutory requirement maintains a level of administrative burden and costs that most alternative forms of regulation have been designed to help mitigate.

The deployment of advanced telecommunications capabilities technology can be significantly accelerated at minimal cost relative to the base of local exchange carrier intrastate revenues.

While it is evident that numerous social and economic benefits could be realized through investment in a technologically advanced telecommunications infrastructure, the public policy issue of how fast to accelerate such investment is significant. Widespread deployment of new technologies in the public network will require substantial financial resources and could potentially result in higher costs to those who would benefit.

In order to assess these financial ramifications, the Deloitte & Touche/Braxton team identified three potential investment acceleration scenarios, which have been categorized as moderate, aggressive and extreme, based on the degree of acceleration as compared with business-as-usual plans.

The two major local exchange carriers in the state, NJB and United, developed ten-year business plans to determine the ramifications of meeting three accelerated infrastructure deployment scenarios. In particular, the focus of the analysis was to determine the impact of accelerated infrastructure deployment on capital investment, depreciation and capital recovery, operations and maintenance expenses, new revenue streams, and earnings as compared to a business-as-usual scenario for the ten-year period 1991 to 2000. The three different scenarios - the moderate, aggressive, and extreme - each has increasing levels of advanced telecommunications technology deployment. The extreme scenario is an "outlier" plan which exceeds the practical limits of new technology deployment, but serves as an outer boundary for the financial analysis. The aggressive scenario is a realistic plan that would place New Jersey at the forefront of technology deployment as measured by national and international criteria throughout the next decade. The moderate scenario represents a middle ground between today's business-as-usual deployment plans and the aggressive scenario. Thus, policymakers have at hand both the relative costs and benefits of accelerated infrastructure investment to consider as part of their evaluations of public policy alternatives.

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.

Even under the extreme scenario, which would be impractical to pursue, the annual required percentage increase in revenues only slightly exceeds 10%, and then for only three of the ten years included in the period under analysis. The annual percentage increases in the remaining years of the period are significantly below the 10% level.

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.

It should be recognized that all of these accelerated investment scenarios incorporate significant capital investment in technology over the ten-year period, beyond the business-as-usual scenario: $907 million in the moderate scenario, $2.1 billion in the aggressive scenario, and $3.9 billion in the extreme scenario. However, the incremental revenue increases required to support the acceleration of technology deployment appear reasonable. This observation is based on the general inflationary increases anticipated over the same time frame and the level of capital investment and capital recovery costs included in these scenarios.

New Jersey has several economic and demographic characteristics that have not only helped reduce telecommunications user costs in the past, but will help reduce the total cost of accelerated telecommunications technology deployment. These include:

- The relatively high density of the state of New Jersey is clearly an advantage. The population density in New Jersey is 1,034 persons per square mile, as compared to an average of 70 persons per square mile for the total United States.

- There are 531 individuals employed per square mile in New Jersey, as compared to an average of approximately 33 individuals per square mile for the nation.

- There are an average of 28 business firms per square mile in New Jersey, as compared to an average of less than two business firms per square mile in the total United States.

High density is generally advantageous to the deployment of telecommunications infrastructure. For example, the density and close proximity of both residential and business customers reduce the average length of fiber cable required to serve the state's customers. This reduces the investment required for the fiber cable and electronics required to offer "Information Age" service capabilities.

The telecommunications network in New Jersey is already reasonably sophisticated when compared to the networks of other telephone companies across the country. During the 1980s, the local exchange carriers in New Jersey invested several billion dollars to upgrade the network, providing new technology and services to large portions of the state's citizens and building the foundation for an even more advanced telecommunications infrastructure. This historical investment and upgrade of the network will help to reduce the overall cost of accelerating telecommunications technology deployment in the state.

The growth in the demand for both traditional and newer services has produced a diversified revenue base of several billion dollars over which to spread the incremental costs of accelerated technology deployment. This diversified revenue base is derived from the high level of population density in the state, the high level of dependence of the citizenry on telecommunications services which generate significant revenues, and the features and functionality already resident in the telecommunications networks which generate additional and growing revenue streams. This growing revenue base helps to mitigate the need for additional revenues to support the acceleration of telecommunications technology deployment under the various scenarios discussed. These advantages can help propel New Jersey to a long-term leadership position in the deployment of telecommunications technology.

In conclusion, a significant strategic opportunity exists to advance the public agenda in New Jersey through the accelerated deployment of a reasonably priced, advanced telecommunications network in the state.

This study highlights the unique position of New Jersey in establishing public policy initiatives for telecommunications in the 1990s. Telecommunications can and should play a significant role in supporting the economic, educational, and health-care needs of New Jersey in the twenty-first century. As discussed previously, the benefits of deploying advanced telecommunications technologies cannot only be measured from the revenue streams of the state's local exchange carriers. Benefits will primarily manifest themselves in improved communications, operating efficiencies, and/or decision-making by residential and business customers using telecommunications capabilities to support the performance of many activities. However, one trend is undeniable: the telecommunications network of the 1990s and beyond will be required to deliver advanced capabilities to meet the increased demands of all subscribers as information and video technology permeate both the workplace and the home.

Additionally, it is important that the acceleration of telecommunications technology be accomplished in a manner which does not jeopardize the significant public interest benefits achieved to date in New Jersey - the lowest basic exchange rates in the country. As a result of the favorable rate structure, demographic factors, such as population density, broad intrastate revenue base, and current level of technology deployment, the acceleration of advanced telecommunications technology in the state's telecommunications network could be accomplished with limited impact on New Jersey ratepayers. This conclusion is particularly significant when viewed in comparison to the prices that customers in other states pay today for existing technology, not the advanced network of the "Information Age." Effectively, New Jersey residents could have one

of the most advanced telecommunications networks in the country and maintain its position as one of the lowest-priced providers of basic exchange and intraLATA toll services in the country.

These considerations provide a logical framework for balancing the interests of New Jersey's citizens, the local exchange carriers and their shareholders, and regulators alike. Given the potential for the state to reap significant and unique benefits from an advanced telecommunications network, as well as its successful regulatory framework and favorable pricing position, New Jersey is well positioned to accelerate deployment of an advanced telecommunications infrastructure.

This widespread low-cost, high bandwidth network should enable the state's citizens to actively participate in the information exchange capabilities of the 1990s and the twenty-first century. As a result, the practical benefit of these capabilities will manifest themselves in supporting access to capabilities that will improve their productivity and quality of life.

I-2. PROJECT SUMMARY

OBJECTIVES OF THE STUDY

More specific objectives for the study included the following:

- Describe the telecommunications industry within New Jersey and its condition

- Evaluate and analyze the extent of the linkage between the telecommunications infrastructure and economic growth in New Jersey

- Analyze and define the various components of the telecommunications infrastructure needed to position New Jersey to meet the needs of its citizens and businesses in the "Information Age." This analysis should include the assessment of requirements to:

  . Retain businesses currently located in New Jersey and support their future expansion
  . Attract new business to the state
  . Ensure cost-effective, universal "Information Age" services for all residents

- Evaluate the relationship between the capabilities of a modern telecommunications infrastructure and the ability to facilitate the resolution of various public policy issues in New Jersey. These specific public policy issues to be evaluated vis-a-vis the current and future capabilities of the telecommunications infrastructure include:

  . Opportunities to strengthen the availability and access to information in support of educational programs

  . Opportunities to strengthen the quality and cost-effectiveness of health care services

- Evaluate the ability of New Jersey's telecommunications providers (LECs only) to develop and market new products and services

- Evaluate the financial and operational implications associated with providing the various components of the telecommunications infrastructure needed to position New Jersey to meet the needs of its citizens and businesses in the "Information Age."

- Evaluate the current incentives and/or disincentives for telecommunications providers to develop new products and services, improve efficiency, and price competitively

- Evaluate the relationship between progressive regulatory policy and the development of the telecommunications infrastructure

It is also appropriate to establish the limits of the overall study as well as its scope and objectives. The focus of this effort is to assess the issues and implications of technology deployment for the local exchange carriers in the state only. The scope of the project does not include an assessment of the same issues as they might apply to interexchange carriers, i.e., long-distance carriers in New Jersey, nor does the study attempt to determine the most cost-effective technology application to provide the capabilities discussed in the report. We recognize and appreciate that some of these capabilities might also be offered by the cable television industry, various wireless transmission media such as cellular or satellite service providers, and/or alternative access vendors operating fiber networks. This study and its results are intended to serve as the

foundation for determining whether the availability of these capabilities is essential to the state and to put into perspective the estimated cost of providing those service capabilities through the ubiquitous network of the LECs in the state. Obviously, to the extent that such capabilities can be delivered by other providers more efficiently and/or effectively, this should be given serious consideration by policymakers. However, the study does provide a baseline or benchmark for comparative assessment.

APPROACH AND METHODOLOGY

The overall approach to meeting the objectives of this study focused on obtaining direct input from participants in the management of public sector economic development and business retention programs, businesses that have recently been involved in the business location decision-making process, education and health care professionals, and representatives of state regulatory agencies to obtain their perspectives on the current and future importance of the LEC telecommunications infrastructure in New Jersey. In addition, discussions were held with representatives of the Office of Rate Counsel within the New Jersey Department of the Public Advocate.

This was accomplished primarily through interviews and surveys. The results of these activities provided a framework for evaluating the current and future role of telecommunications infrastructure as perceived by these different stakeholder groups. Data obtained from a variety of sources provided comparative "benchmarks" of the importance of telecommunications infrastructure issues in New Jersey versus other areas of the country. This analysis also evaluated in general terms the role of telecommunications and information-intensive businesses on the overall economic profile of the state. For example, we highlighted the contribution of businesses that are relatively more dependent on telecommunications to the expected growth in the employment forecast for New Jersey. To put New Jersey issues and results in context, comparisons to other parts of the country are frequently presented in this study.

An assessment of the state's LEC telecommunications network, current telecommunications technology in place, and product and service delivery capabilities was performed. The study also included an analysis of trends and future requirements for the transport of voice, data, and video information, and how it may impact the telecommunications network. Also, in conjunction with this, an analysis of the New Jersey telecommunications network and infrastructure was performed to compare telecommunications technology sophistication of the state to other areas of the United States. This effort included a comparison of the quality of service delivered by LECs in New Jersey to other major LECs.

The third major component of our approach was to evaluate the financial implications of accelerated technology deployment on LECs in New Jersey through the year 2000. Technology deployment scenarios were prepared by the LECs, at our direction, to determine the additional capital investment required to achieve different levels of advanced telecommunications technology deployment, revenue streams from new products and services, and operating and maintenance cost efficiencies anticipated from the deployment of new technology. This exercise provides the basis for evaluating the trade-offs between the anticipated benefits of advanced telecommunications capabilities in LEC networks and the costs of providing those capabilities to users of telecommunications services.

ASSESSMENT OF THE CURRENT TELECOMMUNICATIONS INFRASTRUCTURE

The telecommunications services available to residential and business users within the state depend on the underlying infrastructure of the state's telecommunications network. The technical capability of this network is a function of three core components, which include switching, transport, and signalling. The network services available to a given user are defined by the combination of the three core technology components available at the end users location.

The technology composition of the network has evolved over time and contains various vintages and generations of switching, transport and signalling equipment. While newer equipment is designed to work with older and more mature technologies, new services made possible by newer equipment cannot always be supported by existing technology. As a result, not all services are available to all end users at the same time.

> **The services supported by a telecommunications network over time depend on: (1) the major network components that enable various service capabilities; (2) the network evolution; (3) the technology and services link; and (4) possible technology/service deployment models.**

Switching, transport, and signalling provide the underlying platform for the services supported by the public-switched network. Because services required by end users differ across market segment and geographic location, the dispersion of technology need not be uniform.

The evolution of a network's technology composition, (and, therefore its ability to provide advanced services) is driven by four factors including: (1) technology advances; (2) network economics; (3) market demand; and (4) the regulatory environment. Each of these factors can impact the network in a variety of ways, and can either accelerate or retard the evolution of the network.

- Technology advances within the LEC networks are driven by a small set of vendors. The advances tend to be evolutionary rather than revolutionary.

- New technology had been traditionally deployed in LEC networks to reduce expenses and not to generate new service revenues. As a result, service capability may lag demand. However, this trend may be changing. An example is the broad deployment of network-based, software-driven call processing capabilities (Signalling System 7) in New Jersey, which enables Custom Local Area Signalling Service (CLASS) and Integrated Services Digital Network (ISDN) services.

- The regulatory environment affects the evolution of the network. Depreciation policies and the nature and extent of regulatory incentives can accelerate or retard the rate of technology deployment.

A technology/service correlation matrix defines the mix of services that can be offered at a given point in time. Because networks are made up of various vintages of technologies, not all services will be available to all users. The services available to a particular user are limited by the least sophisticated technologies deployed at the end user's location. This can be a real problem for large, multi-location business end users requiring uniform services and capabilities at all locations. **In fact, such large users may turn to competitive systems and/or customer premises equipment solutions to overcome the lack of uniform LEC network capabilities at all user locations.**

In general two models of technology and service deployment can be defined: (1) Supply Push; and (2) Demand Pull. The first model suggests that technology deployment not only satisfies pent-up demand, but also stimulates market growth. The major risk is that investment may be underutilized or stranded.

The second model is a risk averse deployment strategy. Technology is deployed to meet well defined customer demand. A long-term risk of this second strategy is that customers will turn to non-LEC sources of supply for specific services as well as the potential loss of new revenue streams if capabilities are not available when customer demand does materialize.

In New Jersey, similar to other regions in the United States, the LECs have traditionally followed a technology deployment path primarily defined as demand pull. However, the two deployment models provide alternative strategies for the evolution of New Jersey's network. Should the service capability of the network be inadequate to meet the needs of the state's residential and business customers, the LECs may be encouraged, if not required, to adopt a more aggressive (supply push) deployment strategy. If the current service levels are deemed sufficient, and the evolutionary pace of the LECs technology deployment plans is acceptable, a demand pull strategy may be sufficient.

The state of New Jersey's infrastructure is defined primarily by the condition of NJB's network technology composition.

The largest LEC in New Jersey is New Jersey Bell (NJB) with approximately 97.3% of all access lines. As a result, NJB's technology deployment schedule defines the services available to the majority of the state's telecommunications users. The LECs differ not only in size, but also in the type of geographic regions and markets they serve. For example, approximately 32% of NJB access lines are classified as business lines, while United and Warwick have 20% and 11% of their respective lines classified as business lines. This implies different service and technology deployments may be appropriate for different markets and geographic locations served by the LECs.

The three New Jersey LECs are responsible for deploying technology and services in their respective franchise areas. The rate of this technology deployment and evolution, however, varies along the three primary technology components.

The rate of digitalization is higher in United's territories than within NJB regions. However, the digital ITT switches in United's territories are not equipped with the capabilities to support new telecommunications technologies and network applications (e.g., Integrated Services Digital Network - ISDN or network-based, software-driven call processing capabilities - Signalling System 7). According to United's network plans, these switches should be replaced by the mid-1990s. NJB is in the process of upgrading all of its analog switches that are not 1A-ESS technology, today's best analog switch. This upgrade should be completed in the 1993 to 1994 time frame. It is expected that these analog (1A-ESS) switches will remain in the network until the late 1990s. United will upgrade its remaining analog and electromechanical switches by 1994.

Fiber is being deployed in all new interoffice routes and interoffice rehabilitation projects. However, currently 37% of all interoffice routes in New Jersey have a fiber presence. This represents approximately 51% of all interoffice circuits. Broadband services cannot be implemented along non-fiber routes.

In the distribution portion of the network, a limited number of access lines are supported via fiber feeder facilities. In New Jersey, approximately 3% of all assigned pairs are supported via fiber feeder. Except for fiber to the home trials, no residential customers are served via fiber.

New Jersey Bell has widely deployed network-based, software-driven call processing capabilities (SS7), and, as a result, approximately 81% of the state's telecommunications users currently have access to services based on these call processing capabilities. By 1995, both United and Warwick stated they expect to support these call processing capabilities (SS7).

New Jersey's telecommunications infrastructure is capable of providing enhanced voice services and narrowband data services on a nearly universal basis.

More than 99% of the state is served by stored program control switches and as a result, most end users have access to enhanced services and features, such as custom calling services and CLASS services. In addition, because the substantial majority of the state's access lines are supported by network-based, software-driven call processing capabilities (SS7), future services can be more quickly and easily implemented. Based on the business as usual plans outlined by the state's LECs, the majority of the state will be served by digital switches and advanced call processing capabilities by 1995. Those locations not served by digital switches will be served by 1A-ESS analog switches. As a result, users will have access to advanced features that take advantage of these advanced call processing capabilities. However, those users with access to analog switching technology only will not be able to take advantage of digital services (e.g., ISDN). As the analog (1A-ESS) switches are phased out during the remaining part of the decade, this will become less and less of an issue.

The current infrastructure is capable of providing wideband and broadband services to select business, government, and interexchange carrier end users.

High-capacity transport (wideband or broadband) services require digital T-1 carrier transport, which can be provided over copper facilities. Wideband services are generally available only to large business and government users (on special dedicated access lines). In the future, with the advent of wideband switching, these services will be supported by the public network.

Broadband services are currently available to business, government, and interexchange carrier customers. Because these transmission speeds cannot be supported on copper twisted pair facilities, broadband services are limited to coaxial cable or fiber transport.

As cost-effective fiber facilities are deployed first in the interoffice portion of the network, and then the distribution facilities, more and more users will have access to high capacity services. Based on the current deployment plans, the interoffice facilities should be all fiber by 1998. However, access to fiber-based broadband transport capability will remain limited primarily to large businesses, government agencies, and interexchange carriers during the 1990s.

The LECs will continue to introduce new technologies into the network to support both cost reduction efforts and provide new services.

The following baseline plans were outlined by the LECs as the timetable for 100% completion of the deployment of the specified technology.

Network Component	NJB Plan	United Plan	Warwick Plan
Digital Switching	2001	1993	1990
SS7 Signalling	1993	1995	1995
Fiber Interoffice	2000	1995	1993
Fiber Feeder	2020	2010	N/A
Fiber Distribution	2030	2020	N/A

Based on the above plans, advanced network features that require SS7 signalling will be available to all of the state's telecommunications users in the 1995 time frame. Digital services will be available to the majority of users by the turn of the century. Finally, broadband services are expected to be available to all users (business and residential) in the 2030 time frame.

New Jersey's current telecommunications infrastructure, capital expenditures, and quality of service are comparable to other Bell Atlantic states, other U.S. LECs, and in the case of international comparisons, highly developed foreign countries.

By all relevant and available measures, New Jersey's current infrastructure is comparable to - if not above average - in comparison to: (a) other Bell Atlantic states; (b) other U.S. LECs, and (c) highly developed foreign countries. Moreover, New Jersey is a world leader in the deployment of SS7, the signalling system that will serve as the basis for many "Information Age" services in the 1990s.

By the mid-1990s, New Jersey should remain (given current LEC technology plans) in the mid-range of LECs in terms of deployed digital switching and fiber technology. In addition, because other LECs are expected to increase SS7 deployment, NJB will lose its advantage in signalling technology deployment.

We compared the quality of service statistics provided by LECs in New Jersey to applicable regulatory standards in the state as well as to the quality of service performance of other large telcos across the country. The performance statistics indicate that both NJB and United are performing at or above the quality of service standards adopted by the NJBPU. Additionally, the comparative statistics demonstrate that overall quality of service performance has improved in New Jersey in recent years. Furthermore, the performance of NJB, the largest local exchange carrier in the state, is on par with, or exceeds, the quality of service performance achieved by the other RBHCs across the United States.

THE ROLE OF TELECOMMUNICATIONS IN ECONOMIC DEVELOPMENT INITIATIVES

The role of telecommunications in economic development has taken on increasing significance during the past few years. The role of telecommunications infrastructure in economic development is also now recognized as critical by government officials and policy makers in their policy statements, reports, and studies, such as the NTIA's comprehensive examination of the telecommunications infrastructure in the United States. Additional evidence of the increased significance of telecommunications in economic development is provided by numerous examples of organizations that use telecommunications for competitive advantage.

Interviews were conducted with economic development program managers and executives of relocating businesses to understand the role of telecommunications in economic development initiatives and programs. The experiences of economic development managers and executives of relocating businesses provide highly relevant perspectives on the impact of advanced telecommunications upon the attractiveness of a particular area for business location. Responses on the relative role of telecommunications in economic development or business relocation in New Jersey vis-a-vis other areas are reported separately.

> **The increasing role of telecommunications in business can be traced 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.**

Based on the discussions with four survey groups, economic development managers and executives in relocating businesses both in-state and out-of-state, it is evident that the role of telecommunications in today's business environment is increasing. Several factors contribute to the increased role of telecommunications in business.

The vast majority of respondents in all interview populations indicated that companies are becoming more information-intensive. The overwhelming preponderance (at least 85%) of economic development managers in major U.S. cities, executives in relocating businesses in New Jersey, New Jersey economic development program managers and executives in relocating businesses outside New Jersey supported this assessment.

A significant majority of interview participants in all survey groups also believe companies are becoming more telecommunications-intensive. Essentially, all of the economic development managers in major U.S. cities reported increasing dependence upon telecommunications, along with the substantial majority of the New Jersey economic development managers. Of the executives in relocating companies, 86% of the New Jersey respondents believe their companies were becoming more telecommunications dependent, while three-fourths of the respondents from outside the state had witnessed this phenomenon.

Additionally, the industries expected to provide the greatest potential for economic growth in the future are generally considered telecommunications-intensive. Economic development managers both in New Jersey and in major U.S. cities identified services-producing industries more frequently than goods-producing industries as those expected to provide the greatest potential for future economic growth in their areas. Economic development managers within the state of New Jersey were nearly unanimous in their expectation that this would occur, as essentially all of these respondents identified services-producing industries. In comparison, only one-third of New Jersey economic development managers selected one of the goods-producing industries as those expected to provide a strong potential for economic growth in the future.

The linkage between high growth industry and high telecommunications intensity is shown by the fact that the higher growth, services-producing industries are considered more telecommunications-intensive than goods-producing industries. All four groups of respondents evaluated services-producing industries as more telecommunications dependent than the goods-producing industries. Furthermore, although the specific industries identified varied by survey

group, all four groups of respondents ranked the finance, insurance, and real estate category and the services category in the three most telecommunications-intensive industries (as listed below):

Rank	U.S. ED Managers	New Jersey ED Managers	U.S. Business	New Jersey Business
1	F.I.R.E.	F.I.R.E.	T.C.E.G.S.S	F.I.R.E.
2	Services	Services	F.I.R.E.	Manufacturing
3	Manufacturing	T.C.E.G.S.S	Services	Services

F.I.R.E. - Finance, Insurance, and Real Estate
T.C.E.G.S.S - Transportation, Communications, Electric, Gas, and Sanitary Services

The role of telecommunications in the business environment is clearly becoming more important as indicated by economic development professionals and executives involved in relocation decisions. The increasing role of telecommunications can be traced to fundamental forces in the business environment including the increasing intensity with which businesses are using information and telecommunications services, and the increased importance of telecommunications-intensive industries, both in New Jersey and nationwide.

Telecommunications is important to a company's ability to compete in today's business environment.

A significant majority of the respondents in all survey groups reported that the availability of advanced telecommunications services is important to a company's ability to compete in today's business environment. Economic development managers from major U.S. cities were nearly unanimous in their opinions that such capabilities were important. Similarly, the overwhelming majority of both groups of New Jersey respondents (the economic development representatives and the executives in relocating companies) considered the availability of telecommunications important for company competitiveness, while three-fourths of executives in relocating businesses outside New Jersey agreed that advanced telecommunications services played an important role in remaining competitive.

A majority of the respondents in the various survey groups also believed that the cost of technologically advanced telecommunications services was important to a company's ability to compete today. The substantial majority of executives in relocating companies identified cost as important or critical; somewhat less but still a majority of economic development managers believed cost was important or critical to company competitiveness.

When the respondents' assessments of the importance to competitiveness of telecommunications availability and cost are compared, it is clear that the participants rate availability as more important than cost. Three of the four groups surveyed reported that the availability of telecommunications services was more important to a company's ability to compete than cost. Executives of relocating businesses outside the state were the one group that assessed the cost of telecommunications services as more important than availability for competitiveness.

The effect of telecommunications upon a firm's ability to remain competitive in an ever more demanding business environment has been recognized by economic development managers and relocating businesses alike. An overwhelming percentage of both economic development managers and executives of relocating businesses agree that both the availability and cost of telecommunications services are important competitive factors in business today. However, the availability of telecommunications services is generally considered more important to remaining competitive in today's business climate.

infrastructure

Telecommunications is expected to be even more critical to a company's ability to compete in the future.

Executives in relocating companies agree that telecommunications will become a more important competitive factor for their businesses in the future. Almost all survey respondents believe that the availability of telecommunications services will be more important for their company's ability to compete in the future, i.e., over the next three to five years. Over 93% of executives within the state of New Jersey considered the availability of telecommunications services important or critical for future competitiveness, while 85% of executives outside the state responded similarly. Furthermore, these assessments of the future importance of telecommunications availability as a competitive factor represent increases over the similar evaluations of today's importance. The implications of these separate assessments is that telecommunications availability will play an increasing role in the competitiveness of the business community in the near term future.

Executives in relocating companies also report that the cost of telecommunications services will be important for future competitiveness of their companies. The overwhelming majority of executives from New Jersey identified cost as either important or critical for the future competitiveness of their companies, as did executives outside the state. These evaluations of the importance of telecommunications cost as a competitive factor also represent increases over the similar assessments of its importance in today's business environment. Thus, telecommunications cost will play an increasing role in companies' ability to remain competitive in the future. This was true for both New Jersey and out-of-state respondents.

Executives in New Jersey more frequently evaluate the availability of telecommunications services as important to a company's ability to compete than the cost of those services. In contrast, executives from relocating companies outside the state more frequently considered cost, rather than availability, as important to competitiveness.

Executives of relocating companies have recognized the increasing role that telecommunications will play in the future competitive environment. They have further indicated that both the availability and cost of telecommunications services will have a more significant impact upon the competitiveness of their businesses in the future. Finally, executives of relocating companies in New Jersey attribute greater importance to the effect of the availability of telecommunications on competitiveness rather than cost.

Telecommunications is a significant consideration in the business relocation process. As such, telecommunications has clear ramifications for economic development initiatives seeking to attract/retain businesses in New Jersey.

The four groups surveyed not only consider telecommunications important for their ability to compete, but they also consider telecommunications an important factor in business relocation decisions. Telecommunications availability and cost were ranked along with other factors businesses evaluate in their relocation decision. With the exception of New Jersey economic development representatives, the availability of telecommunications services is regarded as an important factor in the location decision process (in terms of relative rank among all factors). Executives in relocating businesses especially identify the factor as important, as attested by its ranking of 4th among more than 20 factors by executives of relocating companies in New Jersey and 6th by executives of relocating companies elsewhere.

Economic development representatives and executives of relocating businesses also differ in their assessment of the impact that technologically advanced telecommunications services within

a state would have on that state's ability to attract and retain businesses. Economic development representatives assessed the impact as particularly favorable, as 97% of U.S. economic development managers and 91% of New Jersey economic development managers considered the impact as either slightly/significantly positive. Although many executives in relocating businesses believe the impact would be favorable, the assessment of its impact was not nearly as strong. Forty-four percent of executives in New Jersey relocating businesses and 42% of respondents in relocating businesses outside the state reported the favorable impact of advanced telecommunications capabilities in their future location decisions.

The importance of evaluating telecommunications issues within the business location process is clearly gaining acceptance. Both economic development managers and relocating businesses noted the importance of the availability of advanced telecommunications services to the relocation decision; the cost of telecommunications services was deemed somewhat less important. Furthermore, economic development managers were nearly unanimous in their belief that technologically advanced telecommunications services would positively impact a state's ability to attract and retain businesses.

These findings support the conclusion that telecommunications plays an important role in economic development and will be even more important in the future. The results of these analyses demonstrate that the availability of an advanced telecommunications infrastructure can provide a significant contribution to the general business and economic climate in the state of New Jersey.

TELECOMMUNICATIONS OPPORTUNITIES IN EDUCATION

The observations and conclusions below serve as a summary of the major issues surrounding the application of telecommunications to education in the United States overall, and in New Jersey in particular.

Telecommunications could help address some of the major problems currently facing educational institutions today.

Major problems facing the U.S. educational system today include unsatisfactory educational performance, budgetary pressures, and potential teacher shortages. Education provided over a network - so-called distance learning - could address many of these concerns.

Distance learning can help improve educational quality by eliminating the geographic constraints which have traditionally prevented experts in specific fields from reaching a regional, or even national, audience. Telecommunications can be used to expand the breadth of instruction in the nation's schools, not only increasing the value and diversity of the education, but also increasing student interest and participation in school. Finally, distance learning can help bridge the gap between educational "haves" and "have nots." Any school or student could have access to the same teaching experience.

In providing this expanded curricula, distance education can also help to reduce the costs of providing specific courses by virtue of the cost sharing gained through wide dissemination of distance learning courses. Telecommunications can also help alleviate teacher shortages, and build the technological skillbase in the nation's student body necessary for effective performance in the marketplace.

A broadband, switched telecommunications network offers great potential for facilitating the implementation of two-way interactive voice, data, and video distance learning technologies.

With a high-speed, digitally switched public telecommunications infrastructure, educators could create two-way, fully interactive video and audio environments for providing distance training. Such an educational environment could simulate the close student-teacher bond, which is the fundamental strength in traditional classroom training. At the same time, the span of the public telecommunications network could allow the inherent benefits latent in the distance education concept to be realized: expansion of the traditional classroom environment, sharing of expert resources on a broad scale, cost efficiencies from economies of scale in instruction delivery, and creation of entirely new learning experiences. For example, the interactive video network developed by Bergen County Schools in New Jersey is a leading edge application of distance learning using fiber-based telecommunications technology.

While greatly expanding opportunities in video-based education, an advanced public telecommunications network offers potential to expand the use of computer applications in the learning process. Just as computer systems have emerged as essential tools in the business world, computer-based training is now possible using multimedia workstations and high-resolution displays. High-speed telecommunications networks will create a new way for teachers and students to interact - remotely, dynamically and efficiently. The network could assist educators in creating a more productive and creative work force in the future.

Given the number of distance learning activities in New Jersey and across the nation, there appears to be widespread acceptance that the benefits of distance learning can be realized in the near term.

Based on a study by the Office of Technology Assessment, 49 of 50 states in the United States have incorporated at least one program dealing with the application of telecommunications to education, and more than 20 states, including New Jersey, have implemented four or more programs.

Because of limitations in the existing technological capability of the public-switched telecommunications infrastructure, its use has been somewhat limited in the delivery of distance education.

The nature of interaction over an educational network should replicate as closely as possible the "live," instructor-led classroom experience. At a minimum, educational networks must be able to support one-way full-motion video transmission, as well as data and voice. Educators are calling for their distance learning networks to provide increasing levels of interactivity.

Currently, the public-switched telecommunications infrastructure is used in education for voice communications and in the delivery of low-speed data transfer services. For high-speed transfer of data files and video-based training, education researchers, teachers, and students must use specialized private networks or lease dedicated (nonswitched) facilities.

The existing public telecommunications infrastructure was designed for the low-speed transmission rates required for basic telephone voice conversations. Generally speaking, upgrades to the infrastructure have yet to be made that will allow the public network to provide high data rate, flexible communications services.

Other technologies currently used for distance learning today not only have serious flaws but are too costly for most institutions to deploy unilaterally. While educators have employed a

number of alternative technologies in distance education - broadcast, satellite, microwave, cable, and private networks - each has some limitations in capacity, flexibility, and nature of interaction. Further, the significant cost to an institution of implementing a switched broadband system on their own can pose a severe impediment to implementation.

Network providers face a wide range of choices in the design of distance learning networks, because the "ideal solution" is not in place today. Educational networks tend to be designed instead for specific applications: data transfer, video transmission, educational broadcasting, etc. They employ various transmission media, from copper to fiber to satellites. Today, educational networks may be operated by local exchange carriers, not-for-profit institutions or consortia, for-profit corporations, or some combination. As a result of this diversity, a patchwork of application-specific educational networks exists today.

The "ideal solution" must meet the following requirements:

- Reach the largest possible number of educational facilities, so that many may benefit from the resources available
- Have enough capacity to transmit two-way interactive, full-motion video signals as well as data and voice, since the distance learning networks should be able to replicate the "live," instructor-led classroom experience
- Be cost-effective
- Be extremely flexible and easy to use, so that the network does not tax the technical expertise resident at individual educational institutions

Only by meeting these objectives will the full potential of distance learning be realized. One possible solution that could meet these requirements is a ubiquitous, switched broadband network. Educators have indicated that a switched broadband network could meet and exceed the requirements of the "ideal solution."

States that have emphasized planning and cooperation between various parties interested in improving education have been the most successful.

In most human endeavors, planning and cooperation are essential to the success of complex projects. In the area of telecommunications in education, a broad range of social, technological, regulatory, and financial issues become intertwined. In addition, a wide range of organizations is active in educational issues. For example, the federal government, state governments, universities, local government and school districts, and private industry have all contributed to the advancement of telecommunications into the educational process.

Those states that have emphasized cooperation between state agencies, local municipalities, school districts, and universities have been the most successful in producing a telecommunications plan for education. These groups comprise more than just public agencies and regulatory bodies. The private sector - in the form of hardware designers, network operators, etc. - must also be part of the dialogue. Only by working together will the benefits of a long-term vision of distance learning be realized.

The wide range of choices available in the design and function of telecommunications applications compels states to carefully study their options. As a result, states must evolve, rather than leap, into statewide telecommunications plans for education through the implementation of

pilot programs. These initial studies enable the organizational, financial, and operational structures and methodologies to develop on a small scale, before widespread implementation.

As was well-documented in Linking for Learning, new teaching methods must be developed for the effective implementation of distance education. This concept is reinforced by the numerous in-service training modules which have been incorporated into a large number of distance learning programs, such as in Bergen County in New Jersey. The development of distance teaching skills can be greatly facilitated through the use of pilot programs.

A wide range of agencies are involved in New Jersey educational telecommunications, but no central planning process currently exists.

The success of New Jersey in implementing pilot distance education programs has been the result of the ad hoc initiatives and informal cooperation between a number of different state and local agencies.

For example, the Department of Higher Education is attempting to develop a statewide video network to link all of the colleges and universities in the New Jersey. At the same time, program administrators for JVNCNET, the New Jersey node of the National Science Foundation Network, have set a goal of linking all state institutions for higher learning with a high-speed data network. Centralized coordination between these two initiatives may offer the opportunity for both improved efficiency and increased service levels for the telecommunications needs of the colleges and universities in the state.

Given the complexity of deploying an advanced network, the numerous parties involved, and the importance of educational goals, central coordination would help ensure that an optimal and timely solution is reached for education on a statewide basis.

New Jersey has several activities underway that use advanced telecommunications to enhance education. However, budgetary constraints may slow efforts by educators to deploy technology for education.

New Jersey has played a lead role and benefited from the federal STAR School Program and the implementation of satellite downlinks in the state's schools. The state has also been involved in the development of two-way interactive video systems, Instructional Television Fixed Service (ITFS) technologies, and data communications networks. This experience base will clearly benefit New Jersey as it continues to develop an educational telecommunications policy, as it has gained valuable experience in systems implementation.

Because of budgetary constraints, the Department of Higher Education is not currently able to fund its New Jersey Intercampus Network data and video systems programs. Ongoing activity in this area is dependent on informal organizations and coalitions of interested parties in the state. Also, the state did not receive funding for the Mid-Atlantic Resource Consortium (MARC 5) proposal for the second round of funding under the federal STAR Schools Programs.

A significant opportunity exists to advance the public agenda for excellence in education through improvements to the telecommunications infrastructure.

In New Jersey, as in the nation overall, educators and public officials are seeking to raise the level of performance of students in basic skill areas such as language, mathematics, and the

sciences. At the same time, our educational system is attempting to address operating and capital budgets problems, and the shrinking supply of highly qualified teachers. An advanced telecommunications infrastructure presents an opportunity to help address these pressing social issues.

By implementing a switched broadband telecommunications network, New Jersey would be better able to provide educational experiences of superior quality in the most difficult inner city environment, the most remote rural area, and the most affluent suburb. The resource, experience, and information sharing, made possible through a ubiquitous network, could help break down traditional barriers to achievement and growth. The experience of Bergen County Schools in New Jersey highlights the potential opportunities for telecommunications to significantly enhance the educational process.

By providing schools in the state with readily available and cost-efficient access to advanced telecommunications technologies in the public telecommunications infrastructure, educators would have the opportunity to utilize a broader set of tools in advancing instruction in all subject areas. With a broadband, switched public telecommunications network, schools and colleges could create flexible, mutually beneficial relationships. These relationships would not be limited by the existence of institution-specific systems but could be made available on a widespread basis to broad constituencies in rural as well as urban areas. In doing so, the agenda for raising the American and New Jersey educational systems to a world-class level of performance throughout the population could be more readily realized.

TELECOMMUNICATIONS OPPORTUNITIES IN HEALTH CARE

The health care industry will demand more advanced telecommunications capabilities in the public-switched telecommunications network in the future. The LECs of New Jersey must ensure that the telecommunications infrastructure in the state is well positioned to meet the emerging demands that will be placed upon it by the health care industry in the future. This will help ensure high-quality and efficient health care service in the state of New Jersey, both through the 1990s and into the next century. The following observations provide the foundation for this conclusion.

The health care industry needs to simultaneously increase quality of service and reduce costs.

The demand for more complex and costly health care services will increase. This situation is complicated by the rapid rise of health care costs overall, which are growing at a rate far above that of the Consumer Price Index, pressure on the revenue stream of doctors and hospitals, brought on by prospective payment and managed care plans, and increases in the average age of the population.

Compounding these pressures is the rising ranks of uninsured in the state, whose inability to pay places increased pressures not only on taxpayers but those that can pay for health care services.

Improved telecommunications and information technologies could help the industry respond to these pressures.

Telecommunications technologies can help New Jersey hospitals address the problems of rising costs, the demand for complex services, revenue containment, and the pressure of controlling the cost of service to those who cannot pay.

Trends toward the increased use of information technologies can be readily seen in the state of New Jersey. Hospitals in New Jersey are making extensive use of a range of information systems: significant penetration exists for patient accounting, medical recordkeeping, and materials management systems. Hospital administrators plan further implementation at an aggressive rate in the future. As a result, the benefits of information and network technologies - increased efficiency and improved decision-making - are being realized by New Jersey hospitals.

Within hospitals, health care information systems allow hospital administrators and physicians to efficiently manage patient care schedules, maintain more accurate and complete medical records, effectively operate hospital subunits, keep tighter control of materials, facilitate medical decision-making, and provide strict financial control and reporting. In-hospital networks and bedside terminals can make the information generated by these systems more readily available for medical and operational decision-making, leading to more well-informed patient care decisions.

Together with these information-based technologies, image-based technologies also provide a means to improve health care efficiency and effectiveness. Specifically, electronic imaging systems, which convert x-rays and other medical images into digitized form, can be readily disseminated among a number of experts through the use of computer networks. Imaging systems are already being used at leading edge institutions.

These image-based technologies also offer opportunities for New Jersey to greatly improve its health care service delivery system. Where personal visits are either too costly or logistically impractical, conferences between these experts and practitioners employing videoconferencing systems can help to bring the highest level of medical care to a greater number of individuals. Through teleradiology, hospitals in the major urban centers could share their most experienced medical personnel in the diagnosis of patient conditions. The use of such "remote diagnostics" could be used to raise the quality of care offered to all citizens in the state, not only those with access to the most advanced institutions. Similarly, the remote diagnostic concept could be extended to the rural areas of the state, eliminating unnecessary travel by patients to urban hospitals and improving health care in the more remote areas of the state. While image-based technologies may not currently be the primary focus of administrators, these technologies will be receiving greater emphasis in New Jersey as they mature in the mid-1990s, and after basic information management systems reach full penetration in the industry.

As the use of information- and video-based technologies grows within the health care industry, organizations are increasingly linked externally to one another. Increasingly, hospitals and suppliers are networking to achieve smoother delivery of supplies, lower inventories, and more timely payment for goods received. Payors and service providers are communicating using data links to achieve lower-cost claims processing as well as more timely and less error-prone exchange of information. Hospitals, physicians, and outpatient referral centers are also integrating relationships, which will increase the level of interdependence and raise the required level of information exchange.

Such movement toward new organizational structures is directly evident in New Jersey. Approximately 17% of New Jersey hospitals are already part of a multihospital network, while the majority of hospitals are utilizing Electronic Data Interchange (EDI) with suppliers. Outpatient referral centers are growing rapidly in the state, while hospital administrators express the need to solidify their relationship with physicians in order to increase referrals.

These increasing organizational linkages, together with the increased use of information and network technologies within individual institutions, set the stage for greater telecommunications demand within the health care industry. Health care organizations wishing to share expertise,

patient records, medical images, and financial data will expect the public telecommunications infrastructure to provide transmission of the information necessary for efficient operations and for improving the reach of quality health care delivery.

Specific health care industry technology plans imply accelerated use of and need for advanced information and telecommunications technologies.

Based on hospital administrators' plans for implementation of new systems and the level of maturity of specialized technologies, a projection was developed for the implementation of advanced systems within the health care industry. Information systems for various applications used in at least half of all hospitals can be expected to reach almost full penetration over the coming three to five years. Network technologies, currently being used in selected hospitals, should see rapid expansion in the middle 1990s. These networks will extend outward from the hospital or other health care institution setting to suppliers, payors, physicians, partner hospitals, and outpatient referral centers through the mid-1990s.

Electronic imaging systems will be employed on a larger scale in the 1990s. Video-based systems, currently employed on a limited basis in approximately one-sixth of all hospitals for distance education, could evolve to routine video-consultation capabilities.

These general trends can be deduced from industry and market data, and are also supported by examples of advanced systems actually in operation today. For example, one program is addressing problems in rural health care through the use of high-speed data networks and videoconferencing systems linking rural hospitals to university-based medical facilities. In Connecticut, a statewide network is being used for integrated claims processing. Experiments in digitized transmission of x-rays are taking place in Boston and Nevada, while physicians and hospitals are communicating over data networks in Nebraska and Minnesota.

While the health care technological deployment to date in New Jersey may be somewhat lower than the nation overall, hospital administrators have aggressive plans for implementing these technologies in the future. Further, the high physician density, outpatient referral center penetration, and presence of industry leaders in New Jersey should catalyze demand for advanced telecommunications technologies in New Jersey in the future.

Strong motivation - improved quality of care and cost reductions - exists for increasing the use of telecommunications and information technologies in the health care industry in New Jersey.

Information technologies have great potential for improving quality of health care services while reducing delivery costs. An advanced telecommunications network is essential to the effective deployment of these technologies, allowing hospitals and other health care providers to extend the benefits of information across a large number of institutions and individuals. Some of the efficiencies gained from such a system could be used by health care providers to address more far-reaching issues, such as how to provide health care to the uninsured citizens of the state.

An advanced telecommunications infrastructure in New Jersey would make readily available to all hospitals in the state high-speed data transfer with suppliers and payors, eliminating the need for individual pairs of suppliers and payors to develop private communications links. Similarly, an advanced telecommunications infrastructure would make possible the development of physician networks on a broad scale in the state, allowing more efficient utilization of the

state's highly trained medical professionals. As teleradiology and videoconferencing are introduced, a ubiquitous, high-speed telecommunications network could allow hospitals, physicians, and outpatient referral centers to form flexible relationships statewide to improve health care service in both urban and rural areas of New Jersey.

In the area of home health care, patients can be monitored remotely by physicians on specific vital signs and treatment regimes. Thus, doctors will not have to wait for regularly scheduled office visits to gain an awareness of changing patient conditions. Changes in treatment can be made on a more frequent basis, depending on the progress of the patient that is recovering in the home.

As New Jersey strives to make greater use of home health care, an advanced telecommunications infrastructure will allow physicians and patients to communicate easily using remote diagnostics. By transmitting patient status information over telecommunications networks, both physician and patient can help ensure that home treatments prescribed reflect the most current patient status information available. Thus, an advanced telecommunications network will help the health care industry in New Jersey to address its most pressing problems. The efficiencies of supplier, payor, multihospital, physician, and referral center networks will help hospitals reduce costs. Teleradiology and parallel developments in other imaging diagnosis will help to raise the quality of care throughout the state. These cost savings and quality gains can be used to address other major problems in the health care industry, such as defraying the expense of the uninsured, while providing high-quality care to all citizens of the state of New Jersey.

The New Jersey health care system is well positioned to exploit advanced telecommunications technologies.

New Jersey has clear opportunities to benefit from advanced information, medical, and telecommunications technologies. These benefits can most readily be realized when telecommunications and information technologies become more readily available to a broader number of hospitals, physicians, outpatient referral centers, and patients within the state.

In determining New Jersey's potential to take advantage of telecommunications and information technology to improve health care quality while reducing costs, several factors were considered that contrast New Jersey to the nation. These included demographic factors, hospital financial performance, existing technological maturity, the presence of multihospital systems and outpatient referral centers, and physician density.

It is clear that telecommunications and information systems present an opportunity to improve the health care delivery system in the state. As New Jersey hospitals tend to be larger than the national average, they are in a better position to implement advanced technologies. This observation was confirmed through interviews with hospital administrators, who revealed their plans for technology deployment.

Many structural factors studied favor the growth in demand for telecommunications in health care. For example, with its large concentration of outpatient referral centers, New Jersey also stands to benefit from coordinating these centers with other service providers. As hospitals and outpatient referral centers join resources to provide more extended service delivery systems, the need for information and image transfer between these institutions will increase. Service quality can be enhanced and efficiencies gained if the members of these health care systems can readily share patient registration, patient care, diagnostic imaging, and referral data across telecommunications links.

Similarly, in the area of multihospital systems, such sharing of information and images can also greatly benefit New Jersey. Although the number of hospitals in multihospital systems is lower in New Jersey than the nation overall, consolidation can be expected in coming years. Similar to outpatient referral center networks, New Jersey multihospital systems can share technical and administrative resources to provide higher quality care for a lower cost.

Finally, with its very high physician density, the emergence of physician office networks in the state could have a pronounced effect on the quality of health care service delivery. Benefiting from readily available patient information, New Jersey physicians will be able to prescribe the most appropriate treatment for their patients in the most timely fashion. Further, through the referral networking made possible by the physician telecommunications links, the vast array of medical expertise which exists in the state can be more fully utilized through remote consultation and diagnostic imaging applications.

A small number of structural factors do not favor rapid growth of telecommunications in New Jersey. For example, New Jersey hospitals are less profitable overall when compared to all U.S. hospitals, largely as a result of the strict hospital reimbursement system in the state. Although this may be seen to potentially limit capital expansion by hospitals into telecommunications in the future, it can also be viewed as a strong motivator. Continued pursuit of means to improved efficiency and competitiveness should lead hospitals increasingly toward technology-based methods for enhancing hospital performance.

An advanced telecommunications infrastructure could help accelerate the use of advanced technologies within health care and help ensure the associated improvements in service efficiency and quality.

In order to obtain the benefits described from advanced telecommunications systems, many of the more profitable health care providers have either developed their own networks or have leased special facilities from local telephone carriers and others. Such an approach to the development of a telecommunications infrastructure can create a condition of health care "haves" and "have-nots" and can lead to health care service inequalities throughout the state or the nation.

A broadband, digitally switched, ubiquitous telecommunications network, on the other hand, is one means to provide substantial benefits for health care institutions and individuals in New Jersey. By making advanced telecommunications services available in the public telecommunications networks, these benefits can be brought to patients everywhere, from those in the most advanced research hospitals to the smallest community health center.

Internal computing capabilities and information transfer capacity is already improving in hospitals in New Jersey. As these systems continue to evolve and interrelationships in health care develop further, New Jersey hospitals will increasingly look to the public networks with more extensive telecommunications demands. In order for the public telecommunications infrastructure to continue to keep pace with the rapid innovations in (and information-intensive nature of) health care technology, it is essential that LECs continue to deploy advanced telecommunications technology in the public network.

While health care institutions in New Jersey could benefit from greater use of today's switched telecommunications network (especially cost reduction benefits), today's switched network already restricts some desirable applications. Moreover, many of the benefits of quality health care expected to flow to individuals can be achieved only through the deployment of a more advanced telecommunications network.

IMPACT OF TELECOMMUNICATIONS-INTENSIVE INDUSTRIES ON THE NEW JERSEY ECONOMY

Various analyses were performed to determine the role that telecommunications-intensive industries play in the overall economy of the state of New Jersey. For the purposes of this analysis, employment, job growth and employee earnings by industry sector were used as measures of overall economic activity. At issue here is the impact of telecommunications capabilities on the ability to achieve expected employment levels and job growth in industries identified as telecommunications-intensive. Also addressed in this discussion is the importance of small businesses in the current and prospective economic picture in New Jersey. The synthesis of the results from these various analyses provides the basis for the following observations and conclusions.

There is general consistency in the definition of telecommunications-intensive industries.

Our study of telecommunications-intensive industries surfaced the same types of businesses as highly dependent upon communications, regardless of the analytical approach or secondary sources used. The telecommunications-intensive industry sectors include the services sector, finance, insurance and real estate, and firms involved in wholesale and retail trade. These sectors fall into what is often referred to as the services-producing sector as contrasted with manufacturing or construction businesses which are generally referred to as the goods-producing sector.

The identification of telecommunications-intensive or -dependent industries noted above is also consistent with the results of other activities performed in conjunction with this study. For example, the services-producing sector, particularly finance, insurance, and real estate, and the other services sector, were noted as telecommunications-intensive in our interviews with economic development program managers, representatives of businesses which have recently been through the relocation decision-making process, and representatives of regulatory agencies.

The analysis of employment and job growth projections affirms that the economy has shifted from a manufacturing to services base.

The analysis of employment and job growth statistics clearly demonstrates the significant shifts in the employment base in this country from primary reliance on the manufacturing sector to service businesses. Similar results are reflected in the changes in job mix in the employment base of the mid-Atlantic region as well as the state of New Jersey. More important, the growth in employment in New Jersey over the most recent nine-year period for which data was available (1979-1988) exceeded the growth rates of employment for both the nation and the mid-Atlantic region. The services-producing sector provided most of the growth in employment in the state, while the manufacturing sector experienced employment decline. These statistics highlight the overall significance of employment in the services sector, previously identified as telecommunications-intensive, to the overall economic profile of the state of New Jersey.

The services-producing sectors are expected to be the catalyst for employment and job growth in New Jersey in the future.

The services-producing sectors (F.I.R.E. services and retail trade) are expected to generate over 85% of the employment growth and creation of jobs in New Jersey for the years 1988-2000.

Additionally, the services-producing sectors are expected to represent the overwhelming majority of jobs in the state by the year 2040, while the goods-producing sector, which includes manufacturing firms, is expected to decline.

Similar results are obtained when assessing the earnings contributed by the various industry sectors. The services-producing sectors, many of which have been identified as telecommunications-intensive, will be the driver behind the earnings of employees in New Jersey in the future. Thus, the realization of job creation and employment growth in these sectors is essential to the overall economic position of the state in the future.

Telecommunications-intensive industries are expected to be an essential component of the state's employment growth and job creation in the future.

New Jersey and the states in the mid-Atlantic region are identified as having a greater proportion of their employment base in telecommunications-intensive industries than the remainder of the United States. New Jersey and the mid-Atlantic region possess a higher proportion of businesses and employment in the services-producing sectors, such as F.I.R.E. and services sectors. Moreover, the New Jersey economy is expected to further increase its dependence on such telecommunications-intensive industries in the future. Likewise, New Jersey is expected to obtain a greater proportion of job growth in telecommunications-intensive industries than the mid-Atlantic region, even though both areas have a significant representation of businesses in telecommunications-intensive businesses in their geographic area.

The combination of these statistics and forecasts clearly demonstrates that employment growth and job creation are expected to continue, and accelerate, in those sectors of the economy which have been identified as telecommunications-intensive. Thus, while there are a myriad of factors and influences which shape rates of job formation and economic growth, it is clear that the telecommunications infrastructure and service delivery capabilities within the state must meet the needs and requirements of the telecommunications-intensive industry sectors where the greatest amount of job growth is expected to be generated in the state. Thus, the development and deployment of telecommunications technology in the state must keep pace with, if not stay ahead of, the increasingly sophisticated and complex demands for transport of voice, data, and video by the sectors.

Future public policy directions should consider the "risk" of not achieving the employment growth and job creation expected in telecommunications-intensive industries.

Employment growth and job creation in telecommunications-intensive sectors are forecast to significantly exceed the growth rate of other industries. Therefore, the state's ability to realize anticipated employment levels, etc., and general economic position are "at risk" if the job growth in telecommunications-intensive industries is not achieved. Future public policies regarding stimulation of economic activity and job growth in the state should take into consideration that telecommunications-intensive industries present a major component of expected future growth. Therefore, given the growth expectations for employment in these industry sectors and the importance of the availability of telecommunications services in economic development and business attraction, the deployment of advanced telecommunications capabilities and the development of the state's telecommunications infrastructure should be encouraged and supported. The availability of advanced telecommunications service capabilities within the state should be particularly attractive to telecommunications-intensive industries, and would provide a "competitive edge" to attract and retain businesses in telecommunications-intensive industry sectors.

Small business is a major element of future economic growth in the state, and advanced telecommunications capabilities will be essential to the vitality of small business.

Small business enterprises are extremely important to the overall growth in employment and job growth in New Jersey as well as the United States. Over one-half of the employees of all businesses within New Jersey as well as the United States work at locations with fewer than 100 employees. Thus, small business operations are a major component of the state's and the nation's economic fabric.

Additionally, smaller businesses have been responsible for the majority of employment growth and job creation in recent years. For example, during the period 1982-1987, 54% of the net employment growth in New Jersey occurred in businesses of fewer than 100 employees. This compares with national statistics where almost 65% of the employment growth over the same time frame occurred in establishments with fewer than 100 employees. Therefore, small business enterprises are a crucial element to general economic and employment growth.

Small business has been and will continue to be a growth engine for New Jersey, and small businesses have particular telecommunications needs that must not be ignored as plans for infrastructure improvement are made. For example, in the wholesale industry, electronic data interchange with customers is becoming more prevalent. Industries with strong small business components such as construction, retail, and wholesale often have a large number of dispersed locations that must communicate with each other and/or with numerous customers. The needs of these businesses must not be overshadowed by industries with larger company sizes and more employees per location.

FUTURE NETWORK REQUIREMENTS

Over the next ten years, technological change in desktop computing power, digital video systems, and information compression techniques will enable the American public to electronically communicate with visual information in much the commonplace manner used today to communicate with voice and data. Technological developments in transmission, switching, and network intelligence will enable carriers to provide the pathways for the "Visual Information Age." Yet, unless investments in infrastructure are made to bring about low-cost, high bandwidth network capabilities that are generally available to most citizens, the benefits of the visual revolution in telecommunications may be limited to large business and institutional users.

Advances in technology will permit desktop computers to process and store image and video information at a decreasing cost. Local exchange carrier networks constrain users' ability to transfer high bandwidth information, such as images, and restrict real-time or interactive video communication.

The personal computer has been a part of the office and home environment for only a decade. During that time, the processing power and information storage capabilities have increased dramatically. For example, the personal computer available at the start of the 1980s had about 64,000 bytes of active memory and processed only about 350,000 instructions per second. By 1990, personal computers could actively store in memory 16 million bytes of information or more and process over 20 million instructions per second.

Advances in desktop computer power will permit individual work stations to process and display much more image and video (moving images) information. In turn, images contain far more information than text or data, since digital information must be transmitted for each

"picture element" (pixel) on the screen. There may be 480,000 such pixels on a standard computer monitor, which each require several bits to describe their color and brightness. If motion is added, this information must be refreshed many times per second. Thus, transmitting an "ordinary" home television color signal in a digital format could require almost 20,000 times the bandwidth of the 2,400 bps modems used by many consumers to access today's on-line information services.

Fortunately, developments in image and video compression technology are decreasing the bandwidth needed to transport video image information, while advances in chip technology will reduce the cost of incorporating image compression technology in desktop and consumer electronic equipment.

Recent international standards development will facilitate widespread availability of video-oriented products in the mid-1990s for use in videoconferencing, transmittal of consumer video information, as well as high resolution still images. For example, one standard (the "P*64 standard") will permit the production of low cost videoconferencing equipment using speeds of 64 kbps to 1.5 mbps. Another, the MPEG (Motion Picture Experts Group) standard, will permit video information similar in quality to that of a home VCR to be transmitted at under 1.5 mbps. Other standards under development could permit video equal to today's broadcast television to be transmitted at significantly lower digital bandwidths than would be required today.

Computer chip vendors expect to incorporate these standards into video processing chips during the next few years. In turn, these video processing capabilities could be incorporated into the main processing chips used by desktop computers by 2000, resulting in significantly decreased costs for desktop image and video capabilities.

Equipment manufacturers believe that these technological developments will result in increased demands for network bandwidth to the desktop at a time when compression techniques will bring the bandwidth required from higher-quality video into the range that an upgraded switched public network could support more cost effectively. For example, desktop systems could require up to 1.5 mbps for videoconferencing, image file transfers, and interactive display of image information; 10 mbps or more could be required for bulk image file transfers and simultaneous access to multiple video sources, e.g., display of multiple videoconference participants, image applications, or video files.

Other factors affect the need for bandwidth as well. Image and video workstations have significant "peaking" characteristics. That is, there may be a burst of transmitted information, followed by long periods of low information flow. Larger users can concentrate the demands of several desktop devices over a local area network or multiplexer, so that the per-desktop requirement for bandwidth leaving a building is relatively low. Smaller users, such as those with only one desktop workstation or videoconferencing device must, however, obtain an access link from the local exchange carrier that supports only that device. Low-cost, higher bandwidth services provided by local exchange carriers may be more important to smaller rather than larger users.

Today's analog local switched telephone service can transmit data at 9.6 kbps and "basic rate" ISDN channels can only transmit at up to 128 kbps. These speeds have generally proved adequate for the text and number transmissions that form the basis of much of today's information transfer. But while today's public-switched network has essentially reached the limits of its ability to support desktop communications, technology will continue to advance the information

processing capabilities available to the individual. The public network will increasingly constrain the ability of individual users unless its capabilities to handle higher bandwidth traffic are increased.

At the same time, consumer video equipment will increasingly incorporate computer-like digital processing capabilities.

Trends in television and entertainment video also will create a need for increasing bandwidth. At the same time that computers are incorporating video technology, television sets are incorporating digital signal processing and other "computer-like" features. At-home users likely will have separate devices for entertainment video and computer video. These devices could, however, share component technology such as video chips and monitors as well as high capacity communications circuits. Demand for digital video technology in each market could thus drive both product innovation and cost-reducing production volume that could benefit the other.

The result is that home video technology should be available in the 1990s which could make use of switched digital video transport to support nonbroadcast video applications. These applications include on-demand entertainment or interactive educational and information services. Mass market residential video applications would facilitate volume introductions of ubiquitous, higher bandwidth digital technology that would permit smaller businesses and at-home businesses and employees to achieve the same level of network connectivity already available to larger users.

Larger businesses are already demonstrating a demand for higher bandwidth services by installing local area networks that bring more than a megabit per second to the desktop. Smaller businesses - a significant element of New Jersey's economy - will require equivalent capabilities from local exchange carriers if they are to remain competitive. Consumer interest in switched video services also can be expected to increase, particularly as today's video-oriented students become the consumers of tomorrow.

There are two key reasons that support carrier investments to meet the demand for higher bandwidths by smaller businesses and smaller branches of larger businesses, even though low-cost, high bandwidth applications are only now coming into existence:

- The marketplace is demonstrating a demand for increasingly higher power personal computers and workstations, for videoconferencing, and for telecommunication to support them.

- Smaller businesses will need to rely on advances in desktop computers and obtain connections to other businesses using those capabilities, if they are to retain their importance in the new economy.

The use of personal computers in businesses has increased dramatically during the past decade, from one per every twenty desk workers in 1980 to one per three in 1989. This trend will continue into the 1990s.

Desktop computers increasingly will be tied into networks, with a majority of business personal computers part of networks in the 1990s. Local Area Networks (LANs) being implemented today provide 10 mbps of connectivity to the desktop. Emerging fiber-optic-based LANs will support 100 mbps and are being designed to support video and voice as well as data traffic. Larger users who install such high-speed LANs (which consolidate traffic from many users) may interconnect LANs in multiple locations using dedicated facilities available from local

exchange carriers; alternate fiber optic providers, such as Teleport; or private digital microwave systems. For example, the number of New Jersey Bell intrastate dedicated 1.5 mbps access circuits (which also have voice uses) has increased from 10 in 1984 to 1,948 at the end of 1989.

The need for high-speed connectivity to smaller businesses is increasing.

Small business, including at-home businesses, will find themselves at an increasing competitive disadvantage as larger users make high bandwidth video/image application an integral part of their day-to-day affairs.

- Larger businesses will seek to "speak" with their customers and suppliers in the same manner as they communicate internally.

- Unless smaller businesses can use image information as effectively and efficiently as their larger rivals, they will be at an increasing competitive disadvantage.

The U.S. Small Business Administration has identified an increasing role for small business as "partners" of larger businesses, based in part on information-processing technologies which facilitate efficient small business specialization. Unless small business increasingly employs advanced information technology, it will not be able to exploit these opportunities or retain a market advantage compared to firms that do.

The need for advanced network connectivity will also grow as the number of individuals who work at home increases. Whether a proprietor of a "home run" business, a telecommuter to a large business, or a professional working at home, a growing segment of users will desire that the communications capabilities available to office desktops also be available at home. Interexchange carriers are already offering higher-speed switched services such as switched 384 kbps and switched 1.5 mbps to customers having dedicated access to interchange carrier's switches. Both large and small users should have reasonably priced access to similar services in local exchange carrier networks.

The bottom line is that New Jersey's economy runs a significant risk if the future telecommunications needs of the state's smaller businesses are not met by New Jersey's local telephone companies.

The demand for higher bandwidth residential access can be expected to grow.

The success of cable television has demonstrated consumer willingness to pay for video services. The Cable TV Act of 1984 prohibits telephone companies from providing "video programming," that is, video transmission equivalent to broadcast video services. Consequently, higher bandwidth transport targeted at residential users may need to rely on applications other than "video programming." There are several such applications:

- Residential units may serve as home base for small businesses or telecommuters. By the year 2000, demand for higher bandwidth services from these units could affect a significant portion of users. Demand for higher-capacity network services to reach such homes could also facilitate demand for other leisure and "family" oriented services, because the terminals, circuits, and user familiarity would be present.

- Independent demand for higher bandwidth switched video programming is likely to develop as well. Various marketing studies have indicated significant residential demand for services such as "on demand" entertainment or other features as well as access to educational programs. Bell Atlantic estimates indicate that 50% of residences would

subscribe to on-demand entertainment within several years after its offering, and 30% would subscribe to interactive video offerings.

- Higher bandwidth access would also permit introduction of more visually oriented, user friendly information services, which are currently limited by the capacity of today's analog residential service, as well as camcorder-based "televisits."

Most important, as today's video-oriented, computer literate students become the consumers of the next decade, the demand for interactive entertainment/educational services can be expected to increase sharply. The analyses set out above represent today's view of year 2000 technology. Industry observers expect that information technology and applications will unfold in ways that are far more dramatic and innovative than anticipated today.

Network technologies under development today permit the transport and switching of high bandwidth services. Under current local carrier plans, New Jersey will have a widely deployed, intelligent, narrow-band digital network by the turn of the century. The key policy issue is the rate at which the network should be upgraded to support generally available higher bandwidth services.

Under current local exchange carrier plans, by the year 2001, almost all New Jersey residents should have available to them a local carrier network that is digital from central office to central office, interconnected by network-based, software-driven call processing capabilities (SS7), and supported by advanced network data base and operations support systems. In most instances, this network will be capable of providing digital communications services such as basic rate ISDN to end users where demand warrants. It will provide fiber-optics-based transmission between telephone company facilities, permitting higher bandwidth services where required. Deployment of fiber-based facilities toward larger users will occur on a case-by-case basis.

Thus, while ubiquitous access to an intelligent digital network will be available by 2001, New Jersey subscribers will not have widely available access to higher bandwidth services by the end of the decade. The key public policy issues regarding New Jersey local carrier investments are:

- How rapidly, if at all, should local exchange carriers accelerate the deployment of an intelligent, digital, broad-based, widely available network?

- At what rate should network infrastructure be deployed to support switched services above the 128 kbps of digital services such as basic rate ISDN?

Chapter XI's analysis of the financial implications of advancing New Jersey Bell and United Telephone plans addresses the first question. The answer to the second question must take into consideration the potential demand for higher bandwidth services and technological developments of which developments in transmission and switching are key.

The key issue in transmission is the speed of fiber deployment in the local loop.

During the next few years, development of fiber optic systems toward the residence will likely become cost-effective for ordinary telephone services. New Jersey's local exchange carriers

can be expected to participate in efforts to validate the cost and benefits of particular manufacturer's offerings. In these evaluations, New Jersey's carriers will have to make three basic choices:

- What should the fundamental architecture of the local loop be?

  Depending on expected costs and service offering, carriers will need to choose between STAR architecture or bus/tree and branch architectures, or some combination. STAR architectures use fibers to each premises, radiating from one or more points in the network in a manner similar to today's copper telephone plant. Bus/tree and branch architectures are similar to today's cable TV systems, in which each premises "taps" off its traffic from a fiber that continues down the street.

- How far will the fiber go?

  Both copper and coaxial cable can carry high bandwidth signals for short distances without the need for repeaters. By bringing fiber to a "pedestal" serving four to eight residences and sharing optical and electronic equipment among them, the per-unit cost of fiber-based service would be reduced. However, the copper or coax "drop" wire to the home might have to be replaced by fiber at a later point.

- How easy will it be to upgrade the fiber infrastructure?

  Since fiber should become economical for basic phone service, carriers may find it beneficial to install such systems in the near term even if the fiber plant cannot easily be upgraded to provide the higher bandwidth services of the future. Carriers thus must strike a fair balance between minimizing the initial cost of using fiber to provide today's services and minimizing the total cost of first installation plus upgrade expense, to provide new capabilities in the future.

Interim approaches to increased network capacity may retard rather than expedite the movement to a higher bandwidth public network.

New Jersey Bell today charges about a $2,000 installation fee, plus a $215 per month charge for a 1.5 mbps dedicated access circuit. Technology under development, High-Capacity Digital Subscriber Load (HDSL), could significantly reduce this cost by eliminating the need for conditioning copper loops used to provide the service, and the requirement for repeaters every mile. A variation, Assymetric Digital Subscriber Load (ADSL) could provide a low-cost, one-way 1.5 mbps circuit (plus an ordinary phone line) over a single copper pair to permit low-cost distribution of on-demand compressed video programming.

The economics of this technology are not yet fully understood. Moreover, should its cost prove reasonable, HDSL and ADSL may only provide an interim step in the process of network evolution. At some point, continued installation of interim solutions may retard rather than expedite the movement to a higher bandwidth public network.

Developments in switching should permit the deployment of high-speed services without replacement of today's digital switches.

Modern digital switches are modular. That is, they can be upgraded on a component-by-component basis. Additionally, adjunct switches can be deployed to provide subscribers with capabilities that cannot economically be incorporated into existing switches in the near term.

Consequently, digital switches installed today need not be completely replaced to obtain the benefits of tomorrow's switching innovations.

Existing digital switches used by New Jersey's carriers can be upgraded in the near term to provide circuit switching capability from 64 kbps to 1.5 mbps. New approaches to network switching route packages of information, rather than holding open a circuit for the duration of each call. One form of such switching, called cell relay, will be used in New Jersey Bell's Switched Multimegabit Data Service (SMDS) which will be initially offered in 1991. The service will switch information at speeds from 1.5 mbps to 45 mbps. Future switching improvements, to be used for Broadband ISDN, will switch cells at rates of up to 155 mbps and could switch broadband video services.

New Jersey's citizens - and particularly its young people - will benefit from a network infrastructure that encourages the open and entrepreneurial exchange of information, including video and images, without regard to location. The size of benefits from an advanced network may depend on public policies that encourage the availability of digital transport at reasonable prices.

Previous chapters have discussed the benefits of a modern telecommunications infrastructure to economic development, education, and health care. But the potential benefits of advanced local exchange carrier networks are far broader.

Most important, while other nations may strive for production efficiency or enhance long time frames for the evaluation of the benefits of investments, the United States thrives on the free, open, and entrepreneurial exchange of information. As a result, small businesses and young entrepreneurs can develop and market a wide variety of goods and services.

Unless the network infrastructure of New Jersey keeps pace with the technology by which individuals can create and exchange information, today's New Jersey youth may find that the opportunity to participate fully in this truly American advantage will have been frustrated. As classroom computers, multimedia learning, and distance education becomes widespread over the next decade, New Jersey's young people will become "fluent" in the process of electronic, visual communication. If they cannot communicate in this fashion from home or a small business, their opportunities for social and economic development will be curtailed to the detriment of New Jersey's citizens and the state's social and economic well being.

While it is too early to tell whether other countries will catch up with the American cultural advantage of open information exchange, some countries may develop an infrastructure that will be ready for such a development. In particular, Japan has made a commitment to fiber-to-the-home. As part of NTT's goal of "V,I&P" (Visual, Intelligent, and Personal Communications), NTT plans to have 100% fiber in the distribution plant by 2015, with the majority of installation occurring between 1995 and 2005.

Telecommuting can provide a variety of benefits to New Jersey.

Businesses are increasingly relying on computers and telecommunications technology to allow employees to perform their jobs at locations other than the traditional job site. Most experiments in telecommuting appear to indicate that benefits outweigh drawbacks. Programs for telecommuting are being more flexibly structured to accommodate employee desire for interaction with colleagues and employer desire for greater oversight. For example, remote or community work centers rather than employee homes may be used as the telecommuting site, or employees may travel to the office several days a month.

Advanced telecommunications, including video and LAN interconnection capabilities to a residence or remote work center would significantly facilitate the telecommuting process. In addition to employee and employer benefits, New Jersey's economy as a whole should benefit as well:

- Commuting costs and auto pollution should be reduced.
- There will be a better matching between employer and employee locations.
- The opportunities for nonambulatory individuals will be increased.

Importantly, our economic development survey found that transportation considerations significantly influenced New Jersey corporate relocation decisions. If telecommunications infrastructure substitutes for transportation infrastructure, there may be significant benefits to New Jersey taxpayers as well.

Other benefits may be significant.

- More efficient delivery of public services

  Advanced network capabilities can help reduce the cost of other government services. For example, movement of persons in custody is a significant expense to the criminal justice system. Use of videoconferencing can minimize the transportation of prisoners for arraignment or other judicial functions where physical presence may not be mandatory.

- Promoting the wider availability of information

  Few households are likely to purchase higher-speed communications links solely for the purpose of accessing information services. However, once that equipment and higher bandwidth links are obtained for entertainment, business, or educational purposes, they will be available for other uses. As libraries and information services increasingly place both text and image information into on-line data bases, New Jersey residents could have access to a variety of services.

Encouraging development of a local telecommunications infrastructure that will permit New Jersey's citizens to obtain interactive access to the visual communication world may be one of the most important policy decisions of this decade.

Pricing policies for higher bandwidth services may be crucial.

Pricing policies for higher bandwidth services may prove crucial to the benefits New Jersey's citizens receive from higher bandwidth service. Traditional telephone industry practices often have kept the price of new or value-added services relatively high in relation to their cost in order to provide a contribution to analog voice service.

Digital service currently is a high-cost, high-price offering. New Jersey Bell charges about $4,000 a month for a 45 mbps link to a central office (equal to one noncompressed video-channel). As higher-speed digital capabilities become an integral part of the local exchange network, the cost of digital service should fall. Pricing digital transport significantly above these declining costs will limit use of digital service by residential and small business customers. Importantly, if advanced technology is deployed in the network on a "technology push" basis, pricing it on a value-added "demand pull" basis may forestall innovative user applications and limit the benefits of the ratepayers investment in a modern infrastructure.

Regulators and local exchange carriers thus may need to find ways of providing reasonably priced digital connectivity to residential and small business locations while maintaining relatively inexpensive basic phone service.

STATE REGULATORY ISSUES RELATED TO LEC INFRASTRUCTURE INVESTMENT

This chapter provides an overview of emerging trends in telecommunications regulation as well as the regulatory framework for LECs in New Jersey. This overview provides the foundation for presenting the results of the survey of state regulators across the country with respect to issues related to telecommunications infrastructure investment. The results from various activities performed in this portion of the study provide the framework for the following overall conclusions:

The users of telecommunications services in New Jersey have the lowest rates for LEC services in the country.

NJB, which serves 97% of the access lines in the state, has the lowest rates for basic exchange services and intraLATA toll calls among the major telephone (BOC only) companies in the country. Along with low rates, the state can claim a high rate of telecommunications technology deployment, and the widespread availability of telecommunications products and services. This speaks well for not only the state's LECs, but also the state's regulatory authorities who have oversight of LECs.

The Rate Stability Plan in New Jersey is an effective regulatory model.

The RSP, which has been in place in New Jersey since 1987, represents an effective combination of the various forms of alternative regulation implemented in states across the country. The RSP caps the rates for essentially all existing services. Service offerings have been separated into competitive and noncompetitive components. The RSP framework provides an incentive for NJB to optimize earnings through the introduction of new products and services, the pursuit of cost containment and operating efficiencies, and the continued deployment of new technology. The rate capping element of the plan provides price stability for NJB customers. Should the RSP continue through 1993, NJB basic exchange and intraLATA toll rates will not have increased for more than eight years. The RSP has created an environment where basic exchange rates have not been increased, where the quality of service to customers has remained high, where NJB capital investment levels have been sustained, and where the financial posture of NJB has been maintained.

Additionally, because the earnings of the competitive businesses are not included in the calculation of the NJB authorized return on equity, the LEC has been provided a direct incentive to maximize revenues, contain costs, and optimize earnings on these new services. Additionally, since the Company's earned return on noncompetitive services such as basic exchange has been in the 7% to 8% range (as compared with the authorized return on common equity for these services of 12.9%), the earnings from the competitive services have helped NJB to avoid the need for rate relief.

The rigorous quality of service standards imposed by the NJBPU as part of the RSP has provided an effective mechanism to monitor NJB. NJB has met or exceeded the quality-of-service standards imposed by the RSP since its implementation.

The regulatory framework governing LECs in the United States is in transition; progressive regulatory evolution is expected to encourage infrastructure investment.

The traditional rate base/rate of return regulatory model for the oversight of LECs in the United States is undergoing an overhaul. Given the evolution of technology in the telecommunications industry, coupled with the growth in competitive alternatives for various telecommunications products and services, alternative forms of regulation are under experimentation or already implemented in most state regulatory jurisdictions across the country. The objectives of alternative regulatory models include: (1) reducing the administrative burden of historical regulatory reviews for the introduction of new products and services, (2) streamlining requests for price changes in response to competitive initiatives, (3) allowing market forces to determine pricing and service levels for products and services where competitors exist, and (4) providing a framework to encourage LECs to improve operating efficiency, introduce new products and services, and deploy new technology.

The most prevalent forms of alternative regulatory frameworks are special contracting arrangements, banded rates/pricing flexibility, and price cap or price freeze programs and detariffing/deregulation of competitive service offerings. Additionally, incentive regulation plans are increasingly common, particularly in states which have high volumes of access lines.

Some have argued that LECs might reduce capital investment under more flexible regulatory schemes. The survey respondents indicated that it is their perception that the movement to more relaxed forms of regulation has had no change to date on the level of LEC infrastructure investment. Furthermore, while about half of respondents expect little change in investment levels, an additional 43% expect increases in LEC infrastructure investment over the next three to five years. Therefore, there is an emerging view in the regulatory community that there is a linkage forming between increased infrastructure investment and relaxed forms of regulation.

Regulatory agencies are becoming increasingly supportive of the role of telecommunications in economic development.

All respondents indicated that the availability of a high-quality, fairly priced, technologically advanced telecommunications network is an essential ingredient of state efforts to attract as well as retain businesses. Likewise, the overwhelming majority of the survey respondents indicated telecommunications capabilities were as important to economic development initiatives as labor costs and the costs of energy. Even more significant, survey respondents from state regulatory agencies overwhelmingly noted that telecommunications will play an even more significant role in the effectiveness of economic development initiatives in the next three to five years. Thus, the regulatory agencies recognize that the development and deployment of advanced telecommunications capabilities in LEC networks must keep pace with the growing and increasingly complex communications requirements of the users of LEC services.

However, regulatory authorities have only recently explored how telecommunication's role in economic development efforts might be incorporated into regulatory policy. A few states have implemented programs to support more rapid deployment of telecommunications technology, although the linkages of these initiatives to economic development benefits have not been clearly established. Very few regulatory agencies have initiated investigations or studies to provide a foundation for adoption or implementation of specific policy actions in support of economic development efforts. More specific actions can be expected in the near future.

Regulators are beginning to recognize the "competitive nature" of telecommunications technology deployment in their states as compared to other states.

Regulatory agencies are beginning to expand their "field of vision" regarding technology deployment beyond the LECs under their oversight. While over 90% of the respondents indicated that their agency plans to monitor telecommunications technology deployment in their jurisdiction in the future, two-thirds of the respondents also indicated that they plan to monitor the rate of technology deployment in other states. This demonstrates the emergence of telecommunications technology deployment as a "competitive" business issue. Regulators are concerned with ensuring that their state's telecommunications infrastructure keeps pace with the service delivery capabilities available to citizens in other states.

This sensitivity is further demonstrated by the general shifts in the focus of regulator reviews of LEC construction plans. Whereas these types of construction program reviews in the past were more focused on issues of "gold plating" the network or excess capacity, the current focus of these reviews is centered on issues such as the quality and availability of service delivery capabilities. Among the issues noted by a majority of the respondents, in their order of priority, were quality-of-service issues, LEC underinvestment in rural areas, investment for "Information Age" capabilities, technology issues (as they relate to strategies for upgrading the network to meet the needs of large users), and network capacity issues. When analyzed on a weighted access line basis, a similar pattern of concerns, and prioritization of issues was indicated; however, the individual issues areas were noted at least three-fourths of the time on a weighted access line basis.

It is interesting to note that the focus of the majority of issues evaluated during the reviews of the construction programs is highly concentrated on concerns about the quality and availability of services. This is in contrast to the types of reviews performed earlier in the 1980s, which focused on the prudence of investment in telecommunications infrastructure and the potential to overbuild LEC networks. The recent focus and direction of these types of studies on quality and availability of services, particularly in those areas with a greater proportion of the country's access lines, is consistent with the emergence of concerns over the ability of the LEC telecommunications infrastructure to effectively meet the needs of the "Information Society" in the 1990s.

The regulatory construction program reviews have increasingly addressed technology-related issues such as the deployment of digital switches, introduction of network intelligence and software capabilities (i.e., SS7), and the deployment of fiber optic cable. These results also reflect that the components of a technologically advanced telecommunications network have been subject to wide regulator scrutiny. The technologies most frequently addressed by the majority of respondents during these reviews were the replacement of analog stored program switches with digital switches, fiber optic deployment, and deployment of SS7 and related intelligence systems. Interestingly, ISDN was reviewed by less than one-third of the respondents, but slightly more than one-half when the responses are weighted on an access line basis.

These results clearly demonstrate that the various components of network infrastructure which are required to support a digitally based, software-managed and broadband-capable telecommunications network have been the focus of these reviews.

While regulators affirm that their primary objective is to avoid increases in residential rates, the respondents did indicate a willingness to consider an increase in basic rates to support telecommunications infrastructure development under certain conditions.

The regulatory respondents around the country indicated that their primary regulatory objective regarding LECs is to avoid increases in residential basic exchange rates. This objective, which is reflective of the long history of residual pricing philosophy for residential services, highlights the likely resistance to accelerating technology deployment in LEC networks. However, the respondents also indicated that they would consider network upgrades if they could be implemented without an "adverse" effect on local rates. They would also consider upgrades if specific evidence could be provided that demonstrated the linkage between the benefits of technology deployment and increased effectiveness in the areas of economic development or business retention initiatives and/or if new revenue opportunities could be identified prior to infrastructure investment.

The majority of respondents indicated a willingness to consider increases in basic exchange rates to fund the acceleration of telecommunications infrastructure investment under certain conditions. For example, the majority of respondents indicated a willingness to support an increase in basic exchange rates to (1) promote economic development in the state and (2) make more advanced services available to residences and small businesses in all parts of the state.

Furthermore, responses (weighted by access lines) reflecting the more populous states - the direct competitors to New Jersey - attach explicit importance to a number of infrastructure factors in addition to the level of basic rates. The survey results indicate that these regulators recognize the increasing importance of advanced telecommunications in the "Information Age" and are becoming more receptive to strategic investments in LEC infrastructure to deliver the advanced telecommunications service capabilities expected by customers in the future.

FINANCIAL IMPLICATIONS OF ACCELERATED TECHNOLOGY DEPLOYMENT

The two major LECs in the state, NJB and United, developed ten-year business plans to determine the ramifications of meeting several accelerated infrastructure deployment scenarios, as directed by the Deloitte & Touche/Braxton Associates project team. In particular, the focus of the analysis was to determine the impact of accelerated infrastructure deployment on capital investment, depreciation and capital recovery, operations and maintenance expenses, new revenue streams, and earnings as compared to a BAU scenario for the ten-year period 1991 to 2000. Three different scenarios were developed - the moderate scenario, the aggressive scenario and the extreme scenario - with increasing level of technology deployment in each scenario. Thus, policymakers have at hand both the relative costs and benefits of accelerated infrastructure investment to consider as part of their evaluations of public policy alternatives.

The potential cost of accelerating the deployment of telecommunications technology in New Jersey is nominal compared to the base of LEC intrastate revenues.

The incremental revenue requirement associated with the acceleration of technology deployment could be as much as several hundred million dollars per year. However, a more appropriate benchmark to use to evaluate the cost of accelerating technology deployment in the state is to express the impact in terms of the percentage increase in the overall base of LEC intrastate revenues.

The required percentage increase in annual revenues 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 in order to accelerate the rate of technology deployment under both earnings and rate of return methodologies. 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.

Even under the extreme scenario, which would be impractical to pursue, the annual required percentage increase in revenues only slightly exceeds 10%, and then for only three of the ten years included in the period under analysis. The annual percentage increases in the remaining years of the period are significantly below the 10% level.

Thus, the acceleration of telecommunications infrastructure deployment could be achieved with annual increases which are nominal in magnitude. The annual increases in LEC-required revenues under the moderate and aggressive scenarios require annual increases that approximate the anticipated rate of general inflation during the ten-year time frame under review.

It should be recognized that these accelerated investment scenarios incorporate significant capital investment in technology by the LECs over the ten-year period beyond the business-as-usual scenario: $907 million in the moderate scenario, $2.1 billion in the aggressive scenario, and $3.9 billion in the extreme scenario. However, the incremental revenue increases required to support the acceleration of technology deployment appear reasonable, particularly vis-a-vis the general inflationary increases anticipated over the same time frame and the level of capital investment and capital recovery costs included in these scenarios.

There are a variety of factors unique to New Jersey that contribute to the nominal cost of accelerated infrastructure investment in New Jersey LEC networks.

New Jersey has a variety of economic and demographic characteristics that has not only helped reduce telecommunications user costs in the past, but will help reduce the total cost of accelerating telecommunications technology deployment. Examples of these factors/conditions include:

- The relatively high density of the state of New Jersey is clearly an advantage. A variety of demographic advantages in New Jersey vis-a-vis the rest of the country help mitigate the cost of accelerated telecommunications technology in the state. These include:

  - The population density in New Jersey is 1,034 persons per square mile, as compared to an average of 70 persons per square mile for the total United States

  - There are 531 individuals employed per square mile in New Jersey, as compared to an average of approximately 33 individuals employed per square mile for the nation

  - There are an average of 28 business firms per square mile in New Jersey, as compared to an average of less than 2 business firms per square mile in the total United States

  The overall density of both business locations and population are advantageous to the telecommunications infrastructure. For example, the density and proximity of both residential and business customers reduce the average length of subscriber loops that serve the LEC customers in the state. This will reduce the investment required for fiber optic cable, loop electronics, etc., to offer "Information Age" service capabilities.

- Relative to the networks of other telephone companies, the LEC telecommunications network in New Jersey is already reasonably sophisticated. During the 1980s, the LECs in New Jersey have spent billions to upgrade the telecommunications network, providing new technology and services to large portions of the state's citizens, and building the foundation for an even more advanced telecommunications network. This is reflected by the following network characteristics in the state:

  . During the 1980s, the LECs in New Jersey invested a total of approximately $4.5 billion in the development and evaluation of the state's telecommunications network. The ability of the LEC industry to effectively finance this level of network development reflects favorably on the regulatory policies of the state, as well as the significant growth in general economic activity which stimulates continued growth in the revenue streams for the LECs. The ability of the LEC industry to support this level of capital investment is particularly laudable given that LEC rates in New Jersey for basic exchange and intraLATA toll services are lower than any of the other Bell Operating Companies in the country.

  . Eighty-two percent of end users in the state today have access to SS7 signaling; therefore, 82% of the state's users have access to CLASS services

  . Ninety-nine percent of end users have access to stored program control switches; thus, these customers currently have access to custom calling features

  . Forty-five percent of interoffice facilities in the state are served by fiber optic transport facilities

- The growth in the demand for traditional and newer LEC services has produced a diversified revenue base of several billion dollars over which to spread the incremental cost of accelerated technology deployment. This diversified revenue base is derived from the high level of population density in the state, the high level of dependence of the citizenry on telecommunications services which generate significant revenues, and the features and functionality already resident in LEC networks, which generate additional and growing revenue streams. This growing LEC revenue base helps to mitigate the need for additional (and immediate) revenues to support the acceleration of telecommunications technology deployment under the various scenarios discussed.

Thus, there are conditions unique to New Jersey which help mitigate the cost impact of accelerated telecommunication technology. These advantages can be leveraged to propel New Jersey to a leadership position in the deployment of telecommunications technology in the country.

The overall benefits of advanced technology deployment are expected to continue increasing after the year 2000.

The practical benefits to be achieved from the deployment of advanced telecommunications technology will continue to grow after the end of the study period (1991-2000). The expected growth in benefits reflects the impact of the deployment of telecommunication technology on a broad basis throughout the state of New Jersey. This broad-base deployment facilitates the realization of the synergies anticipated from a digital, fiber-based, software-driven network rather than copper facilities. Thus, the ten-year time period (1991 to 2000) included in this analysis provides too brief of a snapshot in time to capture the full and ongoing benefits of

widely distributed advanced telecommunications technology deployment throughout the state of New Jersey. Examples of benefits expected after the year 2000 include:

- Growth in revenue streams from higher customer acceptance and market penetration of the new products and services planned for introduction in the 1990s. Because many of these services cannot be introduced until various elements of technology now under development are commercially available and deployed in LEC networks in the state, the "ramp-up" of new revenues is not expected to be fully realized until after the end of the study period. The incremental revenues expected from the deployment of new technology accelerate rapidly in the 1998 to 2000 time frame. It is not unreasonable to expect that the revenue growth would continue after the year 2000.

- The revenue streams included in the accelerated technology deployment scenarios are based on product/service concepts envisioned today for deployment by the year 2000. Given the rate of technology evolution experienced in the last decade, it is not unlikely that a wide range of additional new and innovative uses of telecommunications technology will emerge in the 1990s and beyond. Thus, the actual revenue requirements identified to support the additional infrastructure investment may be further offset by the development of additional new but unanticipated product and service opportunities.

- A significant portion of the overall cost of accelerated technology deployment in New Jersey is the incremental depreciation expense and capital recovery costs associated with the early retirement of existing plant and facilities that have not been fully depreciated. However, as the rate of new technology deployment starts to taper off in the late 1990s, so does the incremental level of depreciation and capital recovery costs. Since plant retirements are a nonrecurring cost, incremental costs should decline substantially as the network transition nears completion.

- The operating and maintenance cost efficiencies associated with a digital, software-driven and fiber-based network only begin to emerge after 1997. However, these downward trends in operating cost requirements should continue after the study period as the fiber feeder and distribution plant is completed.

In summary, the limited time period selected for assessment of the infrastructure acceleration scenarios may obscure the long-term or "life-cycle" benefits that could be achieved from broad-based network upgrades. These benefits should be given consideration by policymakers in evaluating the trade-offs in costs and benefits from accelerated infrastructure investment in New Jersey's telecommunications network.

OVERALL OBSERVATIONS AND CONCLUSIONS

This report explored the issues of the importance of an advanced telecommunications network in New Jersey from a number of different perspectives. These analyses provide a logical framework for helping to assess the relative merits of advanced network deployment in the state in the formulation of strategic public policy initiatives. The criteria for evaluating this decision extend well beyond the question of financial impact or rate treatment for the LECs in the state; many of the perceived benefits of accelerated telecommunications technology deployment cannot be measured in terms of their effects on the LECs. For example, if advanced telecommunications capabilities can serve as a competitive advantage in attracting business and/or retaining business in the state, the real benefits will materialize through increased employment opportunities for the citizens of New Jersey, maintenance of the tax base in local communities, and support of the overall economic welfare of the state. Similarly, to the extent

that advanced telecommunications capabilities help to improve educational instruction or the quality or the cost-effectiveness of health care services delivery, the benefits realized from these capabilities cannot be measured from their impact on LEC revenues or earnings levels. Neither can the potential benefits of these new technologies and applications be fully realized without advanced telecommunications capabilities. Therefore, it is important to maintain a broad perspective in evaluating the impacts of accelerated telecommunications infrastructure deployment in New Jersey. The costs of infrastructure acceleration are much easier to estimate than the potential benefits to New Jersey.

The analyses performed and their results provide the foundation for the following overall observations and conclusions:

> **While advanced telecommunications capabilities are widely recognized as a general "competitive" weapon in economic development and business retention, the role of telecommunications in New Jersey is even more important.**

Our interviews with economic development program managers, representatives of businesses that have been through the relocation process recently, and representatives of state regulatory agencies illustrate that telecommunications is an important factor in economic development and business attraction, and is expected to become even more important in the future. This conclusion reflects the overwhelming recognition of the study participants that business is rapidly becoming much more information-and telecommunications-intensive. The growth in information intensity will contribute to rapidly increasing demand for information technology and data transport capabilities, including the demand for higher-speed data transport through the public telecommunications network.

Additionally, advanced telecommunications capabilities are expected to be particularly important for the attraction and retention of business in New Jersey as compared with other parts of the country. The focus of future economic development efforts in the state will be on the services-producing sectors of the economy, such as the finance, insurance, and real estate and services sectors. Many states will be targeting such businesses because of their rapid growth, low-asset intensity, and job creation. Furthermore, these sectors have also been identified as among the most telecommunications-intensive sectors of the economy. Therefore, it will be essential for the telecommunications networks in the state to be able to support or enhance the capabilities required by these types of businesses.

Advanced telecommunications capabilities can be a much more significant factor in the location decision-making process for companies in the services- producing sector. Thus, telecommunications can serve as a "lever" to enhance the attractiveness of a state for businesses in the services-producing sector of the economy. As an ancillary benefit, to the extent that an increasing proportion of the state's new businesses is in the services-producing sector, which typically does not generate environmental hazards, this will also provide an indirect benefit to the state by helping to mitigate the impact of additional environmental/pollutant concerns.

The availability of advanced telecommunications services was considered much more important than the price of telecommunications services in terms of impact on economic development, business attraction, and business relocation activities. This is even more significant for New Jersey businesses that have been involved in the relocation decision-making process. The availability of telecommunications services was the fourth most important factor (out of more than 20 factors) for this group in the business relocation decision-making process, approximately four times more important than the price of telecommunications services. These results confirm that the availability of advanced telecommunications capabilities is particularly significant to businesses in New Jersey.

The combination of these observations suggests a policy role for telecommunications in economic development and business retention. It has been demonstrated that New Jersey economic development initiatives are expected to be focused on service sector businesses which are especially information-intensive and telecommunications-intensive. Furthermore, the availability of telecommunications capabilities is significantly more important than the price of these services. The state should continue to develop a telecommunications network which meets the current and future demands of users.

The capabilities of the network must evolve in a manner to satisfy the increasingly sophisticated and more complex needs of business users. Additionally, because the customer demographics in New Jersey have a much wider dispersion of businesses throughout the state, the telecommunications network must have these new capabilities widely available rather than focused in a few major metropolitan business centers. As a result, it will be essential for New Jersey to have an advanced telecommunications infrastructure to support the enhancement of the general and economic climate of the state in the future.

An advanced telecommunications infrastructure is essential for New Jersey to create the level of employment growth and job creation expected in the state.

As discussed in numerous areas throughout the report, businesses in the services-producing sectors of the economy are expected to be the primary focus of future economic development and business attraction efforts in the state. These business enterprises are also recognized as being information- and telecommunications-intensive, placing a premium on the availability of telecommunications services as compared with the price of telecommunications services.

Additionally, the study demonstrates that the substantial majority of employment growth and job creation expected in New Jersey over the next ten years is in those segments of the services-producing sectors of the economy that have been identified as telecommunications-intensive. Eighty-five percent of the employment growth in the state from 1988 to 2000 is expected to come from these sectors of the economy.

The reliance on service-sector businesses is even more significant when contrasted with growth expectations in the manufacturing sector which for decades served as the fuel for economic growth in the state. The absolute number of jobs in the manufacturing sector is expected to continue to decline in the 1990s, although at a slower rate than experienced in the last two decades. Additionally, based on a 1989 survey of the factors determining the manufacturing climate in a state, New Jersey was ranked 13th out of 29 states that are classified as having a high level of manufacturing intensity. However, the state was rated much lower on a number of primary factors crucial to attracting new manufacturing to the state: taxes (37th), unemployment benefits (41st), average hourly wage cost (41st), and energy costs (43rd).

The state's relative positioning on these specific factors, coupled with rigorous environmental protection standards, will make it more difficult to attract significant new manufacturing enterprises to the state. Thus, there is a low probability that higher-than-expected growth in the manufacturing sector could potentially compensate for the unrealized job creation and employment growth expected from telecommunications-intensive industry sectors.

It follows that the state's economic initiatives should encourage employment in those sectors which are telecommunications-intensive. Therefore, the development of the telecommunications network within the state must, at a minimum, keep pace with the demands of businesses in these sectors. Because many of the businesses in these telecommunications-intensive industries are "innovators" in the use of information technology and information processing, the deployment of new telecommunications technology should stay ahead of emerging information

transport requirements if advanced telecommunications capabilities are going to be effectively used as a competitive tool to support economic development and business retention efforts.

At the present time, the LEC telecommunications network in New Jersey is the national leader in the deployment of network-based signalling/intelligence technology, such as Signalling System 7, and is even with the remainder of the Regional Bell Operating Companies in terms of digital switching and fiber deployment. However, based on the publicly available information on future RBHC technology deployment plans reviewed in this report, NJB will lose its leadership position in SS7 deployment and will remain in the middle of the Regional Bell Holding Companies in telecommunications technology deployment through the year 1994. Since the availability of telecommunications capabilities has been identified as one of the key factors in the experience of New Jersey businesses that have recently relocated, this average position will eliminate advanced telecommunications capabilities as a differentiating factor in economic development and business retention efforts.

The acceleration of telecommunications technology could help to better position New Jersey to successfully attract the volume of telecommunications-intensive businesses which are expected to stimulate the substantial majority of employment growth and job creation. Thus, it will be important for the state's public policies to create an environment that is attractive to these businesses to encourage their location in New Jersey.

> **Beyond economic growth, the availability of an advanced telecommunications network in the state would facilitate progress toward other public policy goals for the residents of New Jersey.**

The availability of a technologically advanced and sophisticated telecommunications network could serve to enhance a myriad of aspects of the quality of life in New Jersey. Over the next ten years, technological changes in desktop computing power, video systems, and compression techniques will enable the public to electronically communicate with visual information in much the same way as voice and data communications are done today. Technological developments in transmission, switching, and network intelligence will enable LECs to provide the pathways for the services and capabilities envisioned for the "Information Age."

The development of an ubiquitous, low-cost, high-bandwidth network across the state could provide the vehicle for the state's citizens to actively participate in the information exchange capabilities of the 1990s and the twenty-first century. The practical benefits of these capabilities will manifest themselves in supporting citizen access to capabilities that will improve their productivity and quality of life.

For example, advanced telecommunications capabilities could be used to accelerate the realization of new approaches and technologies being deployed for higher-quality and more cost-effective educational instruction and health care service delivery. Interactive distance learning, digital imaging, and teleradiology are concepts that are already being implemented on a limited basis in various parts of the country as well as in New Jersey. One of the crucial elements for society to fully realize the benefits of these new capabilities is the availability of an advanced telecommunications network, which can allow these new capabilities to be made available on a broad basis across the state. Since schools and medical practitioners are numerous and are located throughout the state, these network capabilities need to be broadly based, which argues for the deployment of these capabilities on a ubiquitous rather than a dedicated or overlay basis.

Likewise, because the benefits of these capabilities can only be optimized when the technology is widely deployed, the methodology followed to recover the cost of these desirable services

should not serve as a barrier to their broad-based deployment or use. In a practical sense, the benefits of higher-quality or a broader-based educational curriculum for school children in the state or the enhancement of the quality and cost-effectiveness of medical diagnosis in the state's hospitals cannot be measured by their impact on LEC revenue streams or expenses any more than the total benefits of the New Jersey turnpike can be measured based on the value of tolls collected.

The benefits of deployment of advanced telecommunications technology are not limited to large businesses or very large users of telecommunications services. The benefits of a technologically advanced telecommunications network are expected to be more significant for smaller business enterprises in the future. The vitality of small businesses is essential to the economy of the state. Over one-half of the employment growth and job growth in the state during the period 1982 to 1987 occurred in establishments with fewer than 100 employees. Therefore, smaller business enterprises are a crucial element of general economic and employment growth, and an environment should be created for them to flourish in the state in the future as they have in the past.

The world of commerce is evolving to the point where information technology and advanced telecommunications capabilities will be critical to small business survival. Two-thirds of the companies relocating in New Jersey have recognized the need for direct communications capability between their information systems and the information systems of customers and suppliers. Furthermore, 76% of the representatives of businesses locating in New Jersey believe that direct communications and compatibility between their internal information systems and the information systems of customers and suppliers represent a competitive business advantage.

As imaging, videoconferencing, and advanced data processing capabilities continue to proliferate in large businesses with the financial resources to purchase these capabilities, whether available from LECs or not, small businesses will increasingly be cut off from new business opportunities if the LEC networks in New Jersey fail to provide them the means to communicate with other businesses, large and small, on a "peer" basis. Small businesses are expected to significantly increase their applications of information technology in the 1990s. This increase in the use of information technology by small business and the need to be able to interact with large business through the public-switched network support the broad-based deployment of advanced telecommunications infrastructure throughout the state.

For consumers in general, there are various capabilities that could be provided through an advanced telecommunications network that would be beneficial or useful beyond the educational instruction and health care opportunities mentioned earlier. For example, the growth in the volume of personal computers maintained at residences has increased dramatically in recent years and is not expected to abate in this decade. As we all become more accustomed to the advantages of broad information access and transport in the workplace, our desire for similar capabilities at home can likewise be expected to grow.

Various market studies indicate that there is significant residential demand for video services such as on-demand access to recorded entertainment or educational programming, interactive information services, and other nontraditional entertainment programming not currently provided by broadcast networks and the cable television industry. Developers of residential applications have noted the limitations of the existing public-switched network to support the quality and response time requirements of residential users. Furthermore, as today's students become increasingly fluent in the use of computers in the classroom, multimedia learning techniques, and distance learning applications, they will come to expect the ability to

effectively communicate using electronic and visual media at home as well as their school or office. These capabilities will require the broad-based deployment of advanced telecommunications technology in this decade.

There is also a variety of other emerging trends that may require the deployment of advanced telecommunications technology to support the more efficient delivery of various public services. For example:

- Given the growing need for "work at home options," increasing traffic congestion experienced on our highways, and continuing environmental concerns regarding pollution levels, etc., support for promoting telecommuting is growing rapidly. The full benefits of the telecommuting concept can only be achieved when voice, data, and video transport capabilities are all widely available to residences.

- Videoconferencing can greatly enhance the efficiency of a wide array of business and government activities. For example, it could be used to increase the cost-effectiveness and security of the criminal justice system by minimizing the transportation of prisoners for arraignment or other judicial functions.

- The advancement of library services incorporating image-based information will provide the public with a host of new information tools; the American Library Association has already recognized the evolution of the library of the future, which will be electronic in nature, where broadband communications systems are a necessity.

In summary, there are many elements of society which would be positively impacted by the availability of an advanced telecommunications infrastructure in New Jersey. What is abundantly clear is that the majority of the benefits realized will affect a broad base of the citizens in the state rather than just a few very large business users of telecommunications services. The breadth or reach of these expected benefits should be considered in the development and prioritization of public policy initiatives related to the development of an advanced telecommunications infrastructure in New Jersey.

Regulatory philosophy is supportive of the deployment of an advanced telecommunications infrastructure in LEC networks; the regulatory framework in New Jersey can help enhance the state's competitive position in the "Information Age."

Representatives of the state regulatory authorities around the country indicate that there are a number of trends in regulatory philosophy that reflect increasing support and encouragement for telecommunications infrastructure investment. Regulators are increasingly supportive of the role that telecommunications can play in economic development and business retention initiatives in their jurisdictions, and are recognizing that there is a competitive advantage to having advanced telecommunications technology employed in LEC networks. Similarly, regulatory philosophy has shifted to an environment where the availability and quality of the telecommunications services offered are the primary issues raised when evaluating LEC investment plans. Overall, the issue has shifted from a focus on questioning why a particular technology is being deployed to one of questioning why a particular technology is not being deployed more quickly and on a broader basis.

Additionally, there has been a significant trend in recent years for regulators to experiment with alternative forms of regulation or more relaxed regulatory policies for LECs than what was traditionally associated with rate base/rate of return regulatory philosophy. These relaxed regulatory policies have been initiated in response to the rapid evolution of technology and the

emergence of competitive alternatives for various telecommunications products and services. Likewise, these regulatory models have been structured to provide an additional incentive for LECs to develop new products and services, aggressively pursue operating cost-efficiencies, and encourage the deployment of new technology.

While representatives of the regulatory agencies surveyed indicated that their primary objective is to avoid increases in residential telephone rates, they also indicated a willingness to consider an increase in local exchange rates to support telecommunications infrastructure development under certain conditions. For example, the majority of respondents indicated a willingness to support an increase in basic exchange rates to promote economic development in the state or to make more advanced services available to residences and small businesses in the state as part of a long-term upgrade program. Thus, the survey results demonstrate that, while skeptical of basic rate increases, regulators recognize the increasing importance of advanced telecommunications in the "Information Age" and are becoming more receptive to strategic investments in LEC infrastructure to deliver the advanced telecommunications service capabilities expected by customers in the future.

The New Jersey regulatory environment has already responded to several of the issues being evaluated by regulators in other jurisdictions across the country. For example, the Rate Stability Plan (RSP), which currently governs New Jersey Bell, is an effective combination of the various forms of alternative regulatory models. It incorporates ceilings on existing products, and segregation of products and services into competitive and noncompetitive sectors, and provides an incentive for NJB to optimize earnings through the introduction of new products and services, the pursuit of cost containment and operating efficiencies, and the continued deployment of new technology. However, the survey of regulatory practices in other states did identify one comparative shortcoming in the existing regulatory framework and model in New Jersey. Approximately two-thirds of the other jurisdictions are empowered to establish pricing flexibility or banded rates for individual services, many without the need for traditional regulatory review. Under present statutes in New Jersey, the NJBPU cannot approve a price increase for any LEC service without a comprehensive review of all revenues, expenses, and investment, i.e., a traditional rate base/rate of return rate case. This statutory requirement maintains a level of administrative burden and costs which most alternative forms of regulation have been designed to help mitigate.

The RSP has created a framework where rates have not increased since 1985, while NJB has continued to invest in the state's telecommunications infrastructure. Thus, the RSP has had a positive impact on the level of telecommunications infrastructure investment in the state. This is expected to continue. This is consistent with the regulator survey results, as 43% of the respondents expect that alternative forms of regulation, such as the RSP, will contribute to increases in LEC infrastructure investment in the next three to five years.

This report provides the results of a business planning process that compared the impact of accelerating the rate of telecommunications technology deployment with a business-as-usual scenario. The business-as-usual scenario served as the base line for determining the financial implications of accelerated technology deployment in the state. For the purposes of this analysis, it was assumed that the RSP would continue after 1993. The business-as-usual scenario indicates that the maintenance of the RSP would provide NJB with a reasonable level of earnings while supporting an increase in infrastructure investment from 1991 to 2000.

Finally, the historical regulatory environment and philosophy in New Jersey has generated the lowest basic exchange and intraLATA toll rates among the major LECs (e.g., Bell Operating Companies) across the country. This laudable pricing position provides the basis for a myriad

of policy approaches to support strategic telecommunications infrastructure investment. These policy approaches are not necessarily available in other jurisdictions where the prices for basic telecommunications services are already much higher. For example, at the present time, the highest flat rate for basic exchange service in New Jersey is only 58% of the national average for basic exchange service. Therefore, if an increase in basic exchange rates or intraLATA toll rates were considered in conjunction with the acceleration of telecommunications infrastructure in the state, New Jersey telephone customers would still have a significant price advantage over the customers of LECs in other parts of the country while additional technology was being deployed in LEC networks.

Deployment of advanced telecommunications capabilities can be significantly accelerated in New Jersey at nominal cost when compared to the base of LEC intrastate revenues; this represents a major strategic opportunity for the state of New Jersey.

The rate of telecommunications technology in New Jersey can be significantly accelerated at nominal cost, as measured by the need for additional revenues. The various scenarios assume an acceleration of network investment beyond the business-as-usual scenario of $907 million for the "moderate" scenario, $2.1 billion in the "aggressive" scenario, and $3.9 billion in the "extreme" scenario. These additional capital investments, while significant, can be implemented with fairly nominal increases in the revenue streams of the LECs in the state, assuming no significant changes in the existing regulatory framework in the state (e.g., disruption of the historical subsidy framework). The ranges of actual percentage increases in the annual revenue streams of the LECs over the ten-year period 1991 to 2000 are noted below:

- Under the "moderate" scenario, the required annual increase in LEC revenues ranges from a low of .4% in 1991 to 3.6% in 1998 above the business-as-usual case. This scenario would have the following impacts on the deployment of new telecommunications technology in most of the state:

  . Accelerate digital switching replacement by three years
  . Accelerate deployment of fiber for interoffice facilities by two years
  . Accelerate deployment of fiber in feeder routes by six years
  . Accelerate deployment of fiber in distribution plant by ten years

- Under the "aggressive" scenario, the required annual increase in LEC revenues varies from well under 1% to a maximum of 6.4% in 1998 above the business-as-usual case. This scenario would have the following impacts on the deployment of new telecommunications technology in most of the state:

  . Accelerate digital switching replacement by three years
  . Accelerate deployment of fiber for interoffice facilities by two years
  . Accelerate deployment of fiber in feeder routes by 12 years
  . Accelerate deployment of fiber in distribution plant by 20 years

- Under the "extreme" scenario, the required annual increase in LEC revenues ranges from .84% in 1991 to a maximum of 11.8% in 1998 above the business-as-usual scenario. However, this scenario exceeds the practical capabilities of the LECs in the state. The extremely aggressive rate of capital investments and resource requirements (personnel, facilities, and equipment) to achieve these technology benchmarks in the extreme scenario would have a much more dramatic impact on LEC earnings than the other two scenarios noted above. The implications of this scenario would likely generate negative ramifications with the financial community, shareholders, regulators,

and various customers of the LEC industry in the state. While obviously an "outlier," the extreme scenario does highlight the upper end of the range of requirements to achieve exceptionally fast paced deployment of new telecommunications technology.

This scenario would have the following impacts on the deployment of new telecommunications technology in most of the state:

- Accelerate digital switching replacement by five years
- Accelerate deployment of fiber for interoffice facilities by seven years
- Accelerate deployment of fiber in feeder facilities by 16 years
- Accelerate deployment of fiber for distribution plant by 24 years

These annual revenue increases would cover the cost of the significant capital investment discussed above as well as the substantial capital recovery for the retirement of existing technology which would be replaced with new telecommunications technology capable of delivering "Information Age" services. Likewise, these incremental costs have been partially offset by the impact of the estimated revenue streams from new products and services and the operating and maintenance cost-efficiencies associated with the broad-based deployment of new telecommunications technology.

These results demonstrate that the deployment of advanced telecommunications technology can be significantly accelerated, as compared to the business-as-usual scenario, for approximately the same increase in "cost" as expected for general inflation in the 1990s (i.e., annual inflation increases in the range of 4% to 6%). Thus, the LEC industry in New Jersey could significantly increase the rate of technology deployment and accelerate the introduction of new products and services in the 1990s for nominal increases in the revenue streams of the LECs.

The level of required revenue growth to support accelerated technology deployment is even more striking when it is recognized that these price increases are based on the business-as-usual assumption that the rate structure for existing New Jersey Bell products and services would remain the same through the year 2000. For example, these revenue increases are based on the assumption that NJB rates would not increase for a period of approximately 15 years. Thus, the net effective increase in revenues required is minimal when compared with the expected escalation of payroll costs and the purchase cost of goods and services.

The results of this study highlight the unique position of the state of New Jersey in establishing public policy initiatives for telecommunications in the state in the 1990s. As discussed previously, the substantial majority of the overall benefits of the deployment of advanced telecommunications technology cannot be measured from the revenue streams of the LECs, because the benefits will primarily manifest themselves in improved communications, operating efficiencies, or decision-making by residential and business customers using telecommunications capabilities to support the performance of other activities. However, one trend is undeniable - the telecommunications network of the 1990s and beyond will be required to deliver advanced capabilities to meet the increased demands of all subscribers as information and video technology permeate both the work place and the home.

Two different models exist for the deployment of telecommunications technology - the "supply push" model and the "demand pull" model. The "supply push" model suggests that technology deployment not only satisfies pent-up demand, but also stimulates market growth. The major risk is that the investment may be underutilized if sufficient demand does not materialize. Under the "demand pull" model, technology is only deployed to meet well-defined market demand or reduce costs. The major risk to LECs of this option is that desired capabilities will

not be available for customers when demand does materialize. Thus, LEC revenue opportunities may be lost to others. Moreover, this option also risks deterring equipment and service providers from developing new and innovative products that would take advantage of advanced network capabilities, since providers generally will require that advanced telecommunications capabilities be available in LEC networks before they will engage in development efforts to utilize these capabilities. As a result, failure to deploy new network technology in advance of specific user requirements may result in the development of products and services which do not optimize advanced network capabilities, thus limiting the synergistic benefits to society of optimum network and product/equipment solutions to telecommunications needs.

Given the importance of telecommunications to the future economy of the state, the emerging demand for new services from both business and residential consumers, and continuous evolution of information technology, the state of New Jersey has a unique opportunity to implement a "supply push" strategy and accelerate the deployment of the network required for the "Information Age" for a nominal increase in costs. Since New Jersey already has the lowest basic exchange rates among the Bell Operating Companies across the country, the acceleration of advanced telecommunications technology in the state's LEC network could be accomplished with limited impact on New Jersey residents, particularly when viewed in comparison to the prices Bell Operating Company customers in other states pay today for existing technology, not the network of the "Information Age." Effectively, New Jersey residents could have the most advanced telecommunications network in the country and still maintain the position as one of the lowest-priced providers of basic exchange and intraLATA toll services in the country.

Future regulatory policy initiatives should support the societal benefits of "Information Age" network capabilities while continuing to protect the interests of the individual consumer.

As noted previously, there is a wide range of benefits expected from the deployment of advanced telecommunications network capabilities in New Jersey, and the accelerated deployment of that technology will help realize the expected benefits sooner. Additionally, it appears that the deployment of advanced telecommunications technology can be significantly accelerated in New Jersey with only small increases in the revenues of the LECs, which is advantageous given the magnitude of the capital investment and capital recovery costs of some scenarios. However, in the development of a regulatory strategy related to accelerated technology deployment, there is a variety of considerations that should shape policies that benefit all stakeholders. Among these policy considerations are the following:

- Given the significant capital investments and costs of capital recovery to accelerate technology deployment, a reporting process should be established for the NJBPU to monitor advanced technology deployment in the state. This could include an annual forecast of accelerated technology deployment plans, estimated costs, and anticipated benefits at the beginning of each year. Additionally, the LECs should be required to report to the NJBPU at the conclusion of each year on actual expenditures and capabilities installed, and to demonstrate that the level of expenditures is on track with the achievement of any technology deployment objectives approved by the NJBPU.

- The scenarios, which were used to determine the financial implications of accelerated technology deployment, identified a set of new service opportunities which were expected to generate additional revenues for the LECs in New Jersey. These revenue estimates are obviously based on thinking in 1990 about telecommunications products and services that would be made available during this decade. Given the rates of technology evolution experienced in this industry in the last decade and the emerging technical capabilities for voice, data, and video communications, it is likely that additional

product and service opportunities will develop in the next decade that are as of yet unanticipated. Regulatory guidelines should be established to ensure that any additional revenues are first used to offset the cost of accelerated technology deployment during the 1990s. This approach will help to mitigate the cost impact of accelerated technology deployment for the individual customer even though, as previously noted, the additional revenues required for acceleration of technology deployment are nominal.

- Similarly, a risk sharing model could be established to balance the interests of stakeholders, since the acceleration of technology deployment is expected to benefit the public as well as the LECs. For example, a framework could be established where any incremental revenue requirements to support the acceleration of technology deployment beyond the additional revenues anticipated from new services, would be split between the industry and its customers; for example, a 50/50 ratio. This risk sharing approach would significantly reduce the potential contribution of the individual customer to the cost of infrastructure acceleration. At the same time, it would provide a significant incentive for the LECs to develop and implement additional new products and services, and aggressively pursue potential operating and maintenance cost efficiencies anticipated from the deployment of new technology in the network. This framework would also help hold the LECs "accountable" for the delivery of new products and services since the industry would have all the investment risk related to the generation of a return on its portion of the incremental revenues required to support the accelerated deployment of new technology.

- The pricing of new products and services should be structured to encourage broad-based market deployment of advanced telecommunications capabilities. Since it is likely that infrastructure investment will lead the generation of new product and service revenue streams, and that multiple product and service offerings will evolve over time as familiarity with new service capabilities grows, it will be important to avoid placing the total cost burden for the deployment of an advanced telecommunications network on the first new service offering. Pricing policies should be established that encourage all customers to use the advanced service capabilities of the network of the "Information Age." Therefore, network access for higher bandwidth services should be reasonably priced and reflect a long-term perspective to better position the citizens of New Jersey to leverage the benefits of the "Information Age," at work, at home, or at school.

- Finally, small businesses play a significant role in employment growth in New Jersey. Because advanced telecommunications capabilities are now considered a competitive tool, it will be essential for small businesses to have access to the same capabilities as large businesses. Small businesses typically do not require the volume of information transport that make dedicated facilities or private systems cost-effective for large businesses. However, the pricing of advanced telecommunications services should not be structured to discourage small business usage of these capabilities. Reasonable pricing for smaller users is particularly important, since it is likely that smaller users will realize the greatest benefits from reasonably priced access to high-bandwidth services, at least in the near term.

These considerations provide a logical framework for balancing the interests of the stakeholders of New Jersey. Given the potential for the state to reap significant and unique benefits from an advanced LEC network, as well as its successful regulatory framework and favorable pricing position, New Jersey is well positioned to accelerate deployment of an advanced telecommunications infrastructure.

II. OBJECTIVES OF THE STUDY

In recognition of the increasing shift of New Jersey's economic base from a manufacturing environment to an information/services-based economy, the New Jersey Board of Public Utilities (NJBPU), in conjunction with the local exchange carriers in the state, agreed to sponsor a study of the telecommunications infrastructure of the local exchange carriers (LECs) in the state. This includes New Jersey Bell, United Telephone Company of New Jersey, and Warwick Valley Telephone Company. Management consultants from Deloitte & Touche and its strategy consulting division, Braxton Associates, were retained to perform this study.

The NJBPU and the telecommunications industry both recognize the importance of the state's public telephone system and telecommunications infrastructure to the economic development and overall viability of the state, both now and in the future. Therefore, one of the primary directives for the study effort was to identify the telecommunications policy issues associated with the evolution of the telecommunications infrastructure of the State, and the implications for telecommunications regulatory policy to ensure that New Jersey maintains a competitive environment to attract as well as retain business enterprises.

Additionally, the scope of the project included an assessment of whether advanced telecommunications capabilities could make a positive contribution to the development of responses to various public policy concerns in the state, such as the effective delivery of quality educational instruction and health care services. Our focus in this area was to evaluate how advances in telecommunications technology could be used to help achieve the benefits anticipated from new information processing and other technologies in these public sector arenas.

Furthermore, the project included an initial determination of the magnitude of the incremental costs of accelerating the deployment of advanced telecommunications technology in New Jersey to be able to introduce "Information Age" services more rapidly to the citizens and businesses of the state. Thus, the study included an initial estimate of the strategic investments which would be required to provide these capabilities along with the impacts of these expenditures on the LEC industry in New Jersey and its customers.

The individual objectives for the study effort, as outlined in the Request for Proposal, included the following:

- Describe the telecommunications industry within New Jersey and its condition
- Evaluate and analyze the extent of the linkage between the telecommunications infrastructure and economic growth in New Jersey
- Analyze and define the various components of the telecommunications infrastructure needed to position New Jersey to meet the needs of its citizens and businesses in the "Information Age." This analysis should include the assessment of requirements to:
  - Retain businesses currently located in New Jersey and support their future expansion
  - Attract new business to the state
  - Ensure cost-effective, universal "Information Age" services for all residents

- Evaluate the relationship between the capabilities of a modern telecommunications infrastructure and the ability to facilitate the resolution of various public policy issues in New Jersey. These specific public policy issues to be evaluated vis-a-vis the current and future capabilities of the telecommunications infrastructure include:

  . Opportunities to strengthen the availability and access to information in support of educational programs

  . Opportunities to strengthen the quality and cost-effectiveness of health care services

- Evaluate the ability of New Jersey's telecommunications providers (LECs only) to develop and market new products and services

- Evaluate the financial and operational implications associated with providing the various components of the telecommunications infrastructure needed to position New Jersey to meet the needs of its citizens and businesses in the "Information Age." This analysis includes an assessment of:

  . The capital requirements necessary to implement anticipated and desired improvements in the telecommunications infrastructure under several different technology deployment scenarios

  . The identification of new products and services and potential new revenue streams which might be realized as a result of accelerated telecommunications technology deployment in the state

  . The identification of potential efficiencies in operating, maintenance, and support expenses which might be realized as a result of additional investments in telecommunications technology

  . The impact of the implementation of each telecommunications technology deployment scenario on stakeholders, including the LECs and their customers

- Evaluate the current incentives and/or disincentives for telecommunications providers to develop new products and services, improve efficiency, and price competitively

- Evaluate the relationship between progressive regulatory policy and the development of the telecommunications infrastructure

It is also appropriate to establish the limits of the overall study effort as well as its scope and objectives. The focus of this effort is to assess the issues and implications of technology deployment for the local exchange carriers in the state only. The scope of the project does not include an assessment of the same issues as they might apply to interexchange carriers, i.e., long-distance carriers in New Jersey, nor does the study effort attempt to determine the most cost-effective technology application to provide the capabilities discussed in the report. We recognize and appreciate that some of these capabilities might also be offered by the cable television industry, various wireless transmission media such as cellular or satellite service providers, and/or alternative access vendors operating fiber networks. This study and its results are intended to serve as the foundation for determining whether the availability of these capabilities is essential to the state and to put into perspective the estimated cost of providing those service capabilities through the ubiquitous network of the LECs in the state. Obviously, to the extent that such capabilities can be delivered by other providers more efficiently and/or effectively, this should be given serious consideration by policymakers. However, this study does provide a baseline or benchmark for comparative assessment.

The remainder of the report is organized into the following chapters.

Chapter	Title
III.	Approach and Methodology
IV.	Assessment of the Current Telecommunications Infrastructure
V.	The Role of Telecommunications in Economic Development and Business Retention
VI.	Telecommunications Opportunities in Education
VII.	Telecommunications Opportunities in the Health Care Industry
VIII.	Impact of Telecommunications-Intensive Industries on the New Jersey Economy
IX.	Future Network Requirements
X.	State Regulatory Issues Related to LEC Infrastructure Investment
XI.	Financial Implications of Accelerated Technology Deployment
XII.	Overall Observations and Conclusions