



## 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.**

*business*

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.

Methodology



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 "televists."
- 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. *education*

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.

*Summary*  
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**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.** *business*

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.

X 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.

<u>Network Component</u>	<u>NJB Plan</u>	<u>United Plan</u>	<u>Warwick Plan</u>
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):

<u>Rank</u>	<u>U.S. ED Managers</u>	<u>New Jersey ED Managers</u>	<u>U.S. Business</u>	<u>New Jersey Business</u>
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.



X **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.

X **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.

X 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



