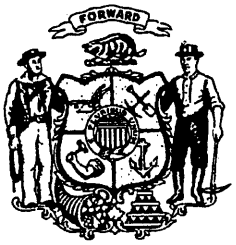
PUBLIC SERVICE COMMISSION OF WISCONSIN



Report to the Legislature's
Joint Committee on Information Policy

Status of Investments in Advanced Telecommunications Infrastructure in Wisconsin

December 1999

PUBLIC SERVICE COMMISSION OF WISCONSIN

Status of Investments in Advanced Telecommunications Infrastructure in Wisconsin

Docket 05-ST-108

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To the Reader:

This infrastructure report fulfills the requirements of Wis. Stat. § 196.196(5)(f). The report includes text, graphs, and maps, which document the progress of investments in advanced telecommunications. As mandated, the report specifically contains information on the progress made in the areas of distance learning, libraries, health care, opportunities for persons with disabilities and other persons in the home, and the deployment of Integrated Services Digital Network (ISDN).

The appendix of the report contains Geographic Information Systems (GIS) maps showing geographic locations of specific infrastructure elements.

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Forward

To the Joint Committee on Information Policy:

We are pleased to send you the Public Service Commission's third biennial report on telecommunications infrastructure in Wisconsin as required by Wis. Stat. § 196.196(5)(f). The report includes text and maps documenting the progress of investments in advanced telecommunications infrastructure. As mandated, the report specifically contains information on the advancements made in distance learning, library services, health care, opportunities for persons with disabilities and other persons in the home, and deployment of Integrated Services Digital Network (ISDN).

The appendix of the report contains Geographic Systems Information (GIS) maps, which show the geographic location of various infrastructure elements in the state.

Sincerely,

Ave M. Bie

Ave M. Bie
Chairperson

Joseph P. Mettner

Joseph P. Mettner
Commissioner

John H. Farrow

John H. Farrow
Commissioner

Part B

Executive Summary

The Public Service Commission (Commission) has prepared this third biennial report for the legislature as required under Wis. Stat. § 196.196(5)(f). This report contains information about the use of advanced telecommunications infrastructure for distance learning, interconnection of libraries, improving access to health care, and providing educational, health care, and employment opportunities for persons with disabilities and other persons in the home. It also documents providers' investments in Integrated Services Digital Network (ISDN) and other advanced telecommunications infrastructure and updates the historical data published in the two previous reports.

In general, the costs of broadband video and other high-speed network connections remain prohibitively high for institutions that provide distance learning, library services, and health care, as well as for programs that mitigate access problems for persons with disabilities. Nearly all of the growth in the use of advanced telecommunications for these purposes over the past several years has come because of subsidies and grants from the Technology for Educational Achievement in Wisconsin (TEACH) program, the Wisconsin Advanced Telecommunications Foundation (WATF), the Educational Telecommunications Board (ETB), the Federal Communications Commission's E-rate, and other programs. Where significant subsidies have been available, the use of advanced telecommunications by nonprofit entities has flourished; where they have not, it has languished.

In areas where the cost of high-speed bandwidth is prohibitive, users are turning to the Internet and to compressed video using ISDN, Switched 56, and other less-expensive technologies. They are also finding creative uses for new technology combined with standard, low-cost analog telephone lines to bring their services closer to the public through telecommunications. The advantage of using slower, but more affordable, technology is that it can reach more people where they live and work. Distance education for adults, access to health care, and access to library services have all improved through the use of the Internet and digital subscriber lines. At the same time, the increased demand for these services is helping spur the growth of competitive alternatives to the incumbent telecommunications companies.

Distance Learning

With the availability of TEACH subsidies, over 160 K-12 schools, technical colleges, and four-year colleges have been able to gain access to full-motion video networks for distance education. This effectively doubles the number of schools connected to full-motion video networks at the end of 1997. Private schools are beginning to join distance education networks, with 11 private colleges and 8 high schools now

connected. Because some networks use different technologies, not all schools equipped with full-motion video facilities are able to interconnect; however, there is more sharing of courses among schools around the state in 1999 than in 1997. Schools with full-motion video are also starting to interconnect with compressed video networks. This makes it possible for them to access educational resources and collaborate in projects located outside of Wisconsin.

The distance education focus in the UW-System is to use compressed video over ISDN to share courses and to provide more classes over the Internet to reach students who do not have access to classrooms. In addition to saving on telecommunications networks, this approach allows faculty to collaborate with colleges from around the world and to make a wider variety of resources available to their students.

Interconnection of Libraries

By July 1999, over 92 percent of the public libraries in Wisconsin had connected to the Internet, with 70 percent of these libraries providing direct Internet access to the public. The TEACH program has made it possible for 170 libraries to access the Internet directly using T1 lines. The T1 lines also connect additional libraries to the existing library systems data networks and have made it possible for three additional library systems to establish data networks. With library networks, smaller libraries can share the automated systems, catalogs, and other electronic services used in the largest libraries, making it easier for the public to access library resources located anywhere in Wisconsin.

Access to Health Care

With limited access to grant money or subsidized rates, the use of advanced telecommunications services to improve access to health care in Wisconsin has not grown very fast. Even with the existing high-speed networks that connect health care providers, the primary use is to transmit data for billing and other administrative purposes and to conduct training, educational, and staff meetings over compressed video. The major exceptions are the Marshfield Clinic Network, which has expanded and has increased the use of video to provide medical services to remote locations; and the Veterans Administration and the Department of Corrections, which are using compressed video to provide health care service between distant locations. In addition to the cost, another reason the use of video for health care services has not grown is because health care professionals prefer to conduct in-person diagnosis, and clinics have been located within relatively short driving distance of most residents in Wisconsin.

In some areas, low-cost telecommunications services in combination with advances in monitoring equipment are now permitting individuals to connect to health care providers from their homes. This allows patients to spend less time in hospitals and health care personnel to gain more mobility and control over their time. The Internet is increasingly used to disburse health care information, making it easier for patients to participate in decisions that effect their health. The Internet is also used to improve access to the latest medical information for health care providers located in more isolated areas of the state. There is a shortage of health care professionals in these areas and the hospitals that train and educate new medical staff could benefit from better access. Rural health care providers primarily have slow, dial-up Internet access, and the cost of full-text access to the leading medical journals is prohibitive for individual medical libraries.

Education, Health Care, and Employment Opportunities for Persons with Disabilities

Progress in using the capabilities of advanced telecommunications to assist persons with disabilities to gain access to education, health care, or employment has come very slowly, but not because of inadequate investment in the infrastructure. Telecommunications services will be more effective only with increased investment to adapt equipment such as computers, handsets, screen readers, and interpretive devices so that persons with disabilities can even more effectively use the telecommunications network. A primary concern is that the pace of technological progress is so rapid that the access to telecommunications now available to many persons may become obsolete unless the abilities of persons with disabilities to use the various technologies are addressed during the development and implementation of accessibility standards.

Ongoing programs like the state deaf relay system (TRS) that allows people with TTY equipment to use the telephone system; the Telecommunications Equipment Purchase Program (TEPP) in the PSC's Universal Service Fund program, which subsidizes the purchase of special telephone equipment; and programs to provide computers for persons with disabilities continue to grow. These programs are very useful for persons with disabilities; however, even more people are must be made aware that these services are available.

Infrastructure Deployment

Infrastructure deployment by the Incumbent Local Exchange Carriers (ILECs) and the Competitive Local Exchange Carriers (CLECs) has progressed since the 1997 report. As of year-end 1998, Wisconsin ILECs have 100 percent digital switching. Fiber optic technologies are being deployed in a number of areas, such as inter-office fiber and fiber in the feeder. Advanced service deployment, particularly ISDN, showed a modest increase, as did xDSL. Both of these technologies provide high-speed connection to the Internet. High-speed data is an important advanced service and will be examined in future infrastructure reports.

The number of certified CLECs has increased since 1997. However, the number of CLECs actually offering service has only moderately increased. The competitive companies usually serve large urban areas. It is not uncommon to find two and three such providers offering service in a large city. The facilities the CLECs install are generally fiber-based, are state-of-the-art, and represent a significant investment in infrastructure.

Wireless providers and cable television companies operating within the state are also investing in infrastructure, expanding their networks, and upgrading their technologies and have the potential to be significant competitors in the near future.

Summary and Conclusions

There have been substantial increases in the use of high-speed telecommunications services to create distance-learning networks and to interconnect libraries where subsidies and grant money were provided. Where the grant and subsidies were not available for high-speed telecommunications, slower and less-expensive ways were found for providing access.

The ability of persons with disabilities to use the network was limited more by difficulties in adapting equipment to be used with the network rather than by the network infrastructure itself. The rapid technological pace makes some of the current adaptive technologies obsolete. The Commission recommends that standards and guidelines for accessibility by persons with disabilities be included in the planning process by the entities that provide telecommunications services and by the entities that use telecommunications to provide employment, education, and health care. In particular, when grants and subsidies are used, planning for accessibility should be mandated.

While the ability of schools and libraries to use high-speed telecommunications services has increased dramatically, problems remain with the ability to share video programming among school networks and data links among library systems with proprietary equipment. The Commission recommends that efforts be made to address interconnection problems, but recognizes that the cost to resolve the conflicts may be substantial.

The Commission found that health care providers in areas with relatively high population densities are using advanced telecommunications services for administrative purposes, training, and education, but not for diagnostic purposes. Except where grant money was obtained, rural health care providers are using dial-up Internet access; they do not have video or data networks. There is some frustration in the nonprofit health care community that they do not have access to the same subsidies made available to schools and libraries even though they, too, provide educational and library services.

In studying infrastructure deployment, the Commission found that the ILECs and CLECs have continued to make infrastructure investments within the state, adding millions of dollars of state-of-the-art facilities. Wisconsin has 100-percent digital switching. Gains have been made in SS7 deployment, although there are still areas of the state that do not have SS7 and therefore cannot obtain some advanced services. Fiber cable mileage and technology applications have increased. There was less dynamic growth in advanced services, and customer demand for some services such as high-speed connections to the Internet are not being met.

It is difficult to recommend a particular technology implementation be mandated or subsidized because technological change is so dynamic. From a regulatory point of view, it is more reasonable to focus on whether customer needs are being met and whether quality service and reliability are being provided rather than on a particular type of infrastructure.

The Commission has opened docket 1-AC-187 to develop rules for establishing generic alternative regulatory plans that are expected to provide incentives for smaller ILECs to upgrade their infrastructure and prepare for competition.

The Commission has also initiated a process to formally collect, analyze, and distribute information on competitive activity in Wisconsin. This will help with the collection of data on infrastructure investment for future reports.

There are two areas of concern that the Commission will continue to monitor. These are the availability of high-speed connections to the Internet and the reporting of data. High-speed access can be provided through a number of technologies. Landline companies can offer ISDN- and xDSL-type services for Internet access. Cable television companies have pilots to provide Internet access through the cable

network. Wireless companies are offering high-speed access, mainly to business customers, via high-speed radio systems. High-speed access will continue to be monitored to determine what technologies are offered and where they are deployed.

CLECs do not currently have the same reporting requirements as the incumbent providers. This policy is under review as the reporting of relevant information is establishing a complete picture and providing a consistent basis on which to review infrastructure and the progress of competition.

Part 1

Introduction

This report is divided into five sections:

Part 1 provides an introduction and general information.

Part 2 examines the progress in the use of advanced telecommunications infrastructure for designated purposes, such as for schools, libraries, health care, and persons with disabilities.

Part 3 describes the progress of the deployment of infrastructure for advanced telecommunications services for the Incumbent Local Exchange Companies (ILECs) and the Competitive Local Exchange Companies (CLECs). The maps related to Part 3 illustrate the areas of the state where these facilities are in place. Most of the maps cover ILEC facilities, because ILECs are still the primary providers of telecommunications services in the state and have infrastructure in place and documented. There is less information available about the CLECs even though the number of such companies operating and offering service has increased since the last report. There are brief comments on wireless and cable television providers at the end of the section.

Part 4 provides some conclusions on the progress of infrastructure in Wisconsin.

The **Appendix (Part 5)** includes a number of Geographic Information Systems (GIS) maps that show the locations of various infrastructure items in the state.

General Comments on the Report

The information in this report is updated from previous infrastructure reports whenever the data was available. The previous reports are on file in the Public Service Commission's Resource Center.

The information for Part 2 on the use of advanced infrastructure for designated purposes was gathered from discussions with providers and users and from sites on the World Wide Web. The infrastructure information used for Part 3 was taken from the 1998 annual reports to the Public Service Commission and from a 1999 data request sent both to ILECs and to CLECs. It should be noted that there is only minimal data available from the CLEC annual reports. Much of this data is filed confidentially and, because there are only a few operating CLECs, it is often difficult to show aggregate information and maintain this confidentiality. In addition, a lack of consistency in some reported CLEC data makes it difficult to compare and summarize the CLEC information.

Graphs and tables are used throughout the text to present data. The sources and date references are shown for graphs, tables, and map information. Confidential data is either marked as confidential or masked by aggregating this data with nonconfidential data.

The results of the 1999 data requests mentioned above are used throughout this report to update, analyze and review infrastructure items.[1] All of the 84 ILECs responded to the data request. Of the 50 CLECs in Wisconsin, 43 responded to the data request. Of the seven CLECs that did not respond, one has requested decertification.

[1] Commission staff has estimated a three- to four-percent error in the data received. The staff has attempted to correct errors in the reported data wherever possible. Errors can often be traced to incorrect data filed by a company, variations in interpretation of questions, or input errors.

Part 2

Use of Advanced Infrastructure for Designated Purposes

This section of the report provides information on the progress made in the use of advanced telecommunications infrastructure for distance learning, interconnection of libraries, access to health care, assistance to persons with disabilities, and to some extent, the deployment of ISDN, as required by Wis. Stat. § 196.196(5)(f)(1). Before reporting on progress in specific areas, a few general observations are made about the way in which advanced telecommunications services are being used by these primarily nonprofit sectors of the Wisconsin economy.

Input received for this report indicates that broadband video and other high-speed network connections remain too expensive to be used extensively for education, library services, health care delivery, or assistance to persons with disabilities. While there has been explosive growth in the number of interconnected schools and libraries in the past two years, this growth is the result of government intervention in the form of grants and subsidies for the purchase of high-speed network connections. Targeting schools and libraries has both advantages and disadvantages. A major advantage is that it speeds up the deployment of advanced telecommunications services to areas that have great need and that provide benefits to the public as a whole. At the same time, grants and subsidies make it possible for telecommunications providers to serve the targeted areas while maintaining their tariffs and profit margins on the sale of the same services to the rest of their markets.

The disadvantage of targeted subsidies is that the smaller, distant, more independent and less organized entities, typical of the health care and disability communities, may still not be able to afford advanced telecommunications services. The possibility exists that users of high-speed networks will function as isolated islands among the more general population. Without access to advanced networks, the health care and disability communities have worked to use affordable standard telecommunications services in new, creative ways that are more accessible to the general public.

ISDN and the Internet are two telecommunications technologies that fit somewhere between the high-speed, high-cost networks and the traditional networks and that help bridge the gap between them. Most of the investment in Wisconsin to provide ISDN was made by Ameritech prior to the implementation of 1993 Wisconsin Act 496 (Act 496) and before there was much demand for its use. There has been considerable speculation that ISDN would be superceded by other forms of digital subscriber line (DSL)

technology before sufficient demand developed to justify Ameritech's investment.[2] However, ISDN, combined with Switched 56 service in areas where ISDN is not available, has become the medium of choice for compressed video and other data needs where cost and concern about long-term commitments rule out the use of higher bandwidths. An added advantage of the focus on more basic technology is that it is easier to interconnect with networks outside of Wisconsin.

The explosive growth and declining cost of using the Internet has made it a low-cost, more ubiquitous alternative for sharing information, providing educational opportunities and other networking advantages. The Internet has been embraced by all of the communities covered by this report, including those that have invested in high-speed networks. The major use for the T1 lines obtained through TEACH has been to provide faster direct access to the Internet. For health care providers, the Internet has facilitated the sharing of data among institutions, made it easier to educate and train staff, and helps patients become informed and involved in their own health care. For persons with disabilities, a major concern has been to keep the Internet accessible, so that they are not left out of the "Information Age," and so that they can network among themselves to share experiences and ideas.

The demands for Internet access have also spurred the growth of competitive alternatives to traditional telecommunications companies. To meet this demand, a growing number of Internet access providers, competitive local exchange companies, and existing cable television companies have made investments to build new facilities or to upgrade existing networks. Once this investment is made, they inevitably look for ways to expand their markets by offering other telecommunications services. One of the primary conclusions of the Governor's Blue Ribbon Task Force report that led to the passage of Act 496 was that competition should become the mechanism to drive investment in the telecommunications infrastructure of Wisconsin.

Distance Learning, Including the Number of Schools and Other Educational Institutions Connected to Distance Learning Networks

Since the last report, the procurement of advanced telecommunications services to facilitate distance education in Wisconsin has been dominated by the availability of subsidized services obtained through the TEACH I program and the "E-rate" subsidies created by the Federal Communication Commission. These programs have made it possible for 163 K-12 schools, technical colleges, and private colleges to obtain DS3 or equivalent service and use full-motion video for distance education purposes since August 1998. This will bring the total number of schools and educational institutions connected to high-speed distance education networks to over 310, almost double the number reported in 1997.

In addition to the increase in the number of schools connected, another change in the use of advanced telecommunications for distance education includes the participation of private schools that previously were not eligible to obtain subsidized services or share resources with public schools. Eleven private colleges and eight private high schools were connected to full-motion video networks by the end of 1999. Another development is a full-motion video network connecting all of the technical colleges in the

[2] There has been a similar concern that the subsidies for DS3 and T1 lines are causing many schools and libraries to invest in these technologies before they have use for the bandwidth. It is expected that creative new uses will be found before these technologies become obsolete.

state, with many colleges also having video connections to their satellite campuses. One area remaining outside of the telecommunications-based distance learning networks is the education of health care professionals in programs sponsored by the nonprofit, religious-based hospitals that dominate the provision of health care services in the rural areas of Wisconsin.

In addition to expanding broadband capabilities, TEACH funds have been used to purchase 22 video switches that coordinate the links between schools. Schools that share the same switch are generally organized into networks that coordinate their distance education programming. Another significant development since 1997 is that it is easier to share classes and programming between networks. The limited capacity and opportunity for interconnection has been addressed by investing in conversion hardware (J-series CODECs) and by creating more interswitch links. With schools and networks from around the state sharing courses and teachers, students have a better selection of courses and more scheduling options. In one example, after the Antigo School District lost its French teacher, students were able to continue their studies with a teacher located in La Crosse.

Unfortunately, the ability to share classes and programming between networks remains limited by the number of connections between switches, the limited capacity for the transport of programming over longer distances across the state, the use of conflicting standards and proprietary equipment for the delivery of video signals, and by scheduling conflicts between school districts. While additional interswitch links have been added, this option is limited by the capacity of the video switches and the expense involved with upgrading the switches. Another possibility would be to transport video programming across the state using the SONET backbone of the BadgerNet, but this would also require an expensive upgrade in capacity.

Systems using the DS3 technology provided by the local exchange telephone companies can interconnect for the most part.[3] The networks that use either MPEG2 or analog video signals over fiber optic cables provided by cable television companies do not share programming with the DS3 networks.[4] A few higher education institutions have addressed this problem by obtaining the equipment to interconnect with both types of networks.[5] The J series CODECs can be converted to handle MPEG2 signals, but this would also be an expensive undertaking. Even if the state decided to convert to MPEG2 as a standard, interconnection problems would remain because some suppliers deploy MPEG equipment with proprietary features.

Full-motion video networks also have difficulty interconnecting with networks in other states or with the compressed video-based programming that is provided through basic telecommunications networks. The UW-System has a compressed video network based on ISDN and Switched 56 lines that can be used at all of its campuses, including the two-year colleges. While the picture obtained using compressed video is not television quality, this is not as important for older students as it is in K-12 schools. With compressed video, collaboration with institutions around the world is relatively easy. Nine of the 13 UW-System

[3] The primary exception is ERVING, the earliest full-motion video network in the state, which has not been able to share classes with the newer networks. Improvements for the ERVING system have been funded in the recent state budget.

[4] The first networks established with cable television technology, Project Circuit, JEDI, and Moraine Park Technical College, use analog signals. KSCADE uses the MPEG2 digital format.

[5] The UW-Eau Claire, Moraine Park, Fox Valley, and Madison Area Technical Colleges, as well as St. Norbert College, connect to both DS3 and analog video or MPEG2 networks. The Marshfield Clinic recently converted its educational link with UW-Eau Claire to MPEG2, while its telemedicine network uses DS3 and compressed video..

university campuses also participate in DS3-based networks, providing programming for high schools in addition to sharing resources among themselves. [6]

With help from Ameritech, the BadgerNet has obtained three ISDN gateways that exchange signals between ISDN-based compressed video and DS3-based full-motion networks. This makes it easier to share programming between the UW-System, technical colleges, private colleges, and the K-12 networks. The gateways are also used for cooperative projects between schools in Wisconsin and those in other states and to obtain video programming from schools, museums, and other resources outside of Wisconsin.

In the last report, it was noted that the Internet had become a ubiquitous presence in higher education and in most schools. The biggest increase in distance learning courses provided by institutions of higher education in Wisconsin has been in the number of courses offered on-line. To facilitate this growth, the UW-System has a project called the Wisconsin Web-Based Learning System (WWBLS) that is a collaborative effort to use the expertise developed at individual campuses to provide support for a variety of web-based learning tools. The goal is to make it easy for any instructor to incorporate the Internet into courses as well as to develop courses to be provided over the Internet.[7]

In addition to network connections and video switches, schools need to establish connections within schools and between buildings. A recent survey by the Wisconsin Department of Public Instruction (DPI) found that school districts are using a wide variety of technologies within schools for data and video transmission. The most common links are T1s and fractional T1s, followed by 56K, fiber optic cables with DS3, coaxial cable, and ISDN. It is interesting to note that one school district uses ADSL, three use ATM, three use SONET, and three use frame relay.[8]

Interconnection of Libraries, Including the Number of Libraries with Video Conferencing and Network Access Capabilities

The 1997 Report focused on the increase in the number of libraries with access to the Internet; 69 percent of public libraries had access at that time. By July 1999, over 92 percent of the 381 public libraries in Wisconsin were able to use the Internet. Of these libraries, 70 percent provide the public with direct access to the Internet, an increase from 35 percent in 1997. The remaining libraries either require the participation of library staff or do not offer Internet access to the public. In addition to providing access to patrons, librarians are able to use the Internet and e-mail for research, for sharing information, and for providing remote catalog and database access.[9]

The TEACH program has made it possible for 170 public libraries to procure T1 data lines. The T1 connections have been used to replace dial-up Internet access with faster direct access and to make it

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[6] The campuses at Green Bay, Parkside, Stevens Point, and Whitewater do not have full-motion video, in part because the UW-System is not eligible for TEACH subsidies.

[7] Details of this project can be found at http://www.uwsa.edu/olit/utility/.

[8] Preliminary results provided to the DPI from a survey of school district technology coordinators conducted by the Milken Exchange on Education and Technology, Santa Monica, California, in 1999.

[9] The latest information on the use of telecommunications technology in libraries, including the number of libraries with Internet access and those with shared networks can be found at the DPI web page at http://www.dpi.state.wi.us/dpi/dlcl/pld/libtech.html.

possible for smaller libraries to share the automated systems, catalogs, and other electronic services available at larger libraries within the system. The T1 lines have sufficient bandwidth for video conferencing, but few libraries have the equipment or extra rooms needed to host video-conferencing sites. If video conferencing comes to libraries, it will probably take the form of desktop video on computers.

In 1997, five of the state's seventeen public library systems had some of their libraries connected by data networks. By late 1999, eight library systems had library networks and many additional libraries had been added to the existing networks. Three additional library systems are in the process of developing networks using the T1 connections from TEACH. In addition to the T1 lines, startup costs include purchase of router hardware and upgrading the wiring within the library buildings. While there are some funds available to rewire older buildings, no funds have been provided to help with the wiring of new buildings.

Currently, there is limited interconnection among library networks. The Division for Libraries and Community Learning (DCLC) within the DPI has a linked system demonstration project that will start in January 2000 to study the feasibility of electronically linking all of the library online public access catalogs (OPACs).[10] With electronic linking, a library patron would be able to determine if a requested item is available anywhere in the state, determine its shelf status, place holds on materials, and make interlibrary loan requests.

Electronic linking of libraries will also make it easier to coordinate the distance education programs offered by various educational institutions with libraries by making course items, research materials, and other resources available to students either electronically or at a library close to the student's location. The lack of supplemental course resources is one of the drawbacks to the use of distance education in remote locations. There has even been some concern about "dumbing down" distance learning courses to match the library resources available to students. The DPI obtained a Federal grant in 1998 to establish the BadgerLink service that makes electronic access to a large data base of periodicals available to Wisconsin libraries with Internet access as well as to library patrons. The project has been very popular and is now to be funded with Universal Service Fund assessments.

An example of the successful combination of distance learning with library resources is the Collaborative Nursing Program, a joint distance learning undertaking by the nursing programs of five UW-System campuses. The program has about 250 students from around the state enrolled in Internet or audiographics courses leading to a BS degree in nursing. Access to library materials is provided through an e-document program, OVID, which uses the Internet to link six UW-System libraries. A similar program is now in place for the UW-Stout's Industrial Technology distance education program. Students have remote access to materials that have been produced in electronic form and can also have materials delivered by e-mail, fax, or regular mail. Because mail delivery may not be timely and e-mail attachments frequently fail to go through, fax machines are currently the preferred method of document delivery.

The 26 UW-System campuses have established an integrated library and information system. Most of the Wisconsin technical colleges and private colleges, with the exception of the SWITCH network in the Milwaukee area, have stand-alone automated electronic library systems. An exception to the generally good

[10] For more details, see the Linked Systems Project Page on the DPI Website: http://www.dpi.state.wi.us/dpi/dlcl/pld/linksys.html

report on library interconnection is with the health science libraries located in nonprofit hospitals, which generally provide only slow dial-up connections to the Internet. The problems faced by the education programs to train health care professionals provided by hospitals in rural areas are discussed in more detail in the health care section of this report.

Access to Health Care

In contrast to educational institutions and libraries, there have been only small, evolutionary increases in the use of advanced telecommunications services to improve access to health care. To date, it has not made economic sense for health care providers to invest in high-speed video networks for telemedicine or diagnostic purposes. In contrast, the use of data networks to make the administration of health care more efficient continues to grow, and compressed video networks are receiving more use in some areas for staff meetings and education.

There is a debate in the worldwide telemedicine community over the benefits of establishing telemedicine networks because grant money is available versus reliance on a slower but surer means of internal growth that addresses specific needs.[11] In Wisconsin, the first telecommunications networks deployed by health care providers were at the Marshfield Clinic and the Gunderson Clinic. They both relied on grant money to get started. The lack of additional growth in the use of high-speed video networks suggests that competition has yet to reduce the cost of transmission or to introduce sufficient new advanced telecommunications services to make telemedicine cost effective. It also suggests that slower, incremental growth of telecommunications applications in health care is prevailing over the use of advanced telecommunications services.

Problems with access to health care differ around the state. In the more densely populated eastern and southern areas of Wisconsin, insurance and cost issues are important, but travel time to reach a physician is not. For example, the goal of the Aurora Healthcare System is to have primary health care facilities within 15 minutes of anyone in eastern Wisconsin. In more rural areas, patients may need to drive 45 miles to reach a doctor, and even further for specialized services. Telemedicine would appear to be a more compelling option for the rural areas; however, the providers in these areas pay the highest rates for transmission, and have they a smaller pool of patients over which to spread the costs.

The Marshfield Clinic Network remains the major exception to the use of video for the provision of health care services in Wisconsin. Two video sites have been added to the network since 1997, with a total of seven locations connected to the headquarters in Marshfield. J-series CODECS have replaced the E-series at Minoqua, Wausau, and Chippewa Falls, but not in Rice Lake. MPEG2 technology has been installed to replace the ISDN compressed video that was being used for distance education between Marshfield and the UW-Eau Claire. Compressed video connections at 384 kbps are used for the new links between Marshfield, Park Falls, and Ladysmith because faster speeds are too expensive without the grants and subsidies, such as those used to start the network or provided through the TEACH program.

[11] See Yellowlees, Peter, "How Not to Develop Telemedicine Systems," *Telesurgery*, May/June 1997 (http://telemedtoday.com/articlearchive/articles/hownottodeveloptelemedicine.htm)

There has been a significant increase in the use of the Marshfield Clinic's network for direct telehealth interactions between physicians and patients since 1997. The most common interactions are for dermatology and psychiatric consultations and for nutrition and diabetic counseling. There has been some experimentation with remote consultations in cardiology and in plastic surgery on burns, mostly in the form of follow-up care after operations. The primary benefit for patients has been the time saved by avoiding return trips to Marshfield. From a technical perspective, one of the biggest obstacles to telehealth has been the difficulty experienced by patients who are not comfortable using the telecommunications equipment. Patients with hearing disabilities have had additional problems because higher volume tends to interfere with the echo cancellation. The Clinic hopes that this problem can be overcome through the use of headphones.

Government institutions operate the other networks that provide telemedicine-type services in Wisconsin. The Veterans' Administration (VA) has a wide area network with T1 service linking Zablocki VA Medical Center in Milwaukee to Iron Mountain, Michigan, and to Appleton. It also has high-speed fiber optic links to VA hospitals in Chicago. After several years of planning and trials, the Wisconsin Department of Corrections' T1 network became fully operational in 1999. It connects seven correctional institutions to the UW Hospital and Clinics, with two additional sites in Boscobel and Racine soon to come on-line. Government agencies are able to use telemedicine more efficiently than other health care providers because they do not have as many concerns about licensure, compensation, or privacy issues, and their clientele have fewer options for care.

The VA network is primarily used for data and administrative purposes, but the T1s between Milwaukee and Iron Mountain are used for telemedicine. One T1 makes it possible for Zablocki to do all of the radiology work for the Iron Mountain site as well as transmit images created by ultra sound and fluoroscopy. It is also used for telepsychiatry, helping to make up for a shortage of psychiatric resources on the upper peninsula of Michigan. A second T1 is used for telepathology, with pathologists in Milwaukee able to examine and manipulate pathology slides in Iron Mountain. This saves the time that would be required to transport the slides to Milwaukee. Zablocki also has entered into a contract with the US Immigration and Naturalization Service in Texas to examine chest X-rays. The hospital uses MCI's network to transmit the X-ray images to Milwaukee.

VA technicians reported that the telecommunications portions of their projects are working well, although more bandwidth would help. The biggest problems have been with the technology and medical equipment used at each end to transmit, receive, and process the medical images.

The Department of Corrections' network uses compressed video for consultation between physicians at the UW Hospital and Clinics and medical personnel at the correctional facilities, and for psychological consultations. In addition, any diagnostic information that can be digitized, such as that obtained from stethoscopes and ophthalmoscopes, is obtained on site and transmitted to the Hospital. The Department's goal is to save on cost and mitigate the security risks involved with transporting prisoners to Madison for medical examinations. The network will also be used for staff training, meetings, and hearings.

Most of the larger health care systems in Wisconsin have decided not to provide remote diagnostic services because they believe patients are more comfortable with in-person visits with their doctors. On the other hand, they are making extensive use of data networks to link their facilities to reduce administrative costs and increase productivity. For example, Aurora has DS3 connections in the Milwaukee area and T1s to

its other locations for computerized patient records, scheduling, billing, and other administrative purposes. It has equipped 13 hospitals and clinics with video conferencing over ISDN to facilitate continuing medical and nursing education, business meetings, and doctors' boards where case studies are reviewed. Compressed video is also used for recruiting purposes, saving on travel costs for potential employees who live outside of Wisconsin.

The Wausau Hospital network has added eight sites and now reaches 22 outlying physician clinics. The central server in Wausau houses patient scheduling, billing, an office software suite, and other administrative information. The server is connected by frame relay to desktop computers in physician offices. To make patient information available to independent physicians and to work with suppliers, the hospital uses an Internet-based health care network. Telemedicine services have not been used at the hospital because most of its clientele lives within a 30- to 40-minute drive of their specialists. The hospital does not expect the travel time saved to compensate for the disadvantage of not being able to make a direct physical examination. Telemedicine would also exacerbate scheduling problems between the patient, primary physician, and specialist. The hospital does have a fiber optic link to the Marshfield Clinic's Wausau Medical Center that is used to transmit test results and other medical images.

The Mayo Clinic video conferencing network is heavily used for administration, continuing medical education, training, library access, and other educational purposes. The network includes three T1s to Franciscan Skemp Hospital in La Crosse, with T1's connecting to 13 satellite facilities in Wisconsin, Iowa, and Minnesota. A DS3 link has been added between La Crosse and Rochester, Minnesota, for a trial using real-time consultation. Specialists are able to observe cardiac operations in progress and provide input. The Mayo Clinic's T1 network also connects Rochester with the Midelfort Clinic in Eau Claire. From Midelfort there are T1 links to 11 affiliated and satellite sites in Wisconsin. Factors limiting the Mayo Clinic's ability to use the network for telemedicine include licensure issues between states and the cost of telecommunications.

The La Crosse area has been a center of networking for the delivery of health care-related services. The Gunderson Clinic and the Franciscan Skemp/Mayo Clinic, which both have T1 data and video-conferencing networks, have joined with educational institutions in the area to form the La Crosse Medical Health Science Consortium. This Consortium applied for grants to establish a two-way optical fiber-based telecommunications network that will connect 23 counties in western Wisconsin, northern Iowa, and southeastern Minnesota. Its goal is to establish centers in each county for the delivery of the following services:

1) Distance education courses in areas of the health profession that currently are in short supply;
2) Programming for the professional development of existing health care providers;
3) Closely tailored preventive maintenance programs, possibly to be delivered to the home via television; and
4) Consultative telemedicine services where appropriate.

A new trend in telemedicine/telehealth has been to establish a connection between the clinic or doctor's office and the patient's home using inexpensive, readily available telecommunications technology. The shift in emphasis away from high-speed video connections to inexpensive links that go directly into the home is similar to the shift in higher education to the Internet for the provision of distance education classes. The simplest links consist of speed-dialing arrangements coupled with monitoring equipment in the home.

The most common of these applications is the use of fetal monitors for at-risk pregnancies. Other projects have the monitoring equipment communicate directly with equipment at the clinic. These arrangements typically use wireless technology in the home by which monitors attached to the patient send signals to a base station that transmits the signal over ordinary telephone lines to patient information systems at a clinic.

Generally, normal telephone lines have been sufficient for connections between health care providers and the home, although some projects use ISDN or other digital lines. The primary limiting factor on the growth of in-home monitoring has been the monitoring equipment, not the telecommunications connection. The monitoring technology is still in its infancy and some of the products have not performed as well as hoped. In addition, the equipment can be very expensive and technically complex. It is expected that home monitoring will eventually save on health care costs by further shortening the time patients spend in the hospital.

ISDN has become the telecommunications technology of choice in the delivery of video images in the health care industry. The advantage of ISDN, in addition to lower costs than T1 and DS3 connections, is its flexibility and connectivity. Users are not required to commit to long-term contracts to obtain service at reasonable rates and are not limited by the scope of individual networks.

The UW Hospital and Clinics have an ongoing teleoncology program that uses ISDN connected to the Internet for both video and data transmission from CT scanners at the Wausau Hospital, Beloit Memorial Hospital, and the Freeport, Illinois, Health Network. In addition to the transmission of images and data for planning treatments, the program uses video conferencing for education and training, patient evaluation and protocol eligibility, quality assurance, and a peer-review program. Because the video images are used for discussion rather than diagnostic purposes, telemedicine issues related to reimbursement or legal responsibility are avoided.

In another example, Aurora Healthcare has provided ISDN lines that connect the radiology labs to personal computers at the homes of 12 of its radiologists. This provides the physicians with more control over their time even though they remain available for consultations. In Aurora's experience, ISDN service has not been as robust as the analog network and technical problems are still too common. It has considered other options for digital subscriber line technology but decided not to try them because of the distance limitations.

Another project that uses a lower level of telecommunications technology to improve access to health care has been the effort, mentioned in the 1997 report, of the Area Health Education Centers (AHECs) in Wisconsin to help physicians and other health care personnel in rural areas to become better connected using the Internet. While this program is continuing, the personnel involved remain frustrated by the limited availability of high-speed connections. The use of more advanced telecommunications services in rural health care delivery systems has been limited by prohibitive costs.

Part of the frustration experienced by the AHECs comes from the fact that nonprofit health care institutions have not been able to use the lower prices available on the BadgerNet, the Wisconsin state government telecommunications network, or to receive TEACH subsidies. They point out that many health science libraries are located in nonprofit hospitals that only have slow dial-up access to the Internet. In addition to physicians, the primary clientele of these libraries are students training to become health care

professionals. These students are needed to relieve the health care labor shortage in the areas where they live.

Another attempt to address the health care labor shortage is through distance education programs like the Wisconsin Program for Training Regionally Employed Care Providers (WisTREC). This program was started with a grant from the Robert Wood Johnson Foundation in partnership with Wisconsin institutions of higher education, government agencies, and community organizations to help educate prospective health care professionals living in underserved areas. It is expected that these students, primarily nurse-midwives, nurse practitioners, and physician assistants, will practice in the areas where they currently reside. WisTREC's goal is to deliver the bulk of the coursework needed to complete a degree to the student's location through the Internet or other forms of distance education.

In addition to the slow Internet connections, rural health care libraries have limited access to full-text medical journals. Doctors and other health care personnel in areas that do not have hospitals close by have even more limited access to the latest information. While the DPI's BadgerLink program that contracted to provide statewide access to a database of periodicals has been a big help, a large number of medical journals have not been included in the contract for full-text databases. Full-text online access to these journals requires a subscription, which can be quite expensive, or separate payments for each article. It would make more sense to share the subscription cost among the entire health care community or over the entire population that benefits from health care services.

Education, Health Care, and Employment Opportunities for Persons with Disabilities and Other Persons in the Home

The ability to use the capabilities of advanced telecommunications to assist persons with disabilities in gaining access to education, health care, or employment has slowly progressed. As reported in 1997, most of the research, development, and investment in technology to assist persons with disabilities has been needed to adapt computers, handsets, and other equipment so it can be used by individuals who are blind, hearing impaired, or have physical problems that make it difficult to use a keyboard or a telephone. The telecommunications infrastructure and the services provided by telecommunications companies have not been the factors that have limited access to these services by persons with disabilities; however, they also have not significantly improved that access.

The major concern is that as the use of telecommunications increases, investments to make the technology accessible need to keep pace. For example, the increased use of video conferencing will be a problem unless the video includes an interpreter or real-time captioning for deaf or hard-of-hearing persons. Generally, the feedback has been very positive on the ongoing programs like the Telecommunications Relay System (TRS), which makes it possible for persons who have hearing disabilities to use the telephone, and the Telecommunications Equipment Purchase Program (TEPP), which provides vouchers to help with the purchase of adaptive equipment.

Several institutions have looked at the trend toward linking all types of technologies together through the Internet and other telecommunications networks, and they are concerned that these links be accessible to

persons with disabilities.[12] This concern has led to the development of standards in web-page design and other areas so that as persons with disabilities obtain adaptive equipment and become connected, they will not have to face unnecessary barriers to using the network. If created in the right manner, the movement to smaller, inexpensive, disbursed, and ubiquitous connections has the potential to greatly benefit persons with disabilities. If access for persons with disabilities is not part of the planning process, the increased proliferation of these connections could further isolate them.

To improve access to technology, it will be critical that individuals creating programs, such as web pages for university classes, to ask questions in the design stage about how the program, class, or information will appear to someone who is blind, or how it can be used by someone who has hearing problems or has difficulty using a mouse or a keyboard. At the same time, guidelines should be provided (and mandated in cases where the creator is using grant money) on how to design web pages or other programs to make them accessible. In addition, when new communication links are planned, sufficient resources need to be made available to help insure that they will be accessible.

Demand continues to grow for adaptive computers and other equipment to help individuals with disabilities to obtain work. One cited problem has been that the TEPP program does not generally consider computers to be telecommunications devices and therefore does not generally provide funding for their purchase. Another concern is that the advertising of programs that provide help with adaptive equipment has not been as effective as possible. This problem is particularly acute in outlying areas and is probably the biggest factor to be overcome in providing adaptive equipment. One suggestion is to provide information in places such as shopping centers, where persons with disabilities spend their time, rather than in hospitals and government offices.

Some programs that assist individuals with disabilities to obtain computers with network connections have lost momentum or changed focus since 1997. The National Telecommunications Institute has decided to concentrate on finding employment for its clients as telemarketers or customer service representatives working from their homes. This eliminates the cost to purchase adaptive computers, train clients, and find employers willing to allow these persons to do computer work at home while networked to the employers' facilities. This experience fits with trends noted in the health care section, where the use of expensive high-speed networks has not grown to the same extent as the use of the Internet and standard connections to homes and individual offices.

Educational institutions have a mandate to make any reasonable accommodations for persons with disabilities. Their practice has been to respond to each request for accommodation as it is received. This has been criticized as being "reactive" rather than "proactive," but it is more cost effective in the short run because it attempts to address specific needs as they occur. In the long run, proactively designing telecommunications systems to address the needs of individuals with disabilities when the systems are installed will avoid future problems. Because of the risk that new technology will make proactively acquired equipment obsolete before it is needed, it is even more critical that all telecommunications technologies be designed from the start to accommodate the needs of persons with disabilities.

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[12] The guidelines for making Web pages accessible developed by the Trace Center at the University of Wisconsin are posted at http://www.w3.org/TR/WAI-WEBCONTENT/. Another source for information is *Producing web pages that everyone can read* at http://www.stakes.fi/cost219.

Part 3

Infrastructure Deployment

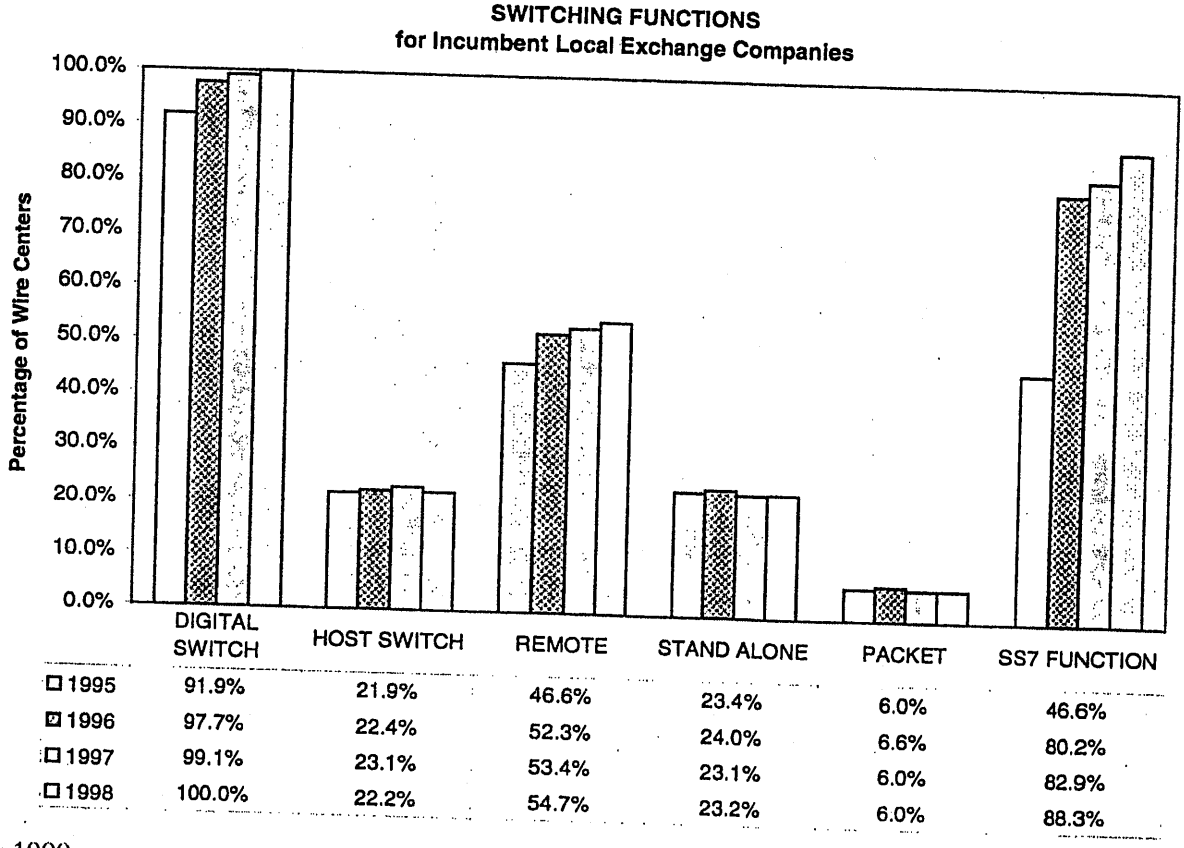
This section of the report reviews the status of infrastructure deployment in the state and its progress since the 1997 report. Deployment is generally reported based on the percentage of exchanges or wire centers that have implemented a particular infrastructure component. This type of assessment and the related GIS maps provide a statistical and geographic picture of infrastructure within the state.

The first portion of this section covers the infrastructure of Incumbent Local Exchange Company (ILEC) facilities. This is followed by information on the Competitive Local Exchange Company (CLEC) services and infrastructure. Finally, this section ends with brief comments on wireless and cable television providers.

Incumbent Local Exchange Company (ILEC) Facilities

The following ILEC information replicates the format of the 1997 report by examining infrastructure in three areas: switching, outside plant, and advanced services. These three categories most often represent the major capital investments for a telecommunications company. Infrastructure information was collected and is reported at the **exchange** level or the **wire center** level. The **exchange** refers to a geographical area where services and prices are the same. The data request used to prepare this report focused on exchange data for ease of utility reporting; data on 602 ILEC exchanges is included in the reported information. **Wire centers** are subsets of some exchanges. Although, for most of the state, exchanges and wire centers are synonymous, larger exchanges are comprised of two or more wire centers. Larger exchanges, such as Milwaukee, have multiple wire centers within the exchange and can have multiple switches within an individual wire center. There is data available on 686 wire centers in the 1998 ILEC annual reports filed with the PSC. CLEC data generally was reported on the basis of ILEC exchange areas and wire centers, where the information was available.

Switching. Graph 1 shows information on various switching parameters for 1995 through 1998. Switching functions establish a communication path between the calling and called parties and disconnect the path when the call is complete.



November 1999

Graph 1

Source: ILEC PSC Annual Reports

ILECs have made steady progress on digital switch replacement over the past four years. In 1995, 91.9 percent of all switches were digital and in 1997 this number increased to approximately 99 percent. As of year-end 1998, 100 percent of the switches in Wisconsin are digital.

Switching facilities can be deployed as host, remote, or stand-alone switches. Host switches are equipped with common processor software that is used to serve customers connected directly to the host and to process some calls for the remote switches. Remote switches serve areas that are geographically separate from the host switch. Remotes connect local calls between customers served from the same remote and derive additional functionality, service features, and connectivity to other networks from the host switch. A stand-alone switch performs independently and does not serve remote switches. Graph 1 shows that there has been no major change in the deployment of host, remote, and stand-alone switches.

Most new digital switches are modular and therefore are flexible and can meet changing needs. All or portions of the digital switching equipment can be updated as needs develop. Many industry experts believe, however, that digital switches will eventually by replaced by packet-switch architecture.

Packet-type switches provide an efficient way of transferring large amounts of data. A packet refers to a set of digital information bits that are given a unique address for identification. These packets of information can take different routes and may arrive in a different order before they are reassembled at the

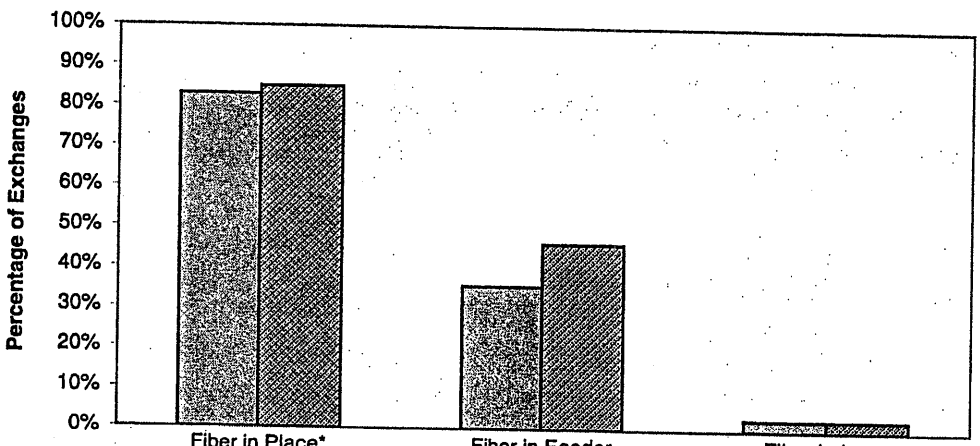
destination. This differs from digital switching where the calls are switched intact rather by having the call information broken into a number of packets for transmission through the network. Graph 1 indicates no major change in packet-switch deployment since the last report. (There was an error in 1996 data that showed a higher percentage of exchanges with packet switching. This was corrected and the number of packet switches has since remained constant.) At year-end 1998, there were 40 reported ILEC packet switches in the state. **Map 1** indicates the exchanges where these switches are located. Growth of these packet-type switches, including frame relay and Asynchronous Transfer Mode (ATM) switches that provide high-speed transmission, will continue to be tracked for future reports. The expectation is that this technology will be increasingly used for future needs such as Internet traffic.

The final switching function shown on Graph 1 is Signaling System 7 (SS7). SS7 is a signaling protocol that is essential for advanced telecommunications services. Signaling provides control and information transfer for routing, call setup and termination, and billing records. With SS7, the signaling take place "out of band," which means the call-setup information uses a different path than the voice traffic. This frees up facility capacity. SS7 also provides the connection to customer information databases that can provide new services or better administer call processing. For example, Caller ID uses SS7 signaling. SS7 deployment is growing; as of year-end 1998, SS7 was available in 88.3 percent of all wire centers in the state.

The upgrade to SS7 can represent a significant investment for an ILEC depending on the type and age of the existing switch. Because SS7 is necessary to provide many of the advanced features that use database lookup functions, such as local number portability and call trace, it is an important component of advanced telecommunications systems. As the telecommunications systems become more complex, SS7 functions provide a resource for analyzing and tracking calling information. The deployment of SS7 will be an infrastructure item considered in alternative regulation plans filed with the Commission. **Map 2** shows the geographic deployment of SS7.

Outside Plant. Outside plant traditionally refers to those facilities that are physically located outside of the central office building. These facilities include fiber and copper cables, electronic equipment, and other types of line-enhancement equipment. Outside plant connects customers to switches and connects switches to other switches. Historically, most outside plant, both inter-office plant and customer-serving loop plant, consisted of copper wires. Fiber optics is changing this historic picture. Fiber optic technology provides for higher capacity and bandwidth than traditional copper plant and is increasingly used to transmit advanced digital services and high-speed data. Fiber provides a construction advantage over copper cable due to its lower weight and easier splicing capability. Fiber optics eliminates electromagnetic interference and has improved security. Graph 2 shows an update on the status of fiber facilities in Wisconsin ILEC exchanges.

Fiber Facilities within ILEC Exchanges



	Fiber in Place*	Fiber in Feeder	Fiber in Loop
1996	83%	36%	3%
1998	85%	46%	3%

* Indicates the percentage of wire centers based on 1998 Annual Report. Data November 1999

Graph 2

Source: 1998 ILEC PSC Annual Report
1999 Data Request

The mileage of installed fiber facilities grew from 9,889 miles in 1996 to 12,093 miles in 1998. A full 85 percent of the ILEC wire centers now have some fiber facilities present. This is a substantial increase in two years. This additional fiber is used for inter-office facilities and fiber in the feeder. Fiber in the loop has not significantly changed.

Feeder fiber is defined for this report as a fiber facility originating in the central office and terminating at an intermediate distribution point such as digital serving area (DSA) equipment location point. A digital serving area groups clusters of subscribers and routes them to a central point where equipment is located that transfers the calling signals from an analog to a digital format. These calls are then routed to the central office. Although feeder fiber serves no immediate customers along its length, a feeder cable serves a large number of customers who are connected at the DSA. **Table A** shows there is growth across the board in the percentage of access lines with fiber in the feeder. As companies continue to install DSA-type equipment, the connection to the central office is often linked with a fiber facility. Some exchanges have 100 percent of their access lines served on fiber facilities from DSAs to the central office. **Map 3** indicates the geographic location of exchanges with feeder fiber deployment.

Loop fiber is defined as the distribution part of the loop from the DSA or serving area interface to the customer drop wire. The loop fiber extends from the end of the feeder fiber and directly serves businesses and residences. The percentage of access lines served with loop fiber within an exchange has not changed from the previous report. There may be some minor adjustment in the percentage of lines with loop fiber; however, companies basically are not deploying loop fiber as quickly they are feeder fiber. Eventually, as existing copper cables need replacement, fiber to serve the customer loop may be one of the technologies considered to replace the copper plant and to meet the demands for emerging new services.

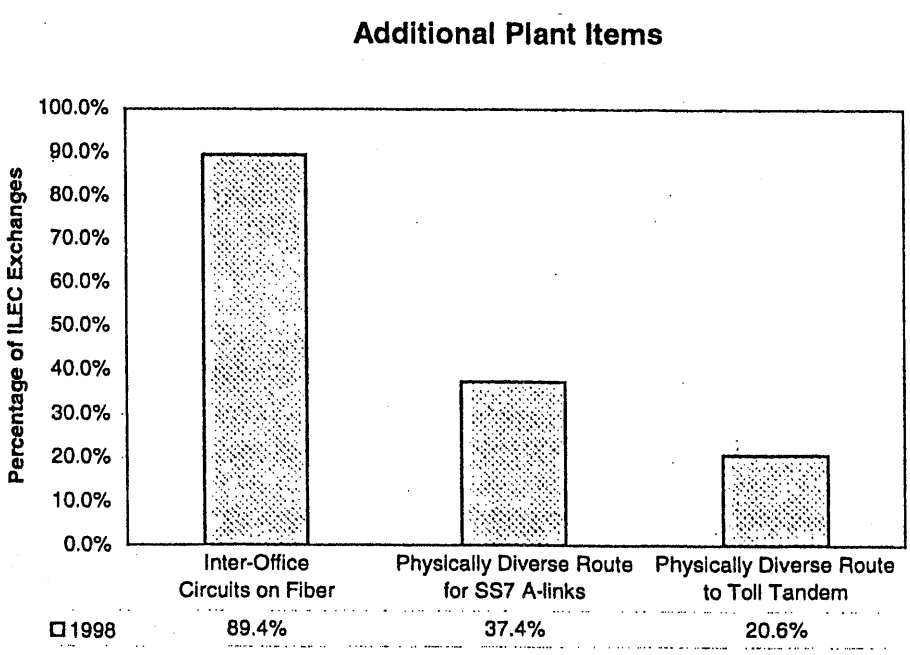
The **Table A** shows information for feeder fiber and loop fiber.

Reported Number of Exchanges Having Percentages of Access Lines with Feeder Fiber and Loop Fiber

Access Line Percentage Range	Exchanges with Feeder Fiber		Exchanges with Loop Fiber	
	1996	1998	1996	1998
0%	387	323	584	584
>0%-25%	164	197	18	18
26%-50%	29	45	0	0
51%-75%	8	18	0	0
76%-100%	14	19	0	0
Total Exchanges	602	602	602	602

November 1999 **Table A** Source: 1999 PSC ILEC Data Request

Graph 2 and **Table A** show that fiber is being deployed and installed within the local exchange. Fiber is also being deployed for inter-office use as shown on **Graph 3**.



November 1999 **Graph 3** Source: 1999 ILEC data request

Inter-office facilities connect telephone company switches to other switches or databases in the network. Almost 90 percent of the exchanges had some inter-office connections on fiber facilities. **Table B**

indicates the range of the percentage of DS-1-equivalent inter-office circuits on fiber facilities. The deployment of fiber for inter-office facilities is progressing much faster than the feeder fiber applications. For over half of all exchanges at the end of 1998, all inter-office facilities are served by fiber. (Technology Futures Inc., forecasts that by 2000, 98 percent of all circuits will be on fiber.[13]) **Map 4** indicates the geographic location of areas with inter-office fiber connections in place.

Percentage of Inter-office Circuits on Fiber (DS-1 Equivalent)

Range of Percentages	Number of exchanges
0%	64
1% to 25%	5
26% to 50%	11
51% to75%	18
76% to 94%	70
95% to 99%	60
100%	374
Total Exchanges	602

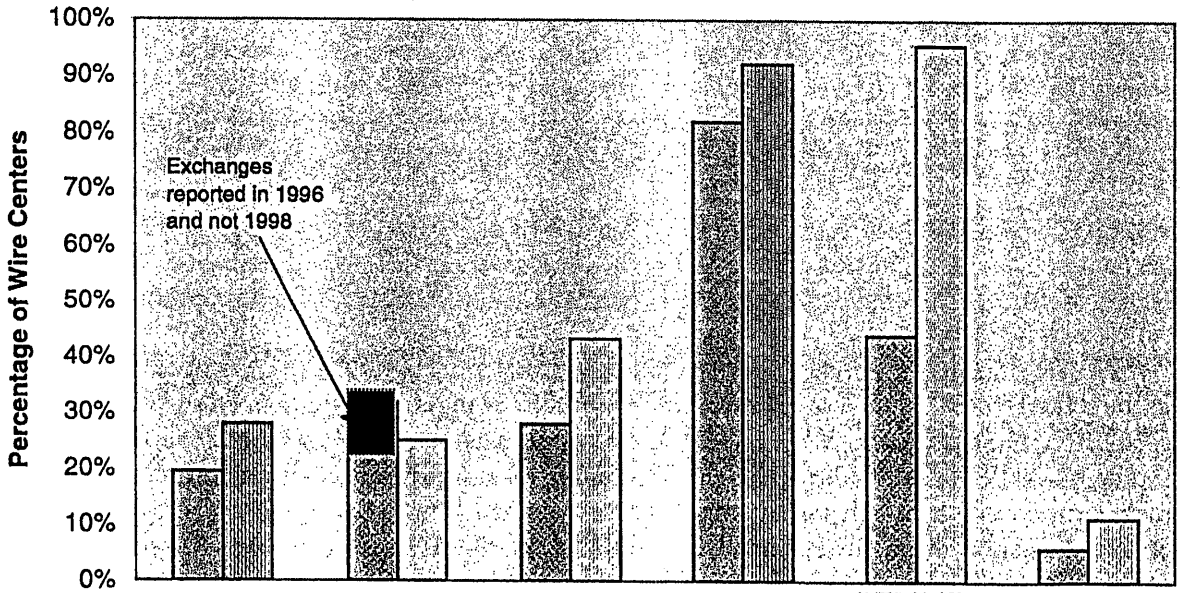
November 1999 **Table B** Source: 1999 PSC ILEC Data Request

Graph 3 also shows data on diverse physical routes for SS7 A-links and toll tandem routes. A-links, or access links, connect the switch with the signal transfer point to route SS7 traffic. Toll tandem routes connect customer-serving central offices with tandem switches in the toll, or long distance, network. At the end of 1998, the ILECs reported that diverse routes for these purposes are in place for fewer than 40 percent of all exchanges. This will be tracked for future reports.

Advanced Services. This third portion of the ILEC section of this report reviews the status of ILEC advanced service deployment, including various service offerings of these companies. **Graph 4** updates the service information from the 1997 report, while **Graph 5** portrays additional items examined for the current report.

[13] Transforming the Local Exchange Network, Analyses and Forecasts of Technology Change, Lawrence K. Vanston, Ray L. Hodges, Adrian J. Poitras, 1997, Technology Futures, Inc.

Advanced Services for Incumbent Local Exchange Companies



	ISDN	XDSL*	SWITCHED 56	CALLER ID*	INTRALATA EQUAL ACCESS	VIDEO SERVICE
1996	20%	32%	28%	82%	44%	6%
1998	28%	25%	43%	92%	96%	11%

* Indicated information by percentage of exchanges

November 1999

Graph 4

Source: 1998 ILEC PSC Annual Reports
1999 Data Request

Since 1996, ISDN service, which was specifically noted in Act 496, showed a moderate increase. ISDN is an international standard that can provide video, fax, and other high-speed data transmissions. ISDN can provide customer video conferencing, fast data delivery, and a faster connection time for Internet access. **Map 5** in the appendix shows the areas where ISDN is reported to be in place.

ISDN availability slightly surpasses digital subscriber line (DSL) service or xDSL, which is a competing technology to ISDN. There are numerous types of DSL technologies available; the industry uses the acronym xDSL with the "x" designating the generic type of DSL available. DSL makes efficient use of copper wires and provides a high-speed transmission similar to ISDN, often at a lower cost than the other broadband-type technologies. Although the information on **Graph 4** shows a decline in the number of

exchanges offering DSL, this is the result of inconsistent interpretation of the data request question.[14] **Map 6** shows the exchanges that are reported to have DSL in place.

Both ISDN and DSL technologies provide for faster Internet access. As use of the Internet continues to grow, Internet users want high-speed connections via their phone lines to give them faster connections and download time. *Scientific American* reports that the rate of adoption of high-speed or broadband technology is unprecedented. It notes that five years ago less that 1 percent of U.S. households were online. In 1999, one-third of all households are connected to the Internet.[15] High-speed data transmission is an important advanced service offering and will be examined in future infrastructure reports.

Switched 56 is another high-speed service that offers dial-up transmission speeds of up to 56 Kbps. The availability of this service offering grew from 28 percent of wire centers in 1996 to 40.7 percent of all wire centers in 1998. **MAP 7** indicates the areas in which Switched 56 service is deployed. For occasional data transmissions, this service may meet some needs for high-speed access on a dial-up basis.

Caller Identification, or Caller ID, has also been made available in more exchanges. SS7 must be in place in the switch (or SS7 can be transported into a non-SS7 switch from an equipped switch) before Caller ID can be offered to customers. With Caller ID, a subscriber views the calling party's telephone number, and in some cases the corresponding calling party's name, via a display device. Law enforcement agencies and fire departments often use this as an efficient means of tracing the location of emergency calls coming to their lines. Approximately 92 percent of all exchanges have Caller ID available. **Map 8** shows the geographic location of these exchanges.

The 1+ intraLATA equal access service shown on **Graph 4** refers to the customer's ability to choose a carrier for long distance service within Local Access Transport Areas (LATAs). IntraLATA 1+ information taken from the 1998 annual report shows that 95.5 percent of all exchanges had 1+ intraLATA equal access dialing at the end of 1998.[16] Because of a recent FCC order (FCC 99-54, released March 1999), all exchanges are required to submit a plan to provide this service. Company responses to a recent PSC staff information request indicated that by 2000, all of the ILEC exchanges will be equipped with intraLATA equal access capability.

The final item shown on the advanced services **Graph 4** is video services. Video service is defined as a video signal transmitted over telephone company-provided end-to-end facilities and could include dial-up digital circuits or ISDN. The availability of video service increased from 6 percent in 1996 to 11.3 percent of all exchanges in 1998. This does not include point-to-point video networks used for distance learning or consumer video transmitted over ILEC-owned facilities.

Graph 5 shows information on other advanced services, SONET facilities and LNP availability.

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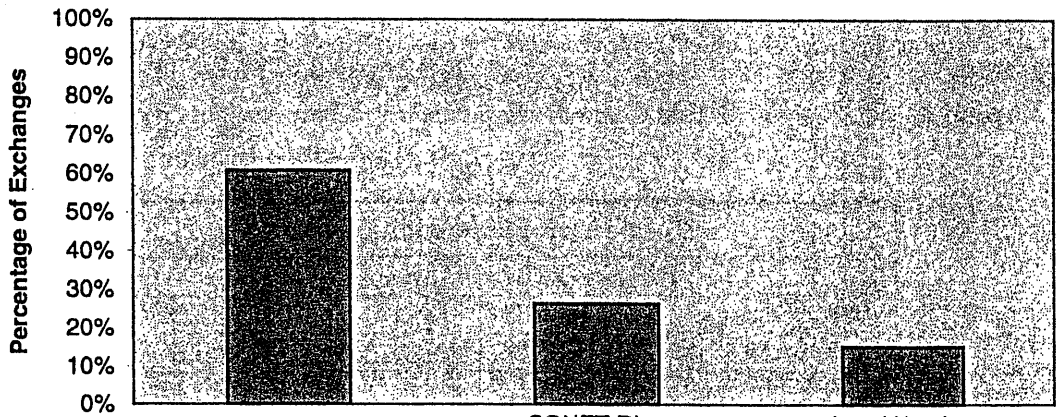
[14] In 1996, one company reported all exchanges thathad DSL service in use, including those where the service was used for the company and not as a tariff item for sale. In the most recent data request, the company only reported exchanges where the DSL service was offered to customers under a tariff.

[15] P. William Bane, Bradley, Stephen P., "The Light at the End of the Pipe," *Scientific American*, October 1999

[16] The last of the interLATA equal access conversions took place at the end of 1996, and 100 percent of all exchanges in the state offer interLATA 1+ dialing.

Advanced Services: Additional Items for Incumbent Local Exchange Companies



November 1999 **Graph 5** Source: 1998 ILEC PSC Annual Reports 1999 Data Request

Synchronous Optical NETwork (SONET) refers to a generic design standard that provides high speed transmission over fiber optic lines. SONET organizes information electronically and can transmit different types of traffic such as voice, video, and data traffic simultaneously. It is estimated that SONET equipment will eventually replace non-SONET circuit equipment now in place. SONET can be deployed in a number of different types of architectures to aggregate traffic and provide high-speed transmission. The ring-type architecture increases reliability, but also increases the cost of the system. Companies often start with point-to-point SONET design with plans to establish the ring architecture at a later date. The data request responses reflect this type of planning philosophy; 61 percent of the reporting exchanges have SONET facilities in place, while approximately 26 percent of all exchanges have SONET-ring architecture in place. **Map 9** indicates where SONET facilities have been deployed.

Local Number Portability (LNP) refers to the ability of end users to retain their telephone number if they make a change of their local telephone service provider. Many companies are installing LNP equipment when they upgrade a switch and will activate LNP once a request for LNP is received. About 15 percent of all exchanges are equipped with LNP.

Two other items reviewed for this report were 911 availability and the treatment of data and ISP traffic within an exchange.

911 service refers to the emergency reporting system where a caller can dial one number for emergency services. In Wisconsin, 911 is often county funded and implemented under a contract with the county and the telephone companies serving that county. **Map 10** in the appendix shows the status of 911 availability as of November 1999.

Information was also collected on whether and to what extent the ILECs measure Internet traffic within an exchange. This type of measurement assists the company in determining trunk design and in making decisions for equipment expenditures. Companies report that at 34 percent of exchanges, they measure and collect Internet-bound and data traffic. This information is often used to monitor call activity; it does not mean Internet or data traffic will be segregated on special facilities. The data request information showed that only at 4 percent of all exchanges is this type of traffic segregated from the voice traffic.

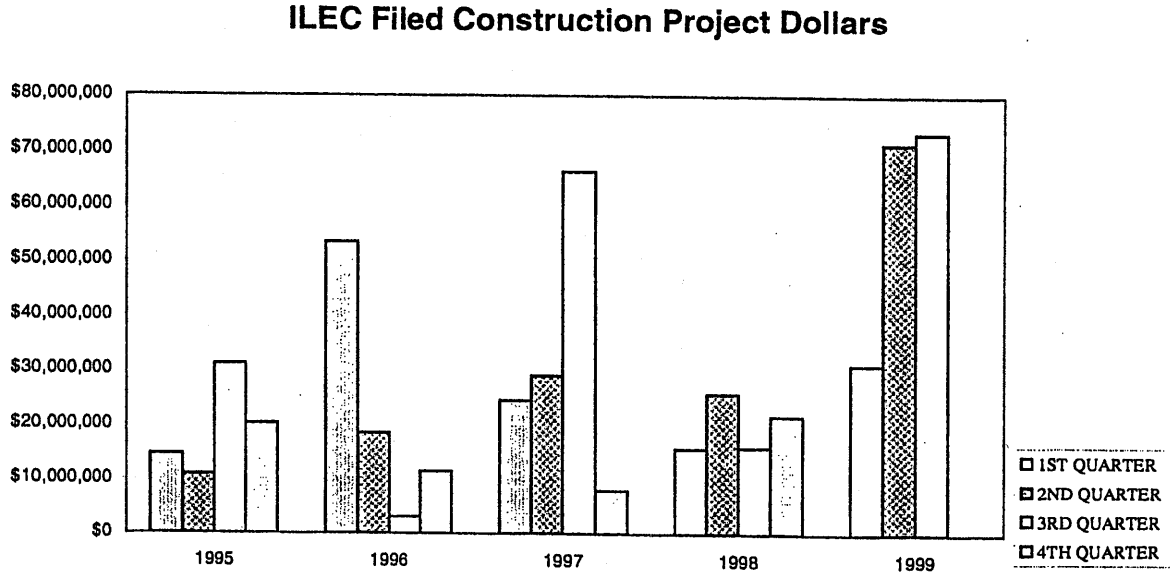
Capital Expenditures. Table C shows the annual capital investments made by the ILECs from 1992 through 1998. These expenditures cover all the types of infrastructure deployment discussed above.

Total ILEC Plant Additions		
Year	Plant in Dollars	Change from Previous Year
1998 Additions	$446,899,834	19.36%
1997 Additions	$374,403,187	-4.26%
1996 Additions	$391,080,104	10.13%
1995 Additions	$355,114,857	20.18%
1994 Additions	$295,488,914	-6.07%
1993 Additions	$314,575,622	3.70%
1992 Additions	$303,348,717	
Average	$354,415,891	

November 1999 **Table C** Source: PSC ILEC 1998 Annual Reports

Another indication of investments made by the ILECs is the dollar amounts of construction projects filed with the Commission.[17] **Graph 6** shows the construction project dollars the ILECs have filed with the Commission.

[17] Not all construction projects are filed with the Commission.



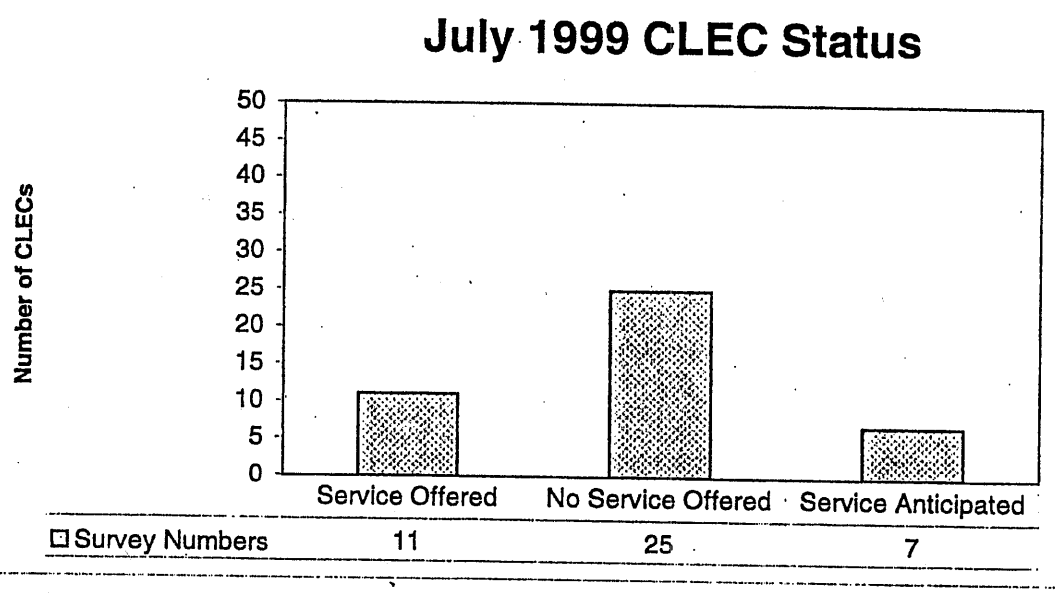
November 1999 **Graph 6** Source: Public Service Commission

Yearly Filed Construction Project Totals				
1995	1996	1997	1998	1999 through 3rd Qtr
$77,219,758	$86,527,250	$127,827,506	$79,241,936	$175,621,686

Competitive Local Exchange Company (CLEC) Facilities

Both 1993 Wisconsin Act 496 and the Federal Telecommunications Act of 1996 changed the telecommunications laws and greatly enhanced the possibilities for competition for local exchange service. Since those acts became effective, the number of certified competitive providers has increased. The number of companies providing service and the areas that have a competitive service presence have grown at a much slower pace.

The 1997 Infrastructure Report identified that 25 companies were certified to provide facility-based local exchange service in competition with the ILECs. As of July 1999, this number has increased to 50 certified companies. **Graph 7** shows the service information as reported by 43 of the 50 certified CLECs.



November 1999

Graph 7

Source: 1999 PSC CLEC Data Request

Graph 7 is a snapshot of the certified CLEC information. CLEC statistics are in constant flux due to mergers, acquisitions, and new entrants. Of the 43 CLECs who responded to the data request, 11 providers reported that service was available. This increased from 6 providers as noted in the 1997 report.

There is limited historic data available for the CLECs. This report presents the data that was supplied by the companies, which limits the amount of comparative analysis with previous years.

Map 11 shows the reported exchange areas in which CLECs serve. Because these companies compete on a selective basis, they may only serve a portion of an identified exchange. The majority of CLECs provide specialized services, often to business customers only. The data request responses show that in 1997, facilities-based competitive companies had a presence in 37 telephone exchanges. In 1999, the number of exchange areas with CLEC presence increased to 45.

Many of the larger cities in the state such as Milwaukee, Madison, and Green Bay, which had competitive providers in 1997, have added other competitive providers within the same exchange areas. Frequently, multiple CLECs are serving in the same wire centers or exchange areas. For example, three CLECs reported offering service within the Green Bay exchange. They may serve the same or different portions of the exchange.

Table D below indicates aggregate non-confidential information from the CLECs responses. One CLEC reported data confidentially; therefore, this company was not included in the totals. CLECs reported a presence in 146 wire centers and 45 exchanges. Unless otherwise noted, the percentages shown in **Table D** are based on the 146 areas with reported data.

CLEC SERVICE RESPONSE			
Service Item	Number of Wire Centers	Percentage of Total	Notes
TYPE OF SERVICE			
ACCESS	143	97.95%	
PRIVATE LINE	79	54.11%	
LOCAL EXCHANGE	76	52.05%	This may be business or local or both
DATA	128	87.67%	
INTERNET	126	86.30%	
COMPANY OWNS/LEASES SWITCH	84	57.53%	
SWITCH EQUIPPED WITH LNP	81	96.43%	Of 84 switches reported
% OF COMPANY-OWNED FACILITIES	82	52.16%	76 have 100% company-owned facilities
% WITH FIBER FACILITIES	76	52.02%	66 have 100% fiber facilities
COLLOCATION IN WIRE CENTER	129		
VIRTUAL	71		
PHYSICAL	58		
OFFER XDSL	99	67.81%	
OFFER CALLER ID	79	54.11%	
SONET DEPLOYED	66	45.21%	
SONET RING DEPLOYED	65	44.52%	
PHYSICALLY DIVERSE A-LINKS FOR SS7	75	51.37%	
PHYSICALLY DIVERSE ROUTE TO TANDEM	43	29.45%	
COLLECT MEASUREMENT FOR ISP TRAFFIC	38	26.03%	

November 1999

Table D

Source: 1999 PSC CLEC Data Request

Because these competitive carriers install infrastructure as they define and expand their service areas, the infrastructure they have in place is state-of-the-art. New switches are installed and fiber routes constructed resulting in significant investment by these competitive companies.

The 1998 CLEC annual reports filed with the PSC show the following aggregate dollar amounts of capital investment in plant: $94,164,396 additions to plant in 1998 and $126,400,000 plant in service at the end of 1998. CLEC investments are fairly recent and are expected to grow as the companies expand to their service areas and offerings.

The information obtained from the 1999 CLEC data request gives only a partial picture of the state of competition in Wisconsin. Recently, the Commission approved the creation of a Competitive Study Committee (docket 05-ST-109) for the purpose of collecting, analyzing, reporting, and distributing information on competitive activity in Wisconsin. As pertinent, information developed through that effort will be used in future infrastructure reports.

CLECs are for the most part fiber-based and serve major urban areas in the state. One company is now offering business service via a high-speed wireless service, and two companies recently announced plans to implement Local Multipoint Distribution Service (LMDS) service in Wisconsin. LMDS is a high-frequency wireless local loop application that will be offered in a number of areas in the state, mainly to business customers. Unlike cellular, LMDS is limited to fixed locations. This technology has the potential to deliver large amounts of bandwidth and can be deployed faster than cable facilities. It is however, limited by line of sight and distance requirements. The FCC auctioned LMDS licenses to a number of providers. This technology is expected to grow and offer competition to two-way cable systems.

Wireless and Cable Providers

Wisconsin has a number of wireless and cable providers operating in the state. Technology Futures, Inc.,[18] notes that given continued growth and improvement in wireless communications, and lower prices for those services, wireless will likely capture a large share of wireline minutes of use and wireline subscribers over the next decade. This same potential holds true for the cable service providers. The PSC has minimal jurisdiction over providers of wireless and cable services and therefore has minimal information on file for these providers. This report will provide only general comments on these providers as infrastructure investors in the state and potential competitors to the ILECs.

Wireless technologies continue to evolve and have increased service quality, security, and calling-coverage reliability. As new systems come online, they offer the latest in digital wireless technology. Some of the high-speed two-way data services compete with cable providers and the xDSL technologies in the wireline market. The services deliver large amounts of bandwidth, often at a cost savings to the customer. Wireless systems can usually be deployed faster that traditional wireline systems and can offer voice, data, local, and long distance services. There are downsides to this technology. Terrain can prevent reception and affect quality of service. There is also some concern from the local citizens over tower locations in their communities.

Cable companies have a somewhat different situation because they have a presence in the community and have facilities in place. Many cable networks are in the process of being upgraded from a coaxial network to a fiber-coax mix to provide two-way transmission service. Cable systems have the potential to evolve from television companies to telecommunications providers by offering high-speed Internet access, interactive TV, and local and long distance services.

In Wisconsin, market tests are underway for digital cable TV and cable Internet access. One cable company recently announced that it had spent $75 million on upgrades in 1998 and will spend that much in 1999. It has scheduled two-thirds of its cable to be rebuilt to fiber in 1999. Cable companies have had problems with service quality in the past. If these cable companies can offer customers high-speed transmission and a reliable customer service, they may be able to win customers over from the traditional telephone companies. The voice application for this technology is somewhat behind the data application. Cable companies are confident they will be able to meet telecommunications needs in the future. Certainly these upgraded cable systems can offer more capacity and speed than copper phone lines can provide.

[18] Vanston, Lawrence K. and Hodges, Ray L., "Wireless Vs Wireline for Voice Services," *Technology Futures, Inc.*, 1998

Part
4

Summary and Conclusions

In Wis. Stat. § 196.196(5)(f)(1), the Commission is instructed to report on the progress made in the use of advanced telecommunications infrastructure for distance learning, for the interconnection of libraries, for the improvement of access to health care, and for assistance to persons with disabilities in gaining access to education, health care, and employment opportunities in their homes. The Commission found that in areas where subsidized rates and grant money have been provided there have been substantial increases in the use of high-speed telecommunications to create distance learning networks and to interconnect libraries. In the absence of grants and subsidies, the use of high-speed telecommunications for these purposes has not grown very fast, although innovative ways to improve access to education, library services, and health care have been found using slower and less-expensive telecommunications technologies.

The ability of persons with disabilities to use the telecommunications network to improve access to employment, education, and health care is limited more by the difficulties in adapting equipment so that it can be used with the telecommunications network than it is by the network infrastructure itself. The Commission found that existing programs to assist with the purchase of adaptive telecommunications equipment are working although there are indications that some customer needs may be addressed with some greater efficiency by the use of adaptive computers. Given the successes that can be achieved by use of this program, getting more information to the public about this resource, particularly in rural areas, is a priority.

The pace of technological development in computer software and electronic equipment used for communications is both a blessing and a concern to persons with disabilities. New developments are making it easier to use computers and the telecommunications system, but they also have made some of the adaptive technology currently being used obsolete. The Commission recommends that the entities that provide telecommunications services and entities that use these services to provide employment, education, and health care incorporate standards and guidelines for accessibility by persons with disabilities into the planning and design of new services. Where services are provided with the use of government funding, grants, and subsidies, the grant and subsidy rules should stipulate that accessibility concerns be addressed in the planning process.

The Commission found that schools and libraries were rapidly procuring advanced telecommunications services that allow them to connect into networks. This process should continue and more emphasis should be placed on interconnecting the various networks so that they can be used to the fullest extent. To the extent possible, schools and the BadgerNet should purchase equipment that enables different video standards and proprietary equipment to interconnect. Interswitch connections should be added, and, as costs come down, consideration should be given to increasing capacity on the BadgerNet's SONET ring so it can handle the transport of video signals across the state.

In its examination of the use of telecommunications to improve access to health care, the Commission staff found that larger health care providers serving areas with relatively high population densities are using advanced telecommunications services for administrative purposes, training, and education. Except where grant money has been obtained, health care providers in rural areas are using dial-up Internet access, but do not have data or video networks. Many of these rural areas have a shortage of trained personnel to staff their health care facilities and these providers believe that advanced telecommunications services could help address this problem through distance education programs and remote access to library materials. There is frustration by some in the health care community that they do not have access to the same subsidies made available to schools and libraries, even though they too provide educational and library services as part of their health care programs.

The Incumbent Local Exchange Companies and Competitive Local Exchange Companies have continued to make infrastructure investment within the state, adding millions of dollars of new state-of-the-art facilities. Wisconsin now is served with 100-percent digital switching. Progress has also been made in the deployment of SS7 signaling, although there are still areas of the state that do not have SS7 available and therefore cannot make use of advanced services such as number portability. Fiber optic cable is being deployed at a steady pace, with both cable mileage and technology applications increasing. There has been less-dynamic growth in advanced services, and customer demands for some services, such as high-speed connections to the Internet, are not being met.

Because technological change is so dynamic, it is difficult to recommend that a particular technology be mandated or even subsidized. Each provider has a different set of variables to consider in making a choice to implement a technology. The concern always exists that any given technology can be outmoded before implementation takes place or before the company has a chance to recover its investment. From a regulatory point of view, it is more reasonable to focus on customer service needs and the quality and reliability of the services offered rather than on a particular type of infrastructure.

In addition to having to choose the technologies to provide, Competitive Local Exchange Companies also must determine which services to market and where to offer service. As expected, Competitive Local Exchange Companies concentrated first on business customers in the most populous areas. Wireless and cable television companies are just beginning to offer services that have the potential to compete with the landline Incumbent Local Exchange Companies and Competitive Local Exchange Companies.

The Commission has opened docket 1-AC-187 to develop rules for establishing generic alternative regulatory plans that are expected to provide better incentives for smaller Incumbent Local Exchange Companies to upgrade their infrastructure and prepare for competition. The Commission has also initiated a process to formally collect, analyze, and distribute information on competitive activity in Wisconsin. This process should help with the collection of data on infrastructure deployment for future reports.

Areas of concern with infrastructure that the Commission will continue to monitor are:

Availability of high-speed access to the Internet. High-speed access is possible through a number of technologies. Landline companies can offer ISDN- and xDSL-type services for Internet access. Cable television companies have pilots in a number of cities to provide Internet access through the cable

network. Some wireless companies are offering high-speed access, mainly to business customers, via high-frequency radio systems. The availability of high-speed access will continue to be monitored.

Data Reporting. Competitive local exchange companies do not currently have the same reporting requirements as the incumbent providers. This policy is under review, as the reporting of relevant data is important to establishing a complete picture and providing a consistent basis on which to monitor infrastructure progress and the presence of competition.

Going forward, the Commission will continue to monitor infrastructure as required by statute. The Commission is also committed to promoting fair competition and to ensuring quality service to customers throughout the state. The maintenance and growth of state-of-the-art infrastructure by the broad telecommunications industry are important factors in enabling these goals.

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Part
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Appendix

REFERENCE MAPS

A..... County Boundaries
B..... Telephone Exchange Boundaries

INFRASTRUCTURE MAPS

1..... 1998 ILEC Packet Switching Availability
2..... 1998 ILEC SS7 Availability
3..... 1998 ILEC Feeder Fiber Location
4..... 1998 ILEC Inter-office Circuits on Fiber
5..... 1998 ILEC ISDN Availability
6..... 1998 Exchanges with DSL Technology
7..... 1998 ILEC Switched 56 Availability
8..... 1998 ILEC Caller ID Availibility
9..... 1998 ILEC SONET Availibility
10..... 911 Availability
11..... Competitive Local Service Provider Locations

WISCONSIN

County Boundaries

Reference Map A

Public Service Commission November 1999

WISCONSIN

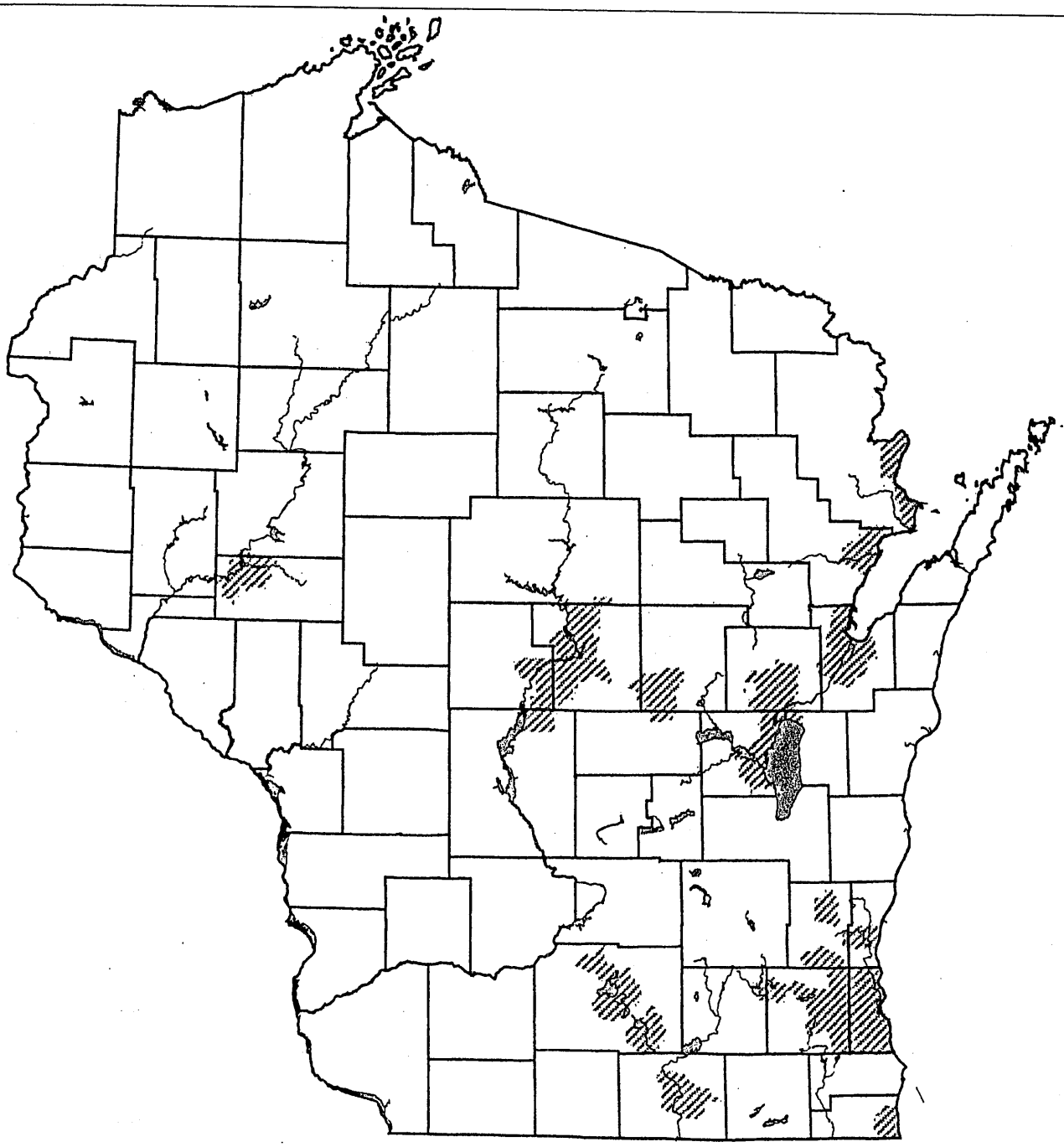
Telephone Exchange Boundaries

Reference Map B

Public Service Commission November 1999

WISCONSIN

1998 ILEC Packet Switching Availability



Map 1

Packet switches are used for transferring large amounts of data quickly and efficiently.

Key:

- County Boundary
- Packet Switching Not Available
- Packet Switching Available

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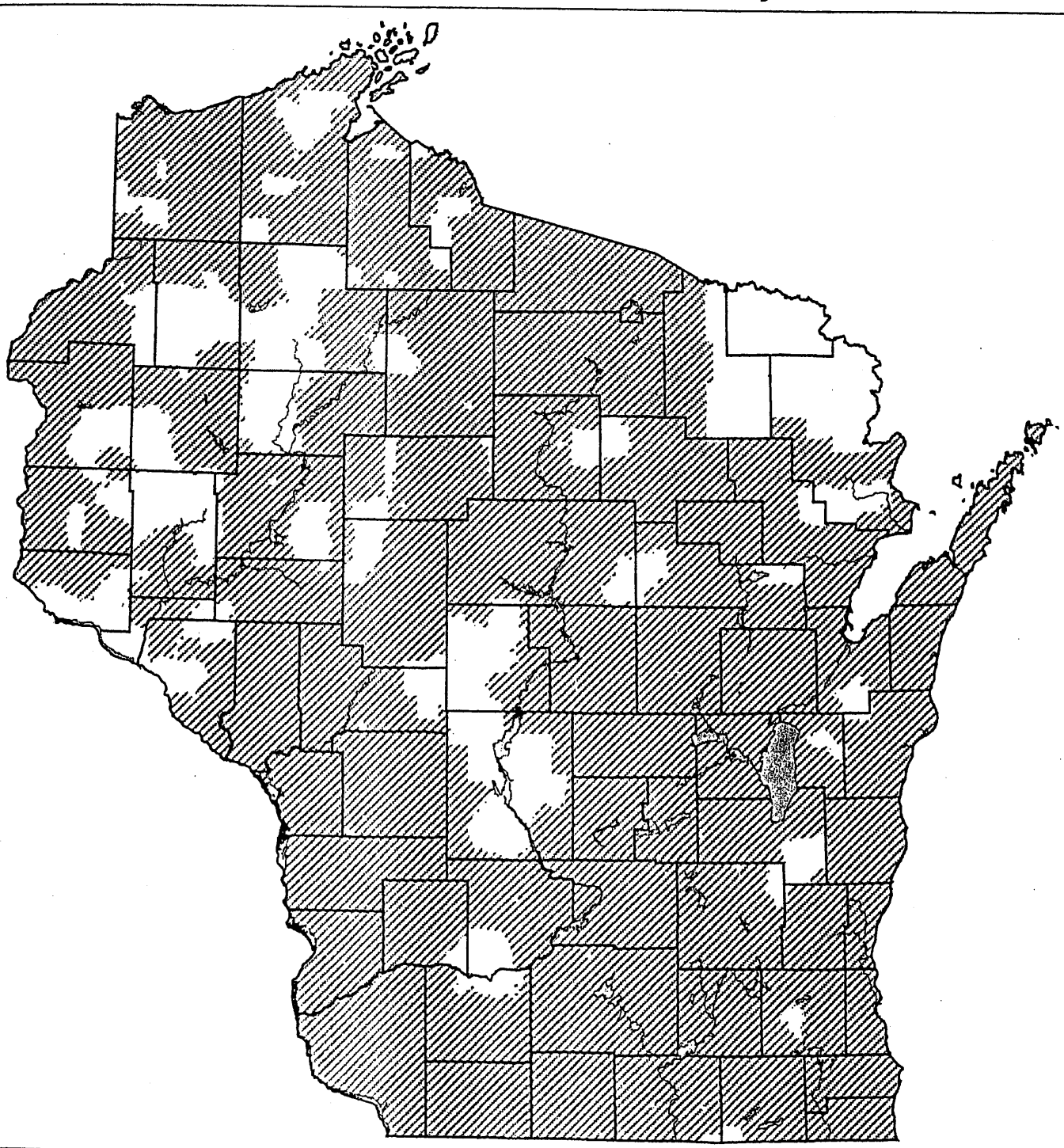
1998 ILEC SS7 Availability



Map 2

Signaling System 7 (SS7) is an essential signaling capability for advanced telecommunications services.

In 1998, the percentage of ILEC exchanges with SS7 availablity increased to 88%, up from approximately 83% in 1997.

Key:

- County Boundary
- SS7 Not Available
- SS7 Available

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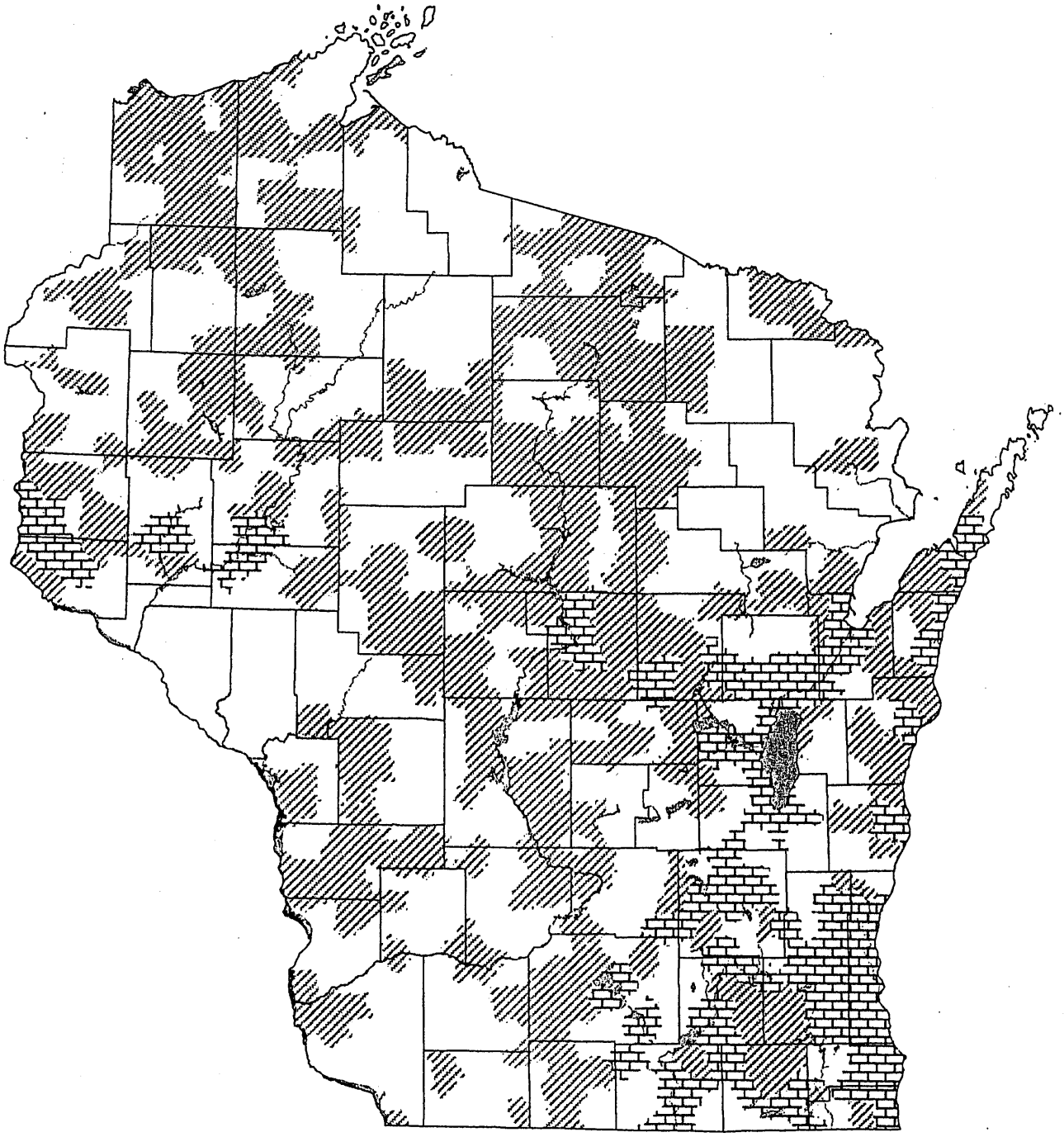
1998 ILEC Feeder Fiber Location



Map 3

A feeder cable is a facility that orginates in the central office and terminates at a distribution point. The majority of exchanges reporting the use of feeder fiber have 1% to 25% of the access lines served with feeder fiber.

Confidential responses should not be read as positive or negative.

Key:

- County Line
- Information Filed Confidentially
- No Fiber Feeder Cable Reported
- Fiber Feeder in Place

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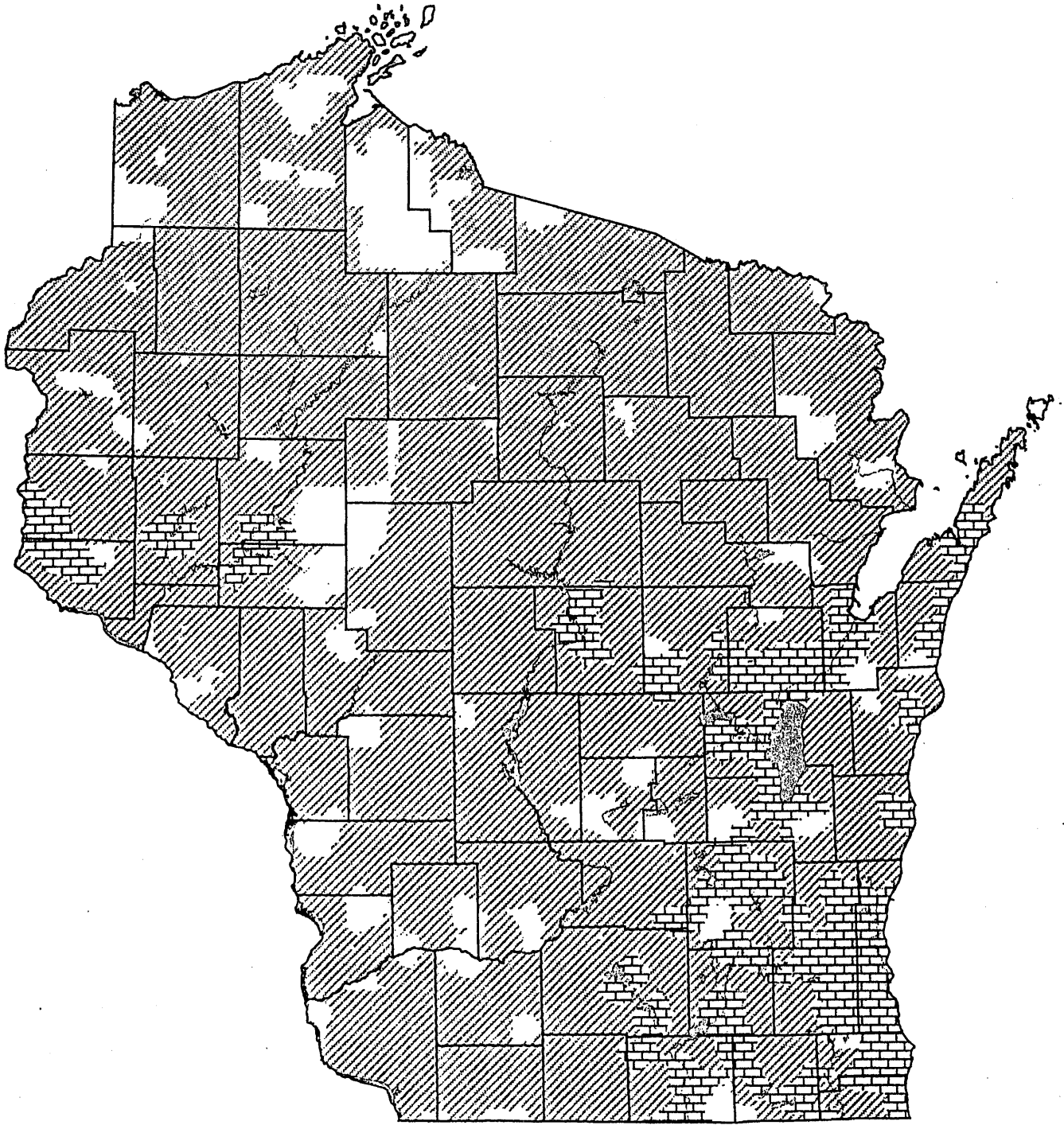
1998 ILEC Inter-office Circuits on Fiber



Map 4

Inter-office facilities connect telephone company switches to other switches or databases in the network. Almost 90% of the ILEC exchanges have some inter-office connections on fiber.

Confidential responses should not be read as positive or negative.

Key:

— County Line

Filed Confidentially

No inter-office fiber reported

Reported inter-office circuits on fiber

Public Service Commission November 1999

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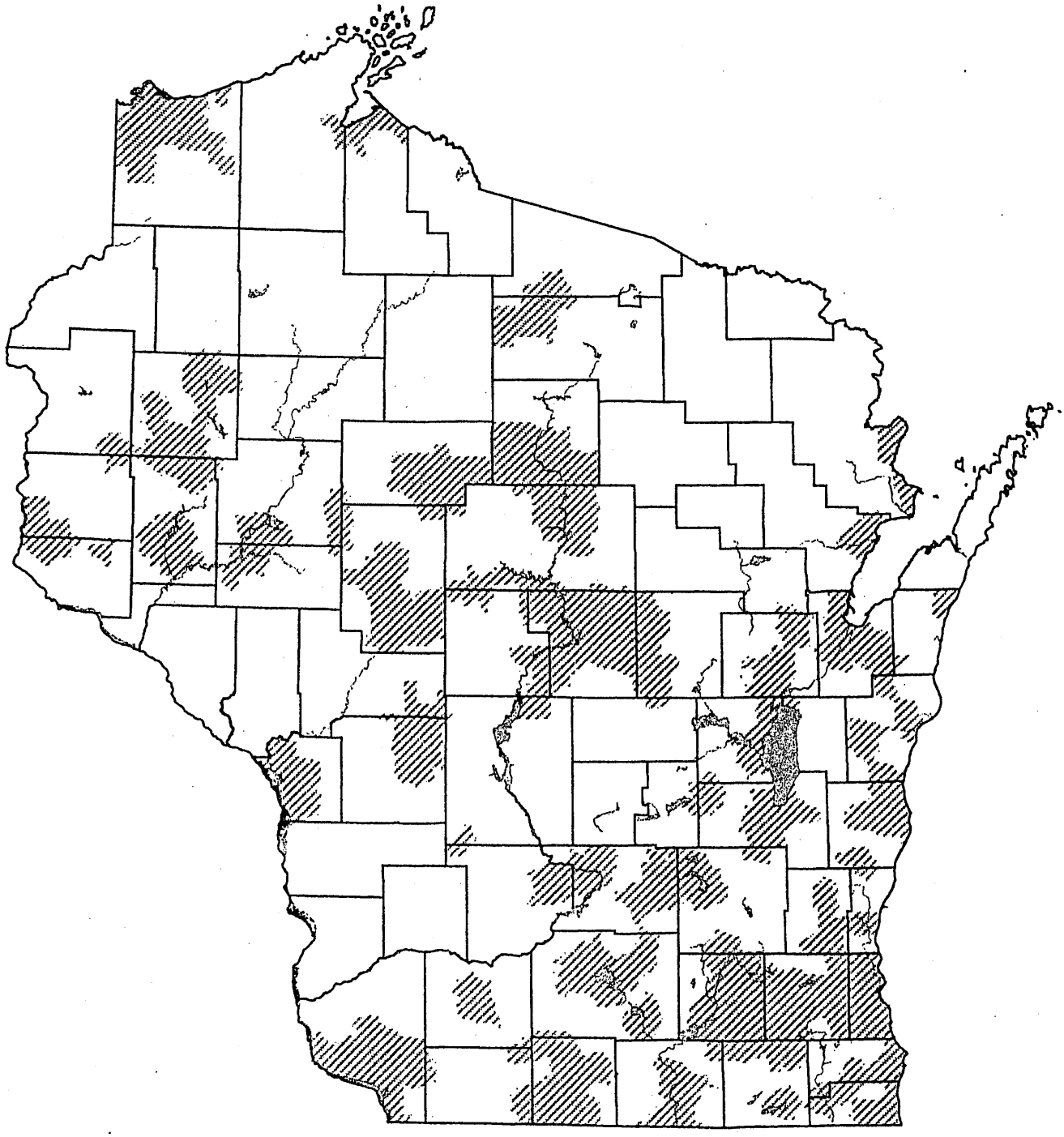
1998 ILEC ISDN Availability



Map 5

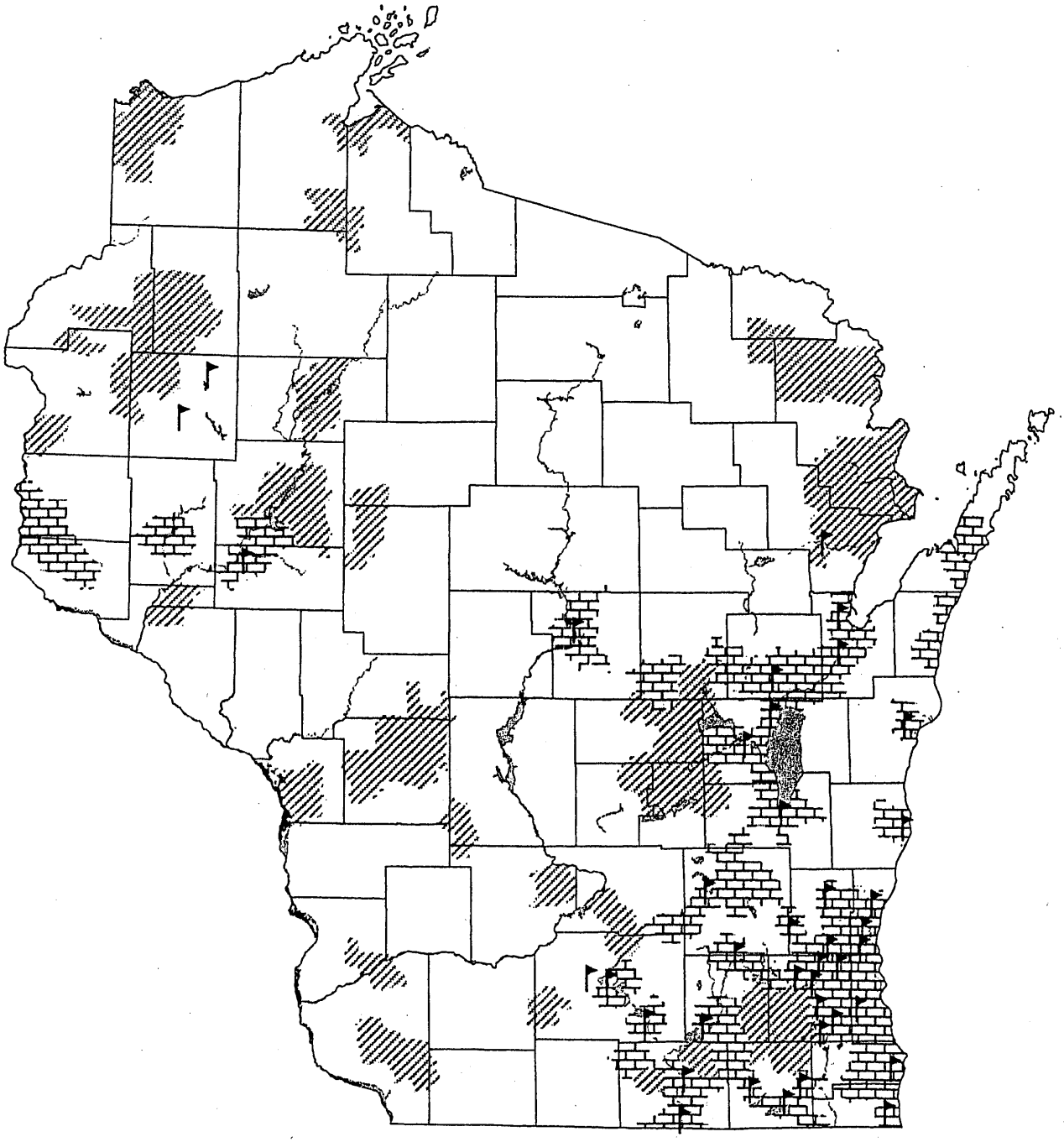
Integrated Services DIgital Network (ISDN) supports simultaneous voice and data services.

Key:

- County Line
- ISDN Not Available
- ISDN Available

Public Service Commission November 1999

WISCONSIN
1998 Exchanges with DSL Technology



Map 6

Digital Subscriber Line (DSL) is used to supply a higher bandwidth via copper circuits.

Confidential responses should not be read as positive or negative.

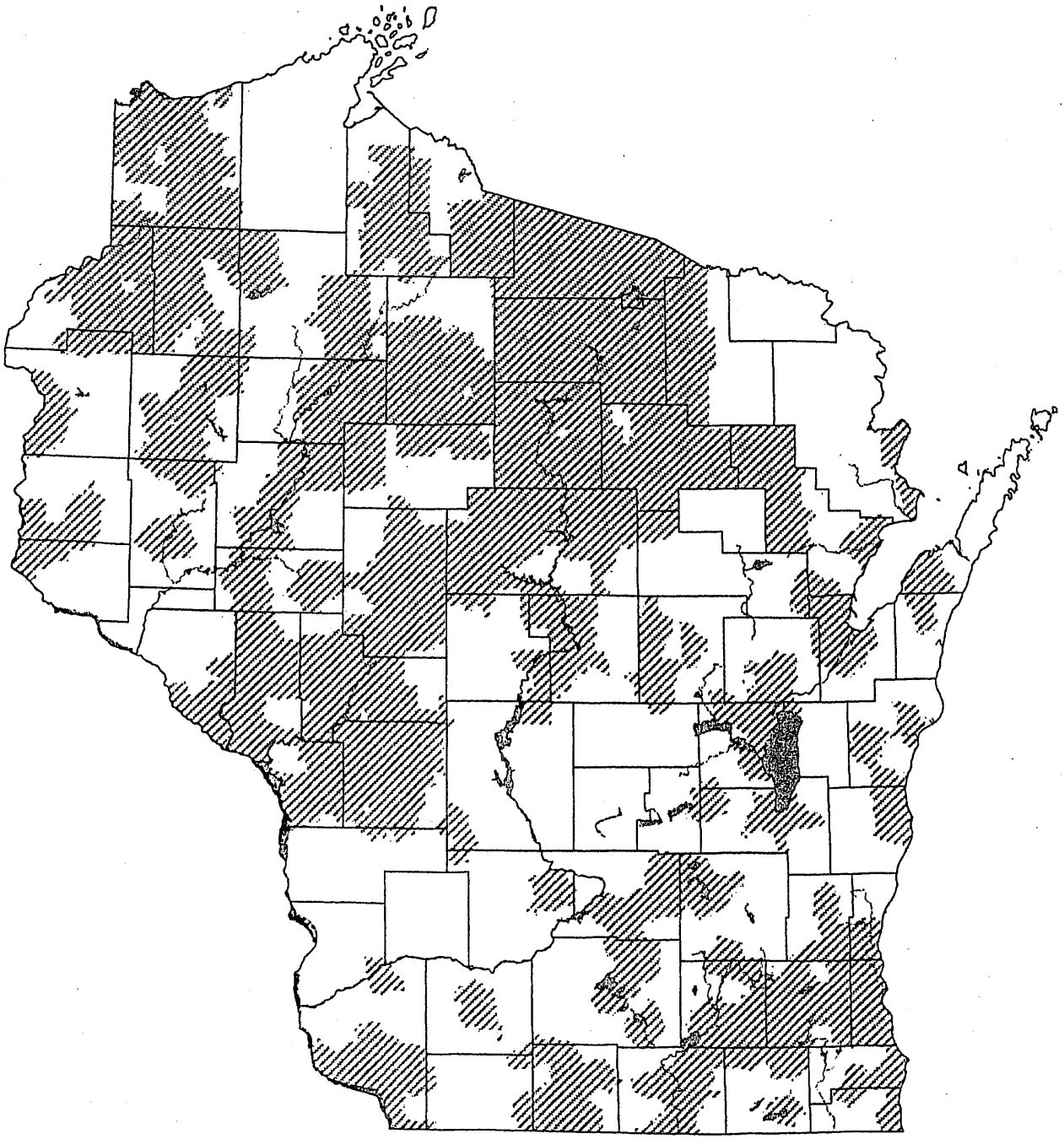
Key:

- County Line
- Information Filed Confidentially
- No DSL Reported
- DSL Reported In Service by ILEC
- Indicates CLEC providing DSL in the general area

Public Service Commission November 1999

WISCONSIN

1998 ILEC Switched 56 Availability



Map 7

Switched 56 is a high-speed data service providing dial-up 56-kilobit service on an as-needed basis.

Key:

- County Boundary
- Switched 56 Not Available
- Switched 56 Available

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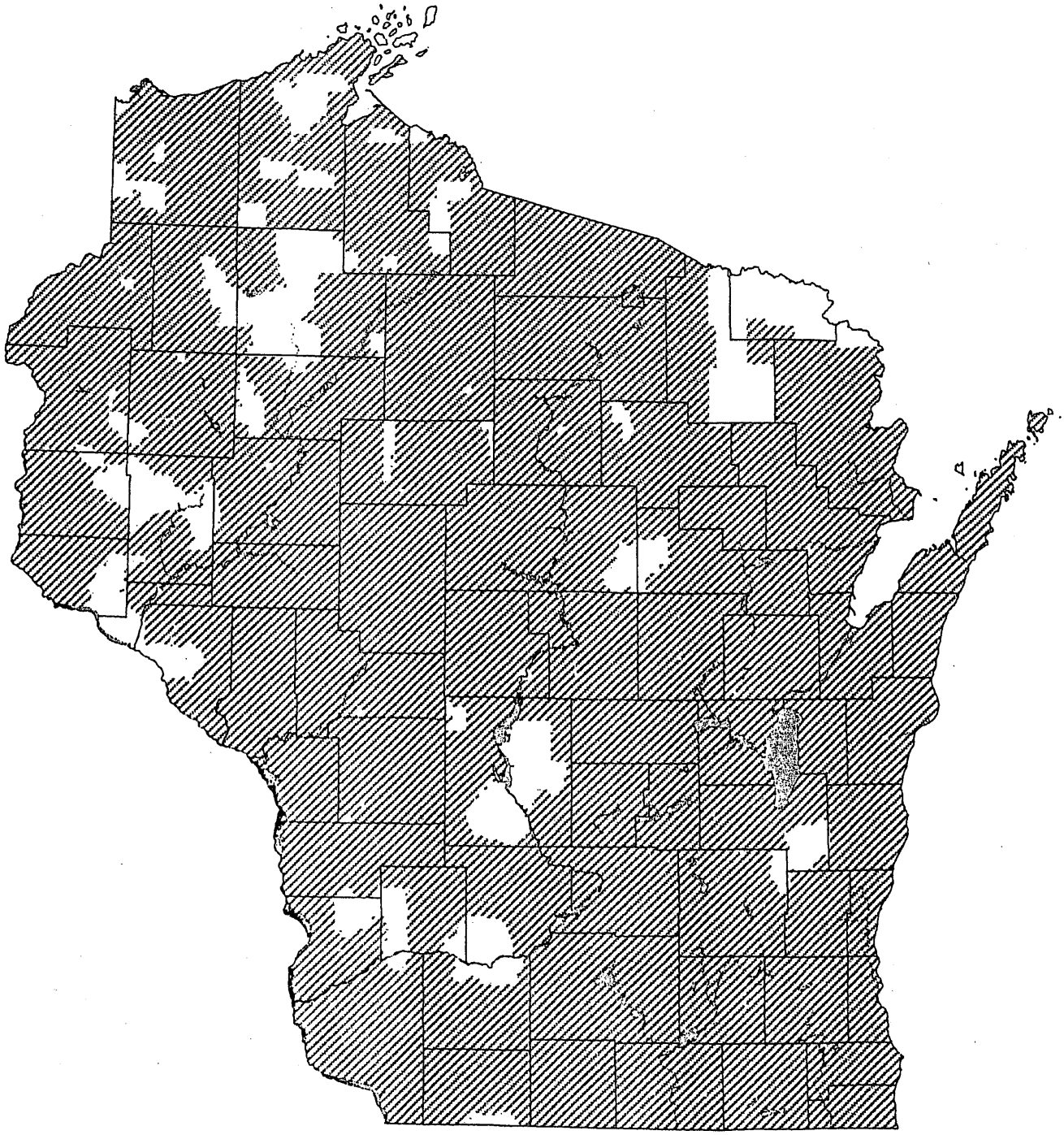
1998 ILEC Caller ID Availability



Map 8

Caller Identification (Caller ID) is an advanced service that provides the calling party's number, and in some cases name, to the called party.

Key:

- County Line
- No Caller ID Available
- Caller ID Available

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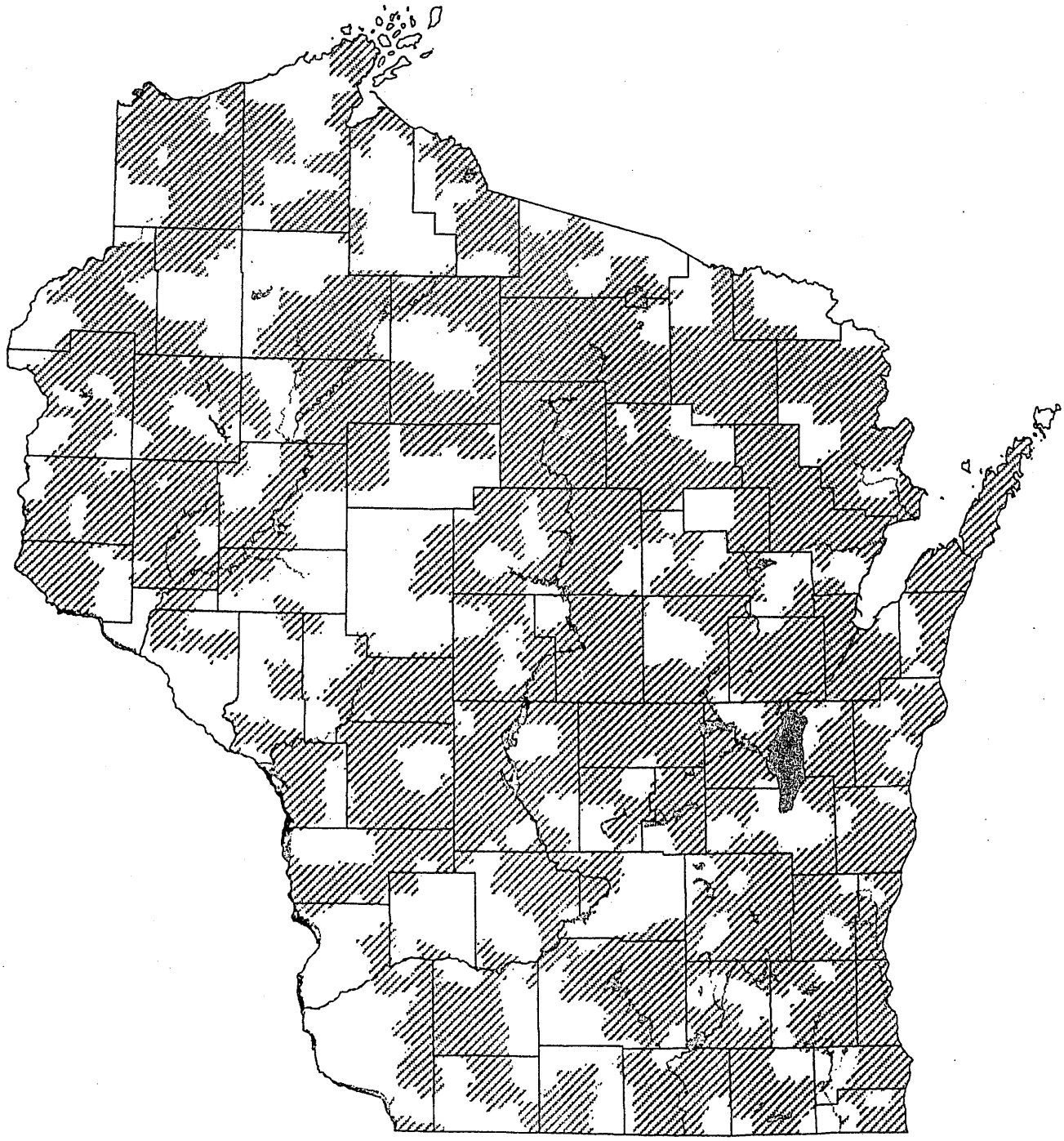
WISCONSIN

1998 ILEC SONET Availability



Map 9

Synchronous Optical Network (SONET) refers to a generic design standard that provides high-speed transmission over fiber optic lines.

Key:

County Line

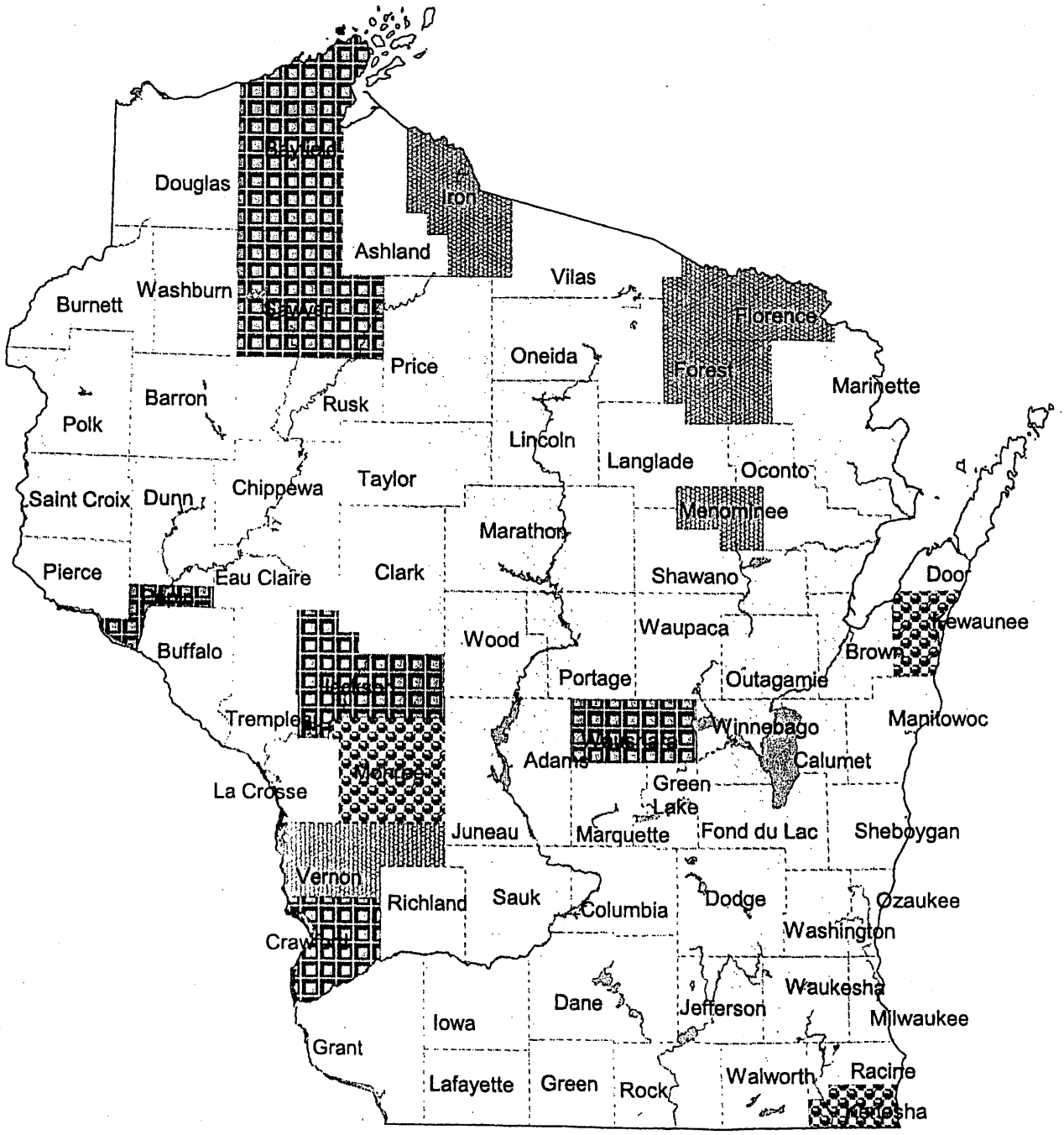
No SONET in Place

SONET in Place

Public Service Commission November 1999

WISCONSIN

911 Availability



Map 10

Map shows the variations of 911 service as of November 1999.

Key:

- No 911 System in Operation
- 911 System in Planning Stages
- 911 with End User Fee
- 911 with No End User Fee

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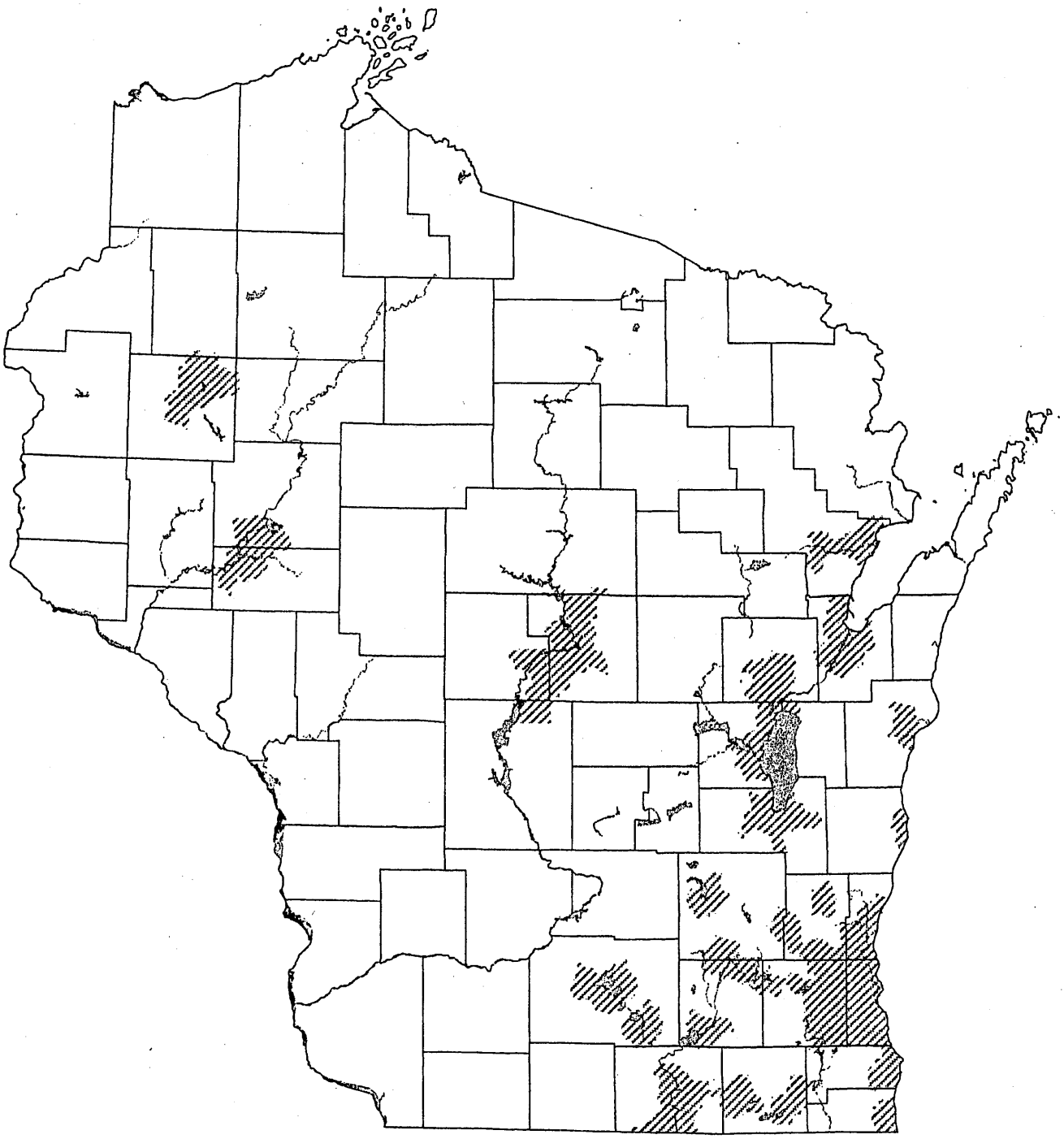
Competitive Local Service Provider Locations



MAP 11

The map indicates areas where competitive providers offer local service. Though these competitve companies have the ability and certification to provide service throughout an exchange, they often compete on a selective basis, serving only a portion of an exchange.

Service provided may be business or residential or both.

Key:

—— County Line

Areas that have one or more competitve providers

Public Service Commission November 1999