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.

[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

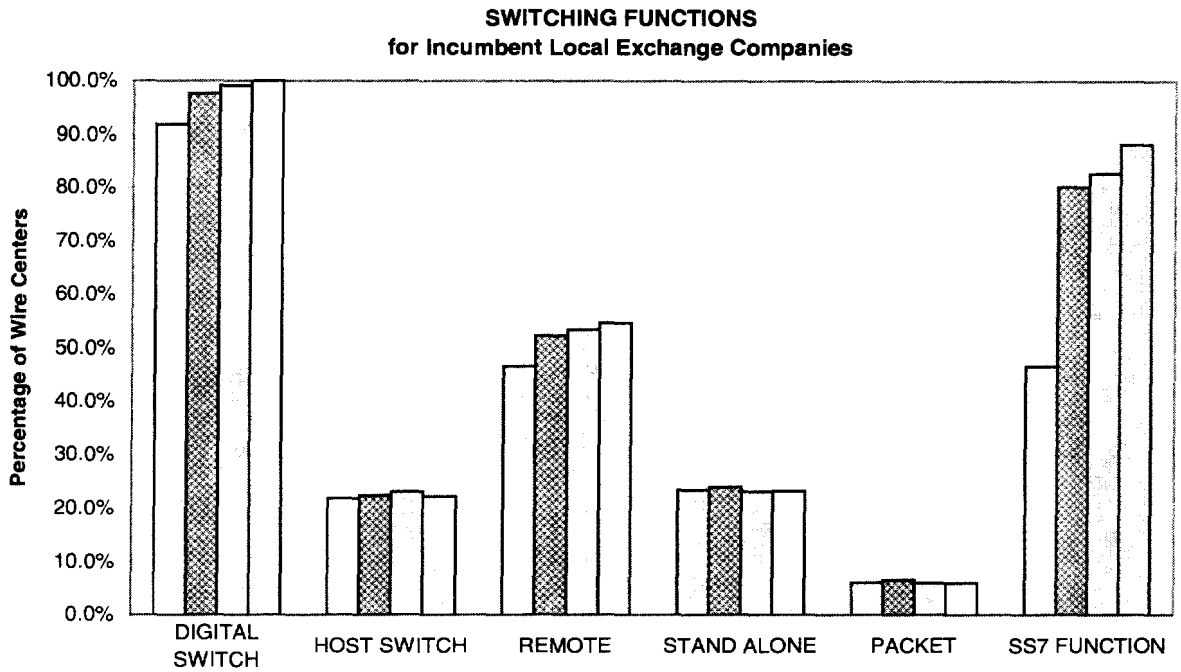
This section of the report reviews the status of infrastructure deployment in the state and its progress since the 1997 report. Deployment is generally reported based on the percentage of exchanges or wire centers that have implemented a particular infrastructure component. This type of assessment and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



	DIGITAL SWITCH	HOST SWITCH	REMOTE	STAND ALONE	PACKET	SS7 FUNCTION
1995	91.9%	21.9%	46.6%	23.4%	6.0%	46.6%
1996	97.7%	22.4%	52.3%	24.0%	6.6%	80.2%
1997	99.1%	23.1%	53.4%	23.1%	6.0%	82.9%
1998	100.0%	22.2%	54.7%	23.2%	6.0%	88.3%

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.

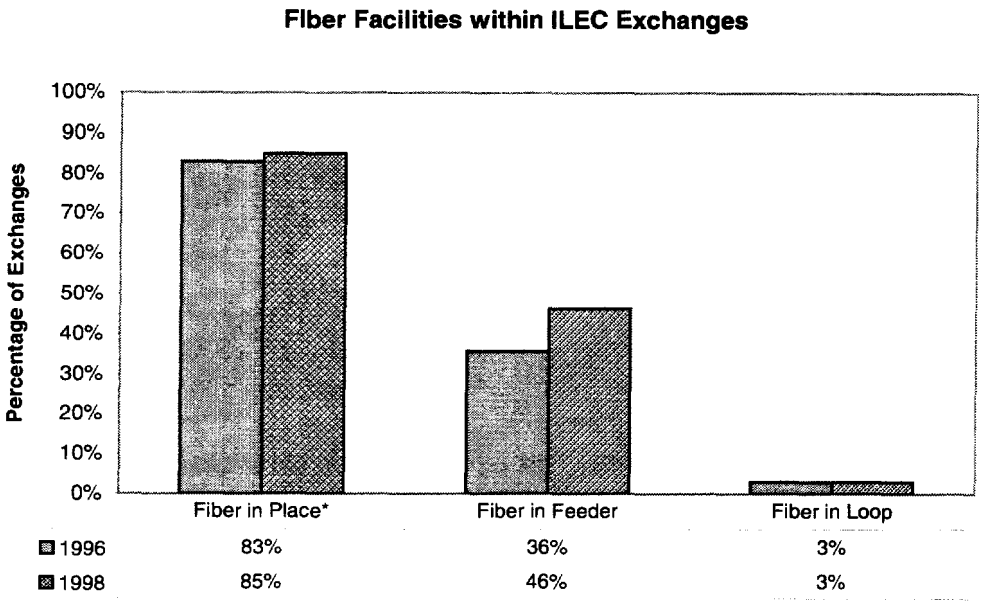
Packet-type switches provide an efficient way of transferring large amounts of data. A packet refers to a set of digital information bits that are given a unique address for identification. These packets of information can take different routes and may arrive in a different order before they are reassembled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



* 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.

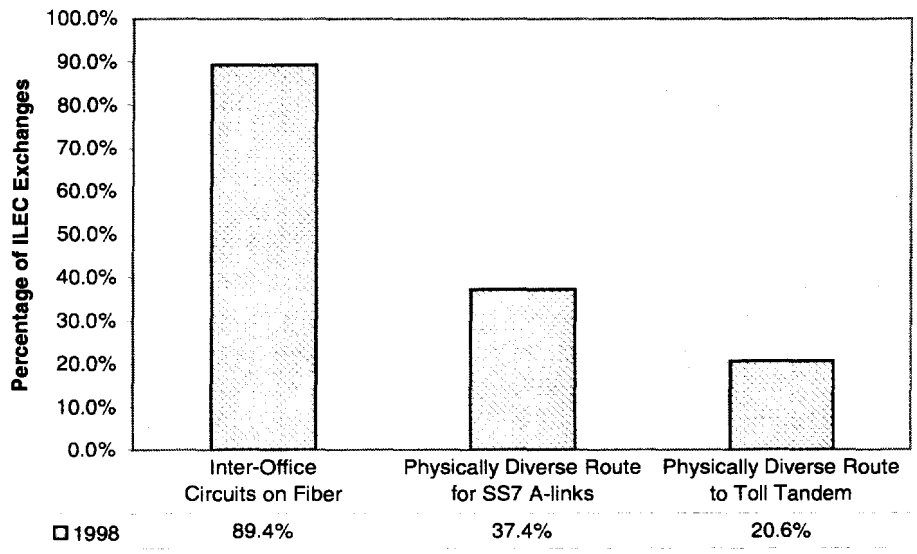
The **Table A** shows information for feeder fiber and loop fiber.

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

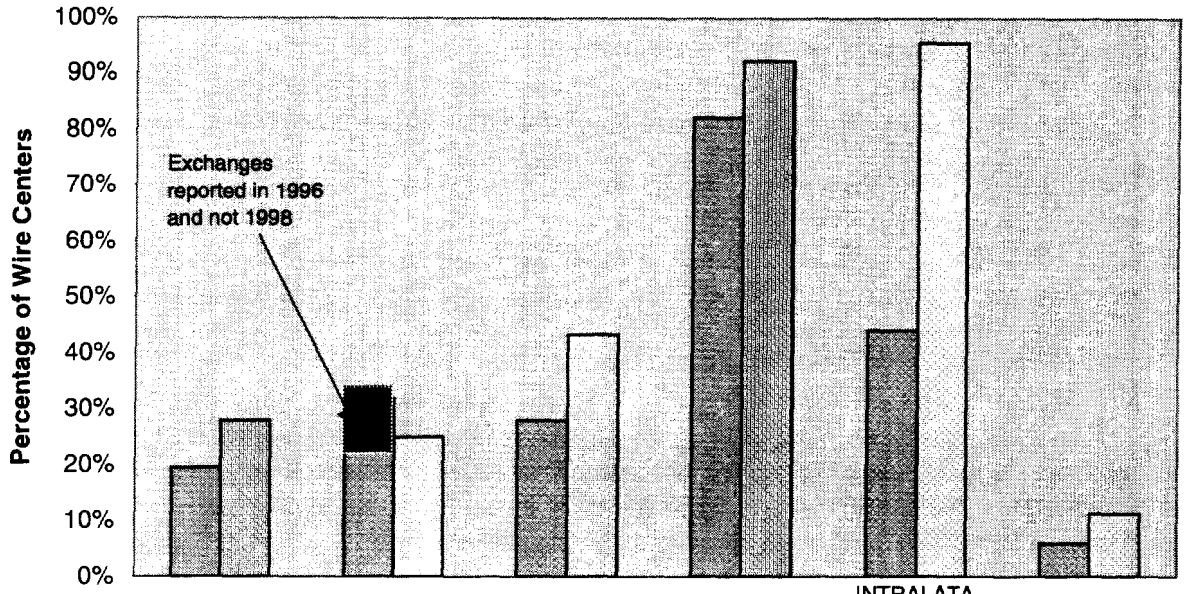
November 1999 **Table B** Source: 1999 PSC ILEC Data Request

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.

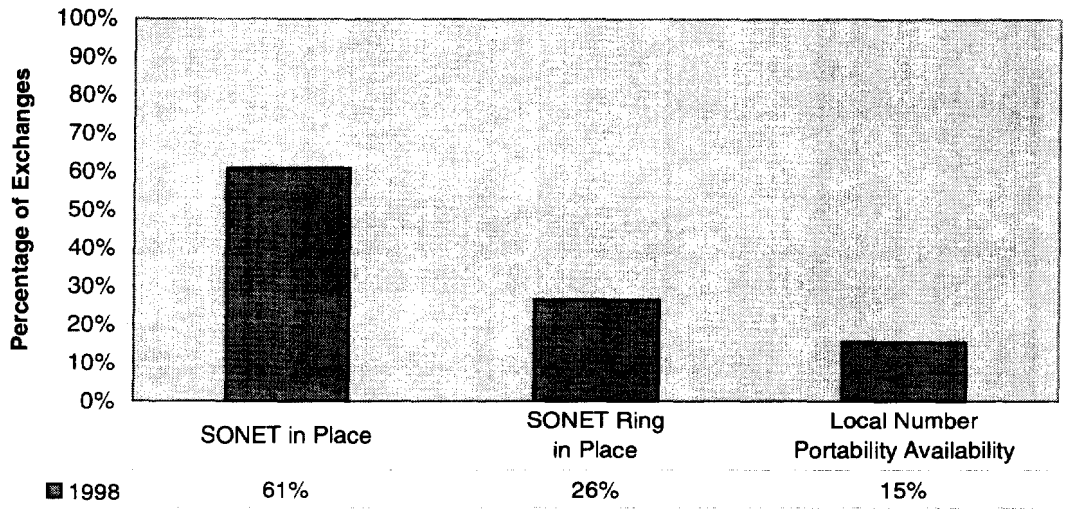
Graph 5 shows information on other advanced services, SONET facilities and LNP availability.

---

[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.



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.

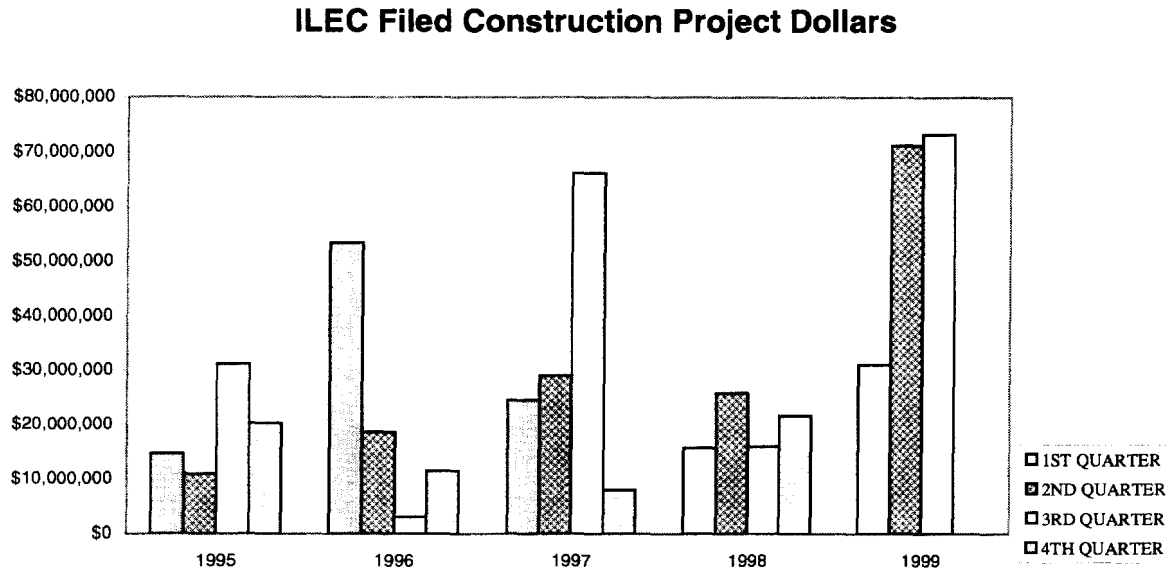
Capital Expenditures. Table C shows the annual capital investments made by the ILECs from 1992 through 1998. These expenditures cover all the types of infrastructure deployment discussed above.

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.



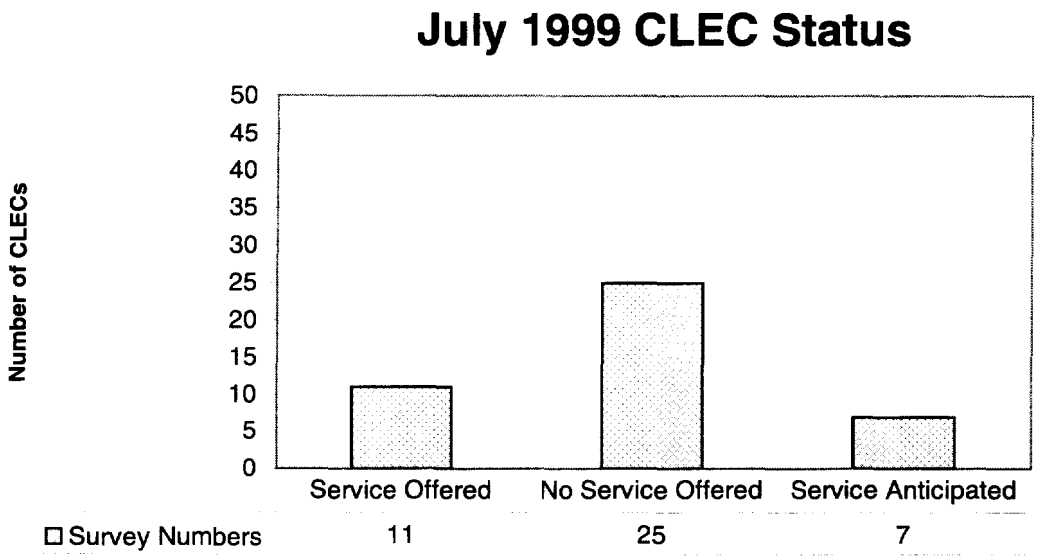
November 1999 **Graph 6** Source: Public Service Commission

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.

lep:t:\report\05st108\12_20_99 report

Part

5

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

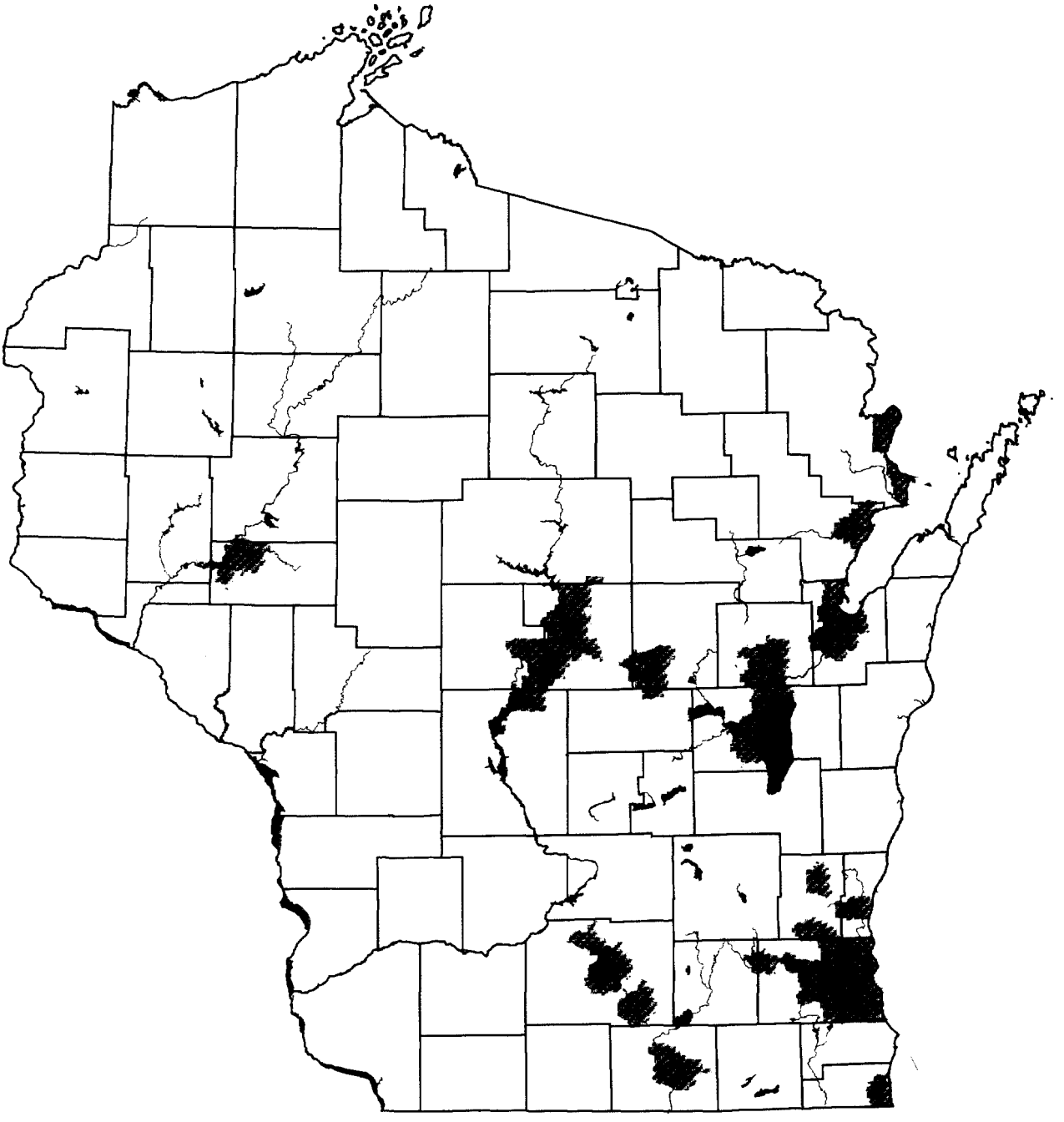
Telephone Exchange Boundaries

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

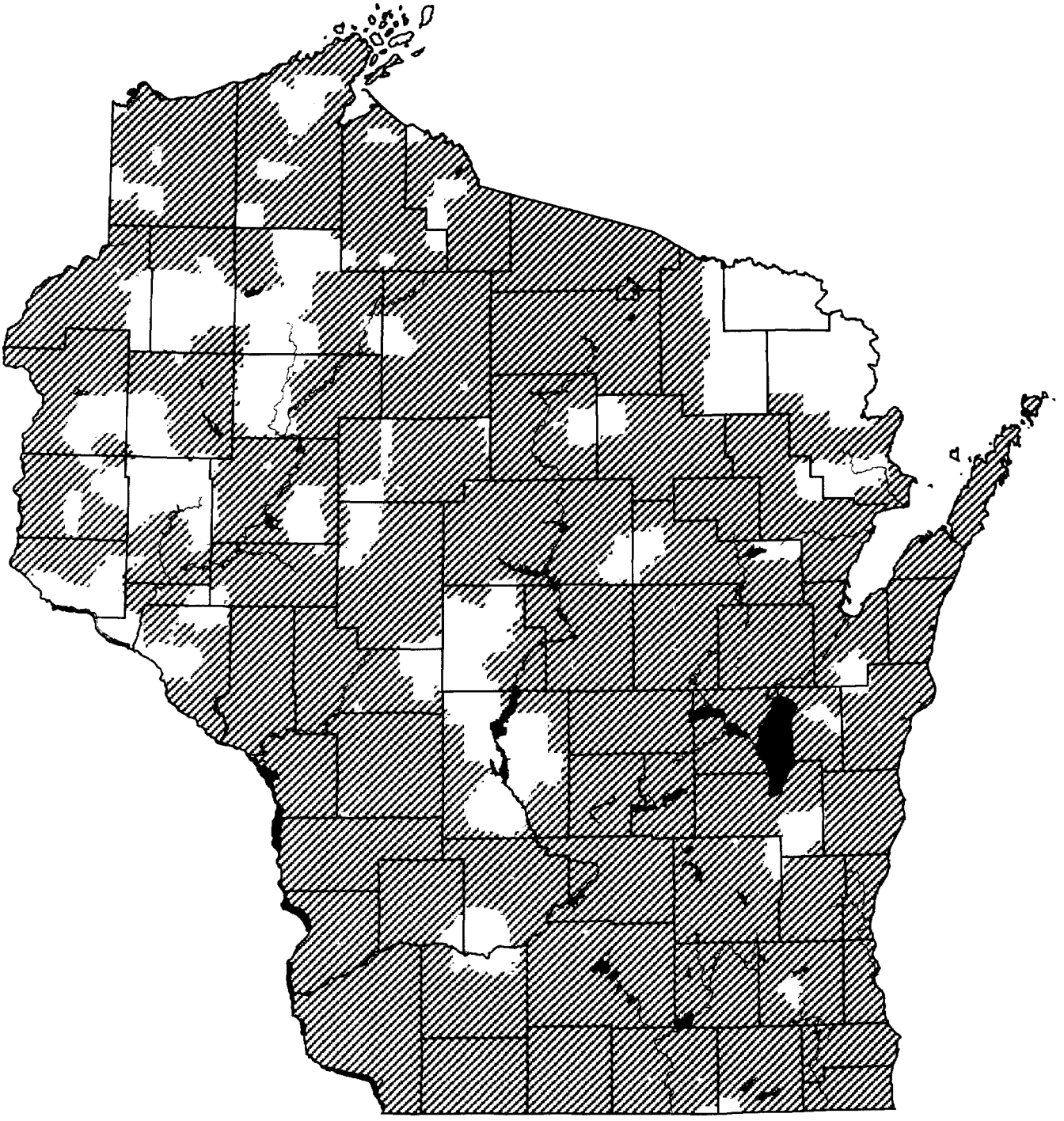
Packet Switching Not Available

Packet Switching Available

Public Service Commission November 1999

WISCONSIN

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.

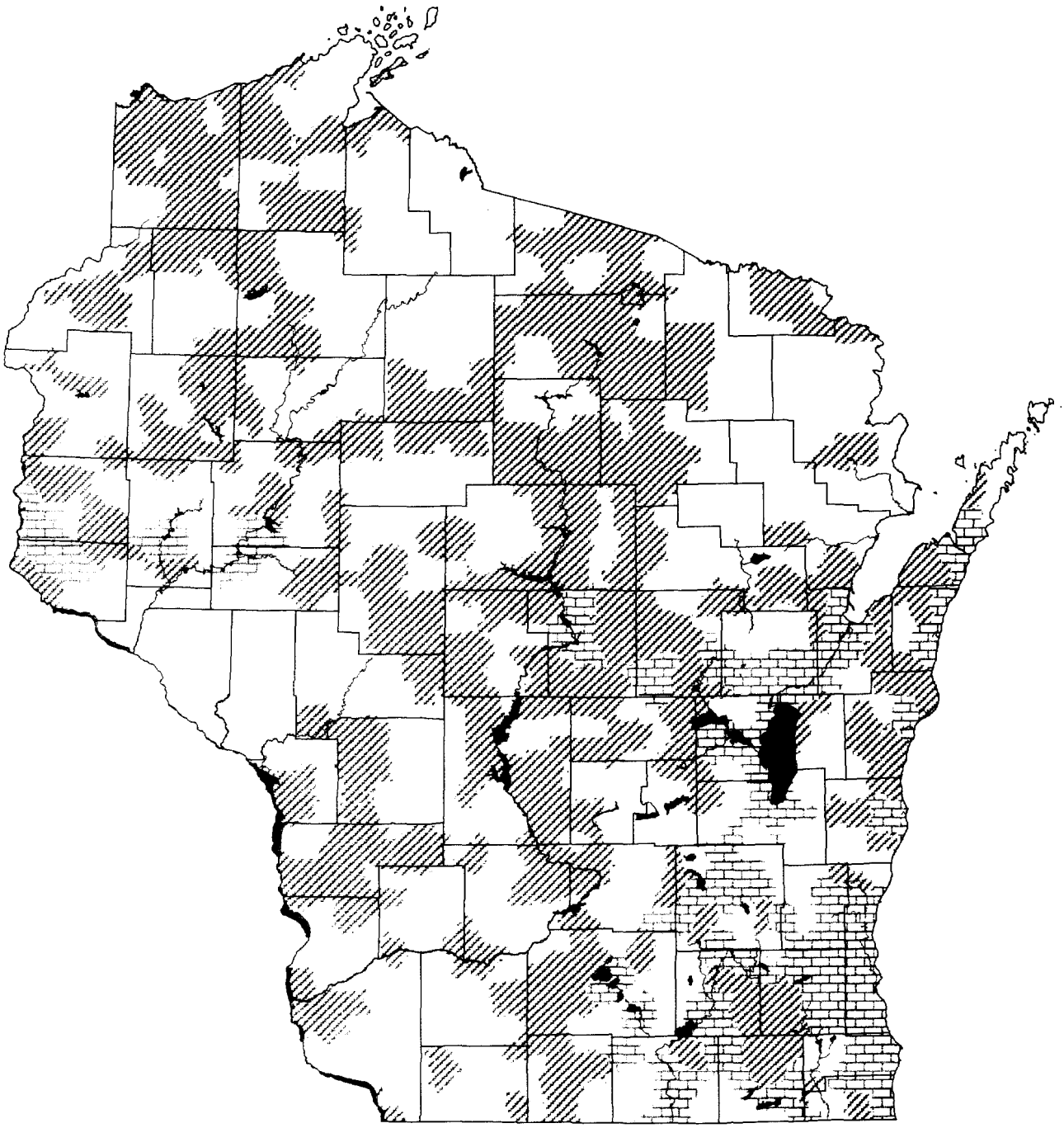
Key:

- County Boundary
- SS7 Not Available
- SS7 Available

Public Service Commission November 1999

WISCONSIN

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.

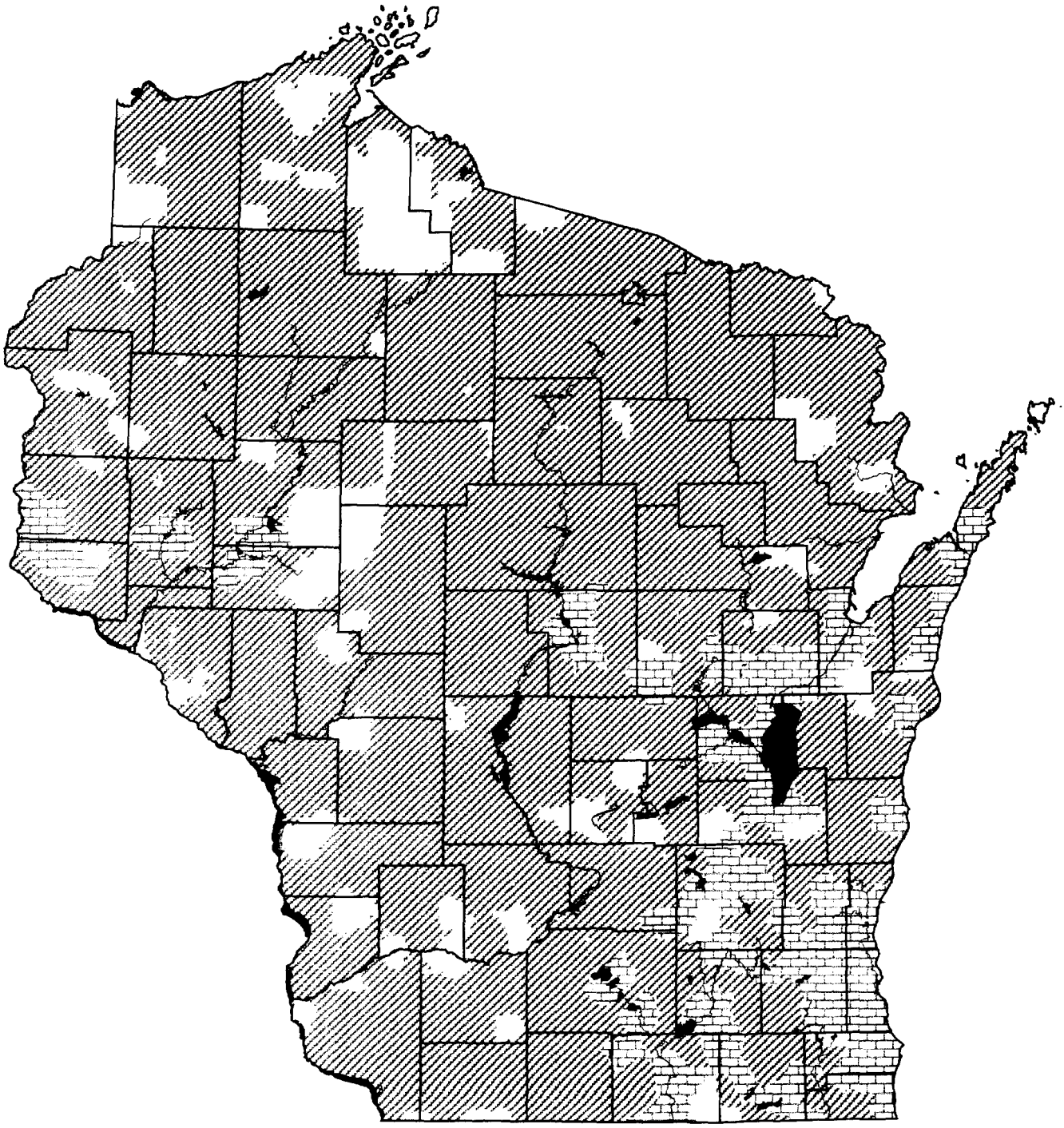
Key:

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

Public Service Commission November 1999

WISCONSIN

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.

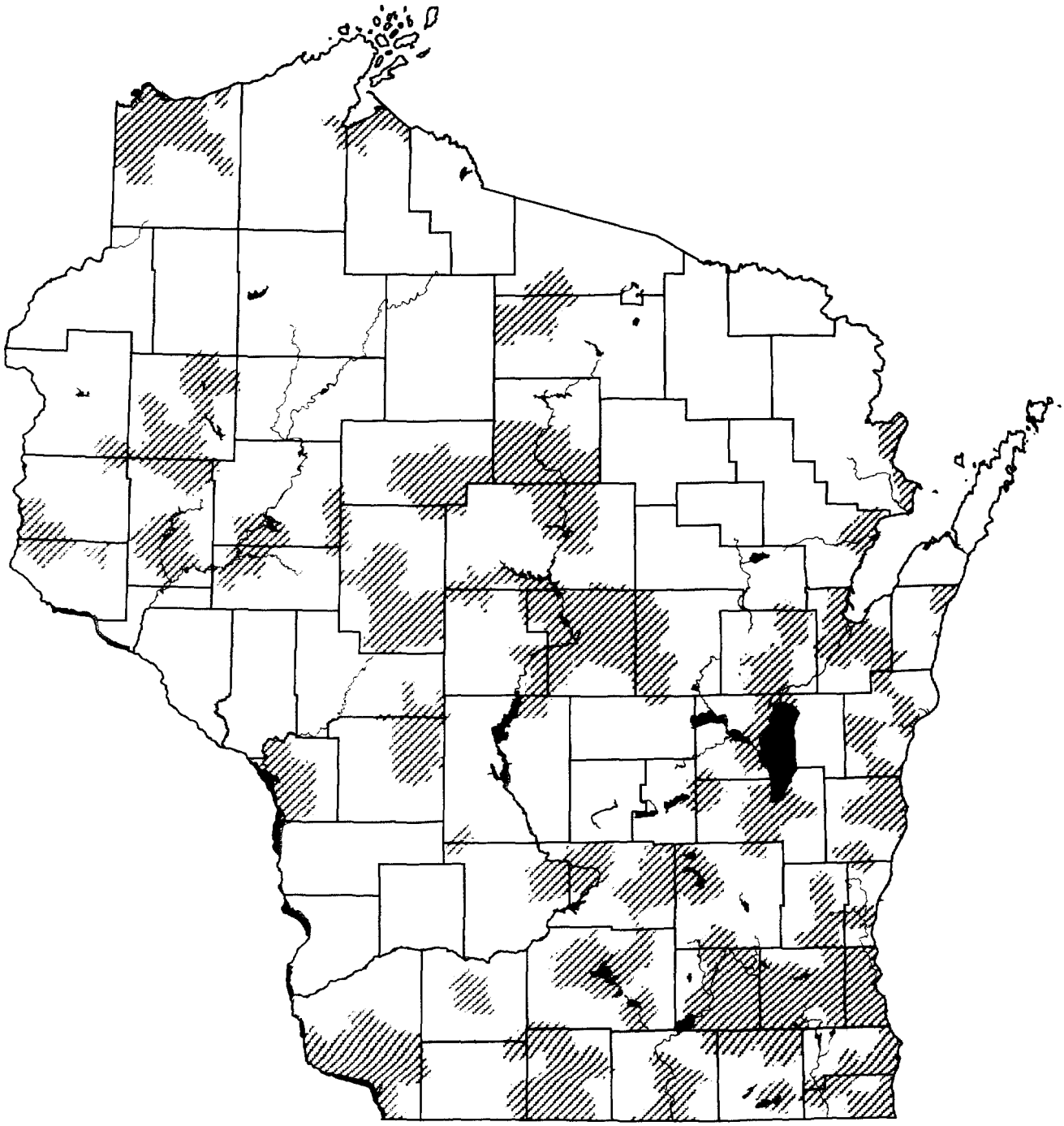
Key:

- County Line
- Filed Confidentially
- No inter-office fiber reported
- Reported inter-office circuits on fiber

Public Service Commission November 1999

WISCONSIN

1998 ILEC ISDN Availability



Map 5

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

Key:

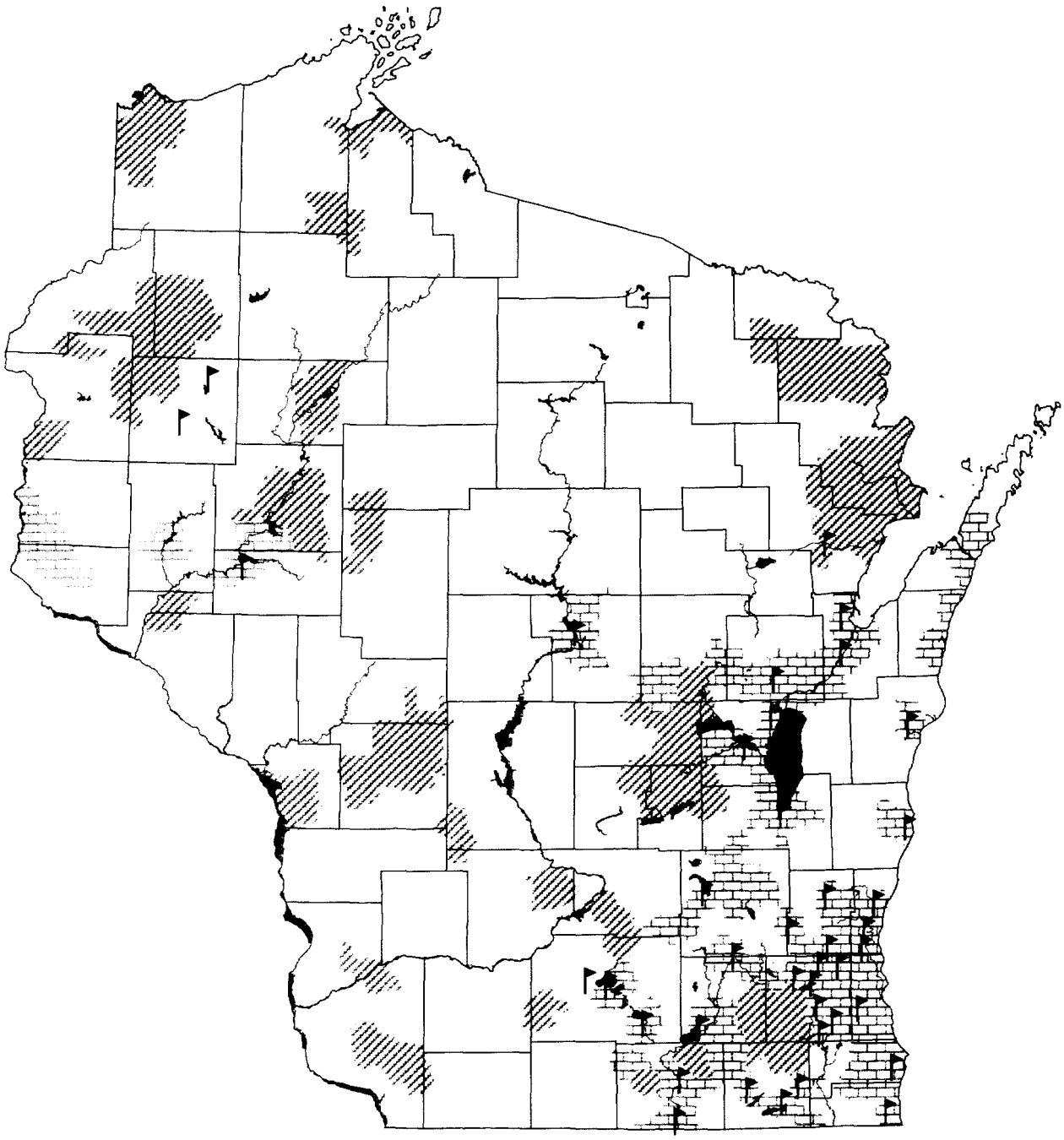
County Line

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.

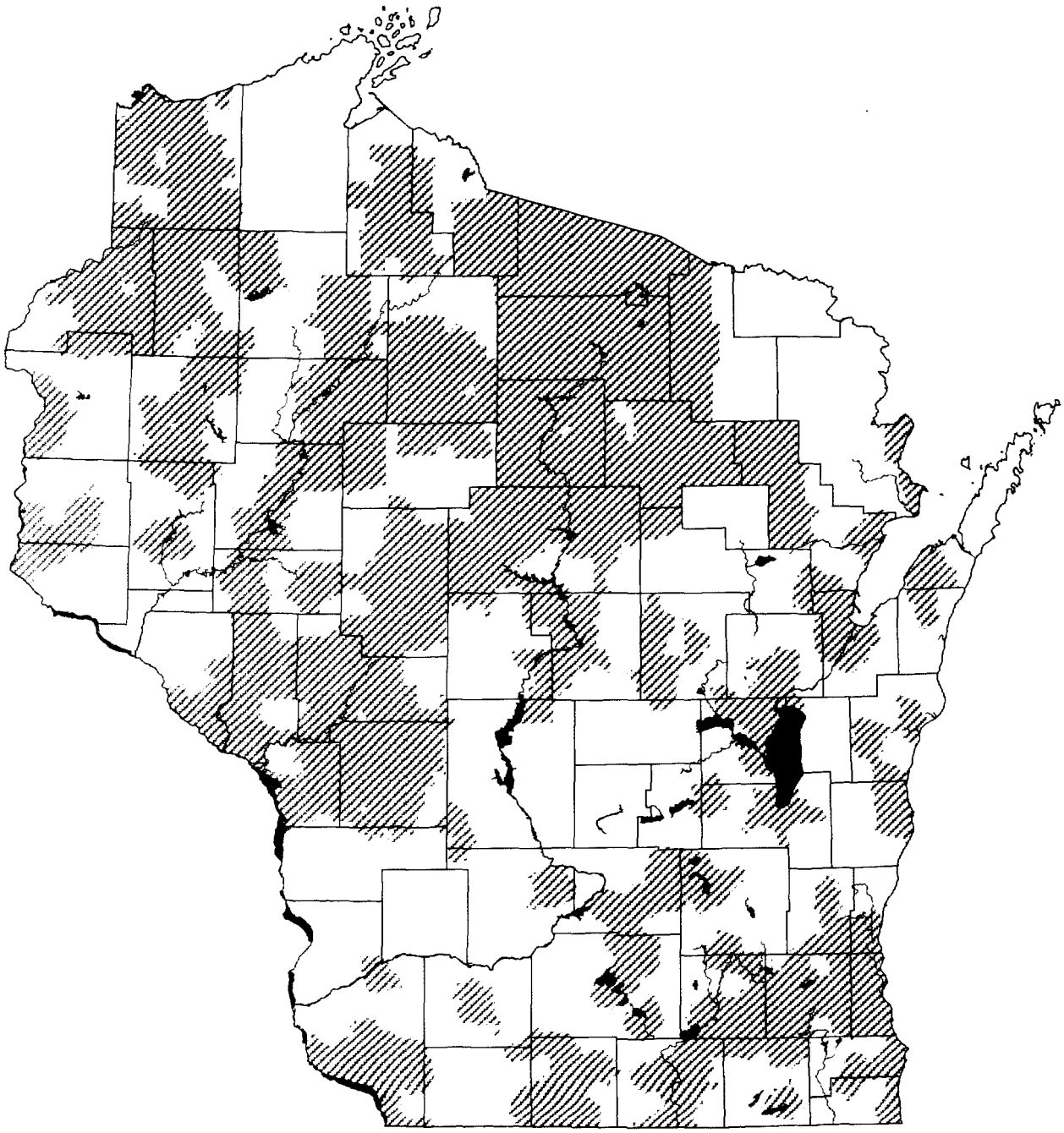
Key:

- 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

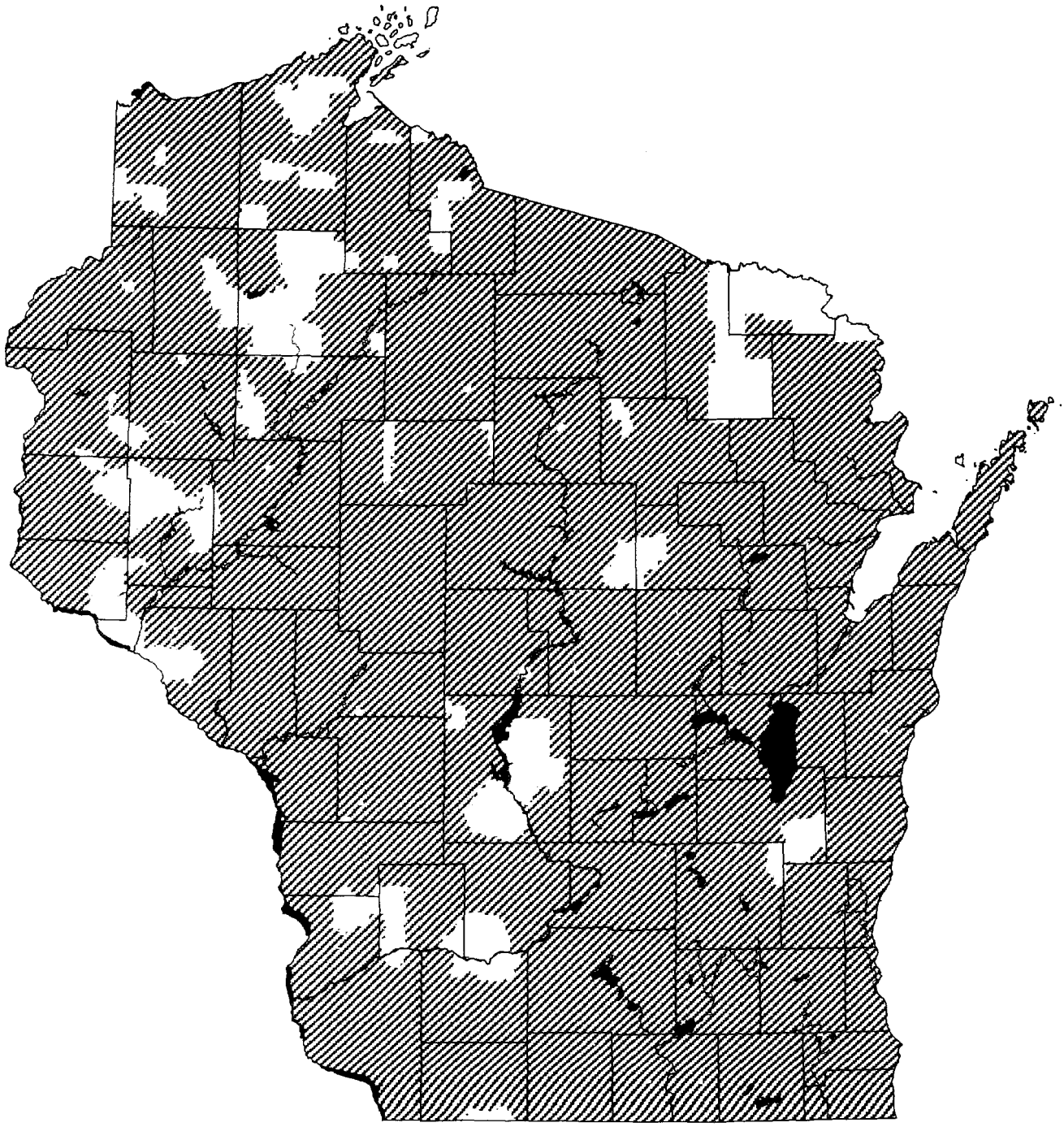
Switched 56 Not Available

Switched 56 Available

Public Service Commission November 1999

WISCONSIN

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

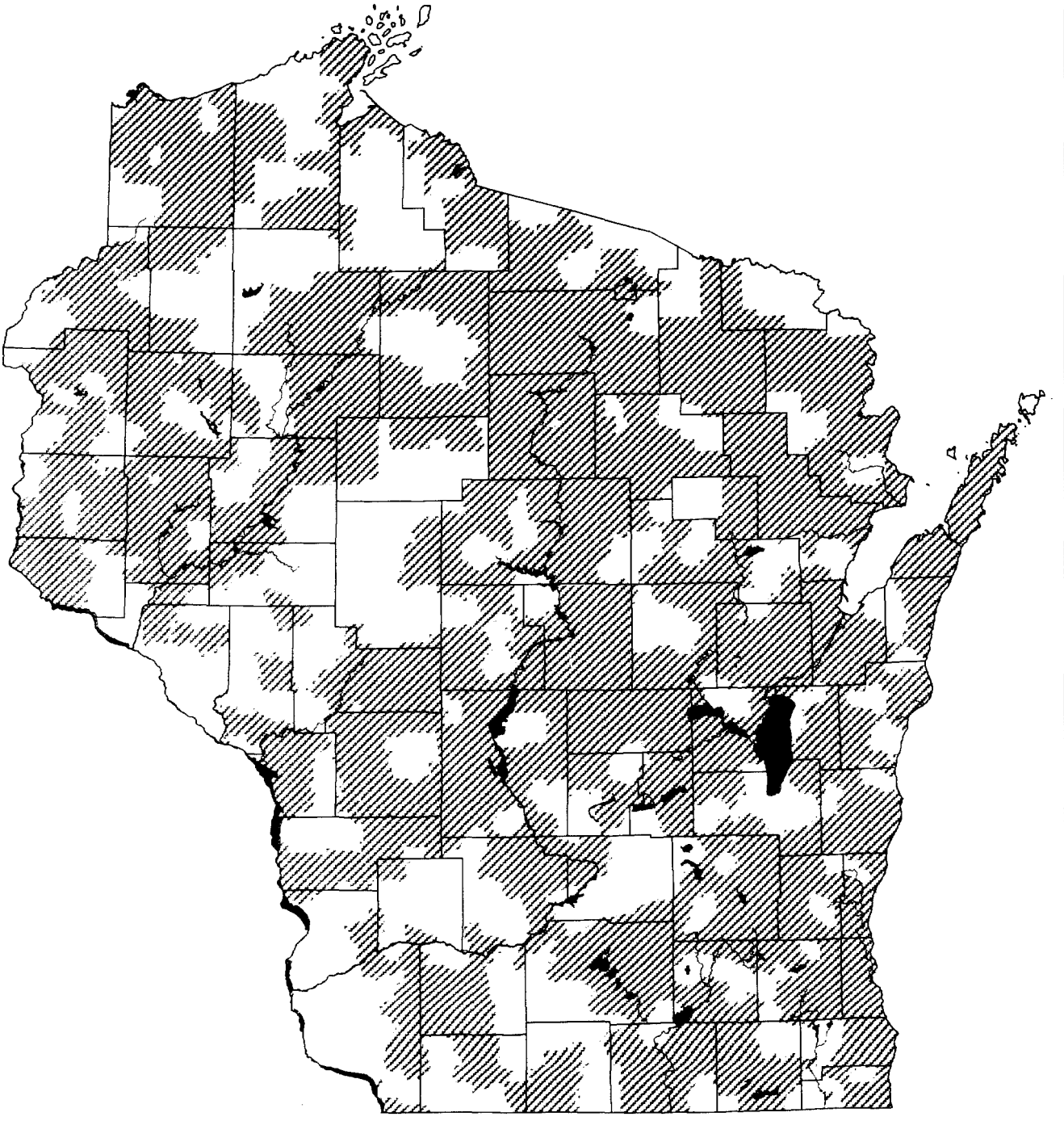
No Caller ID Available

Caller ID Available

Public Service Commission November 1999

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

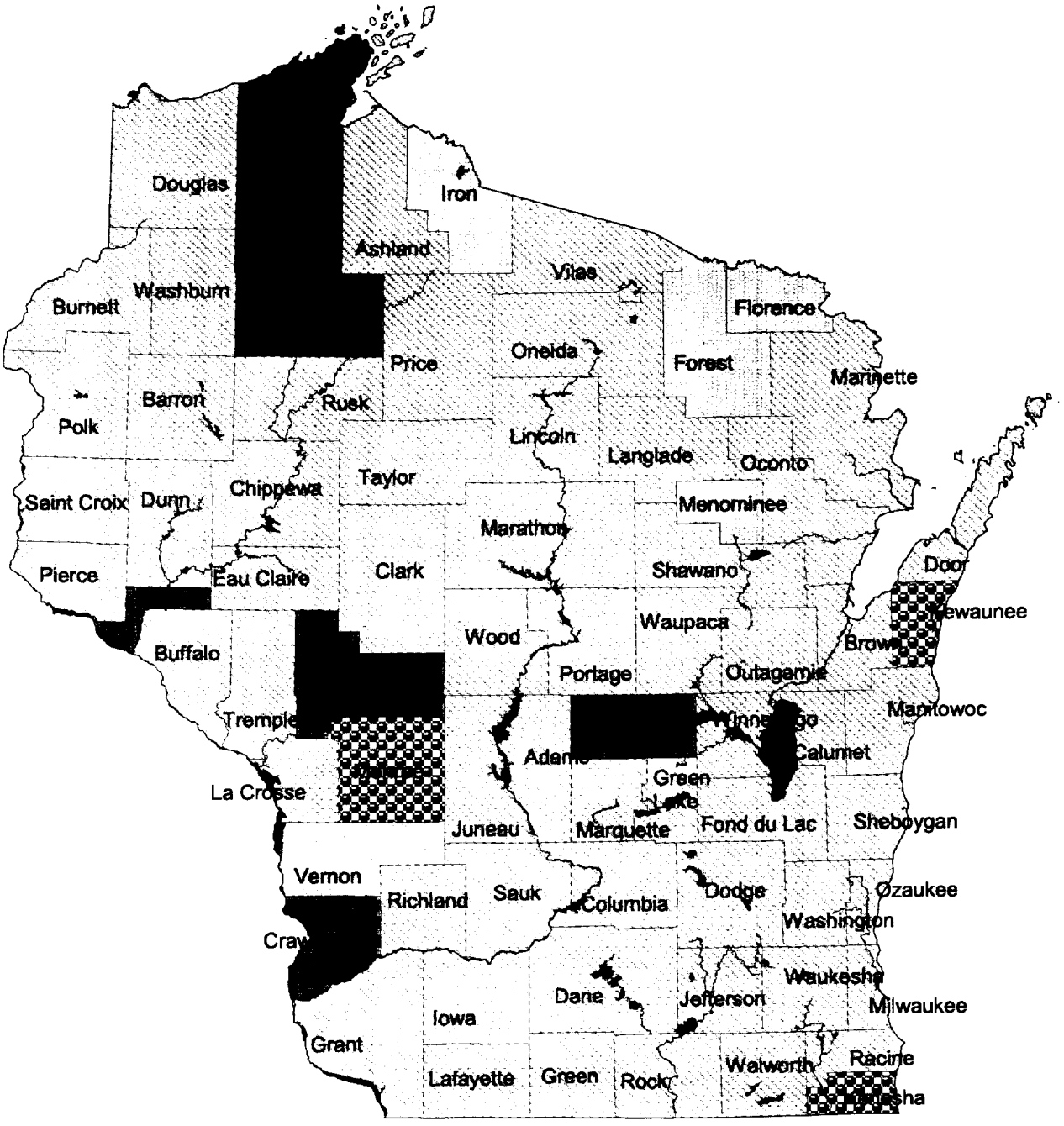
No SONET in Place

SONET in Place

Public Service Commission November 1999

WISCONSIN

911 Availability



Map 10

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

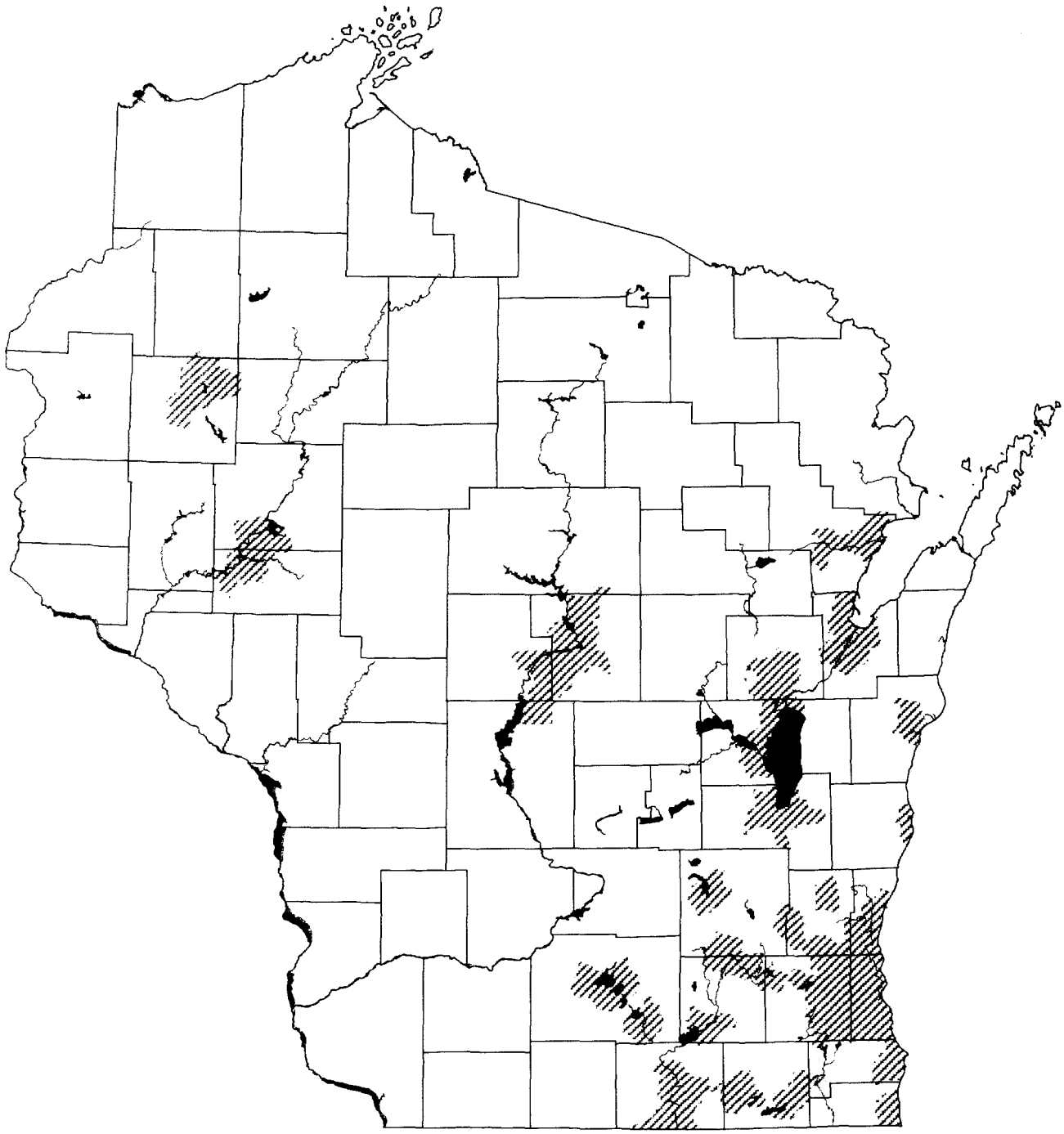
Key:

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

Public Service Commission November 1999

WISCONSIN

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