Arthur D Little

Study of the Role of the Telecommunications Industry in Iowa's Economic Development

Iowa Utility Board and Department of Economic Development

Step 2 Report
Survey of Iowa's Current Telecommunications Infrastructure

June 26, 1992

Arthur D. Little, Inc.

Reference 41484

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Re: 41484

Dear Kathy and Bill:

Enclosed please find the 'Step 2 Report' which includes the survey of Iowa's current telecommunications infrastructure required in the preliminary work plan in Attachment B of the Request for Proposal and more specifically items we promised in the proposal and work plan under Task 1. These items include the following:

- A Finalized Taxonomy for Communications Technologies and Services (Work Plan Subtask 1.1)
- Findings on the Current Deployment of Telecommunications in Iowa (Work Plan Subtask 1.5)
- Review of Communications Vendor Plan (Work Plan Subtask 1.4)
- A demographic and telecommunications database ready for correlation (both for United States and Iowa) (Work Plan Subtasks 1.3 and 1.5)

We have included the following additional items to assist you in your review of these materials and to update you on the progress of the study.

- A summary of the demographic and telecommunications database (United States and Iowa)
- Regulatory/Public Policy Progress Report
- Economic Development Progress Report

The entire Arthur D. Little team is greatly appreciative of your assistance in gathering the necessary data for us to produce this Step 2 Report. We are

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particularly mindful of the considerable efforts made by David Swenson in setting up both the interviews and focus groups and preparing the demographic data for our use. We wish to also thank Bill Smith and his staff as well as Kathy Berry and her staff, for their time, effort, and data collection activities.

We look forward to meeting with you and your representatives at the client feedback meeting which is scheduled for July 6 at 1:30. At that meeting we hope to receive your input and ideas related to this Step 2 Report as well as to informally convey to you our preliminary hypotheses related to this study.

We look forward to our meeting and, as always, if you have questions related to the report before our meeting please feel free to contact me.

Very truly yours,

Bernice K. McIntyre

/spj

Enclosures

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This report defines the scope of communications services for the study and provides data necessary for analysis in subsequent work phases

- Introduction
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  - Services
  - Technology
- Database

This report defines and describes the services and technologies presently available in Iowa. Future technology and application trends are projected. Once this groundwork is laid, statistical data is presented to assess the current level of technological progress of the state's communications infrastructure. Demographic data are also displayed.

This material will provide a baseline used in the subsequent needs assessment and policy analysis phases of the study.

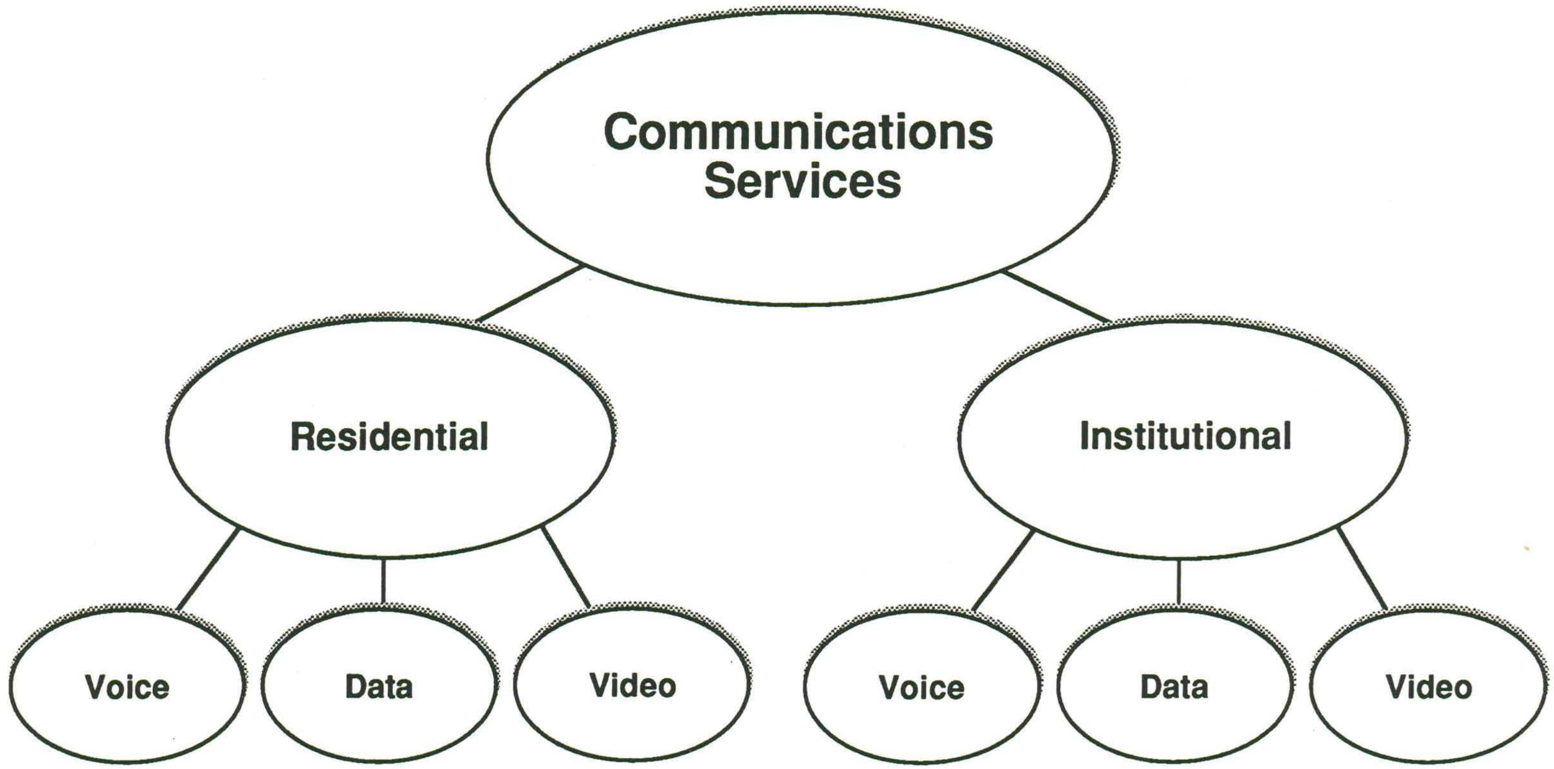
This report establishes a baseline for the subsequent analysis of Iowa's communications infrastructure and its relationship to economic development.

- Services
- Technologies
- Trends
- Data

Communications Services Taxonomy

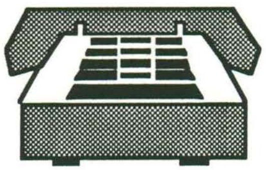
This section of the report defines present and future communications services which fall within the scope of the study. Two broad classes of communications services are examined: (1) Residential; and (2) Institutional . . . encompassing both public and private institutions. The broadest possible range of voice, data and video services are addressed.	

The study examines a broad range of voice, data and video services serving residential and institutional users.



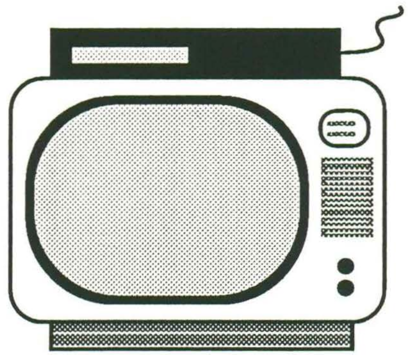
Primary residential communications services consist of POTS (Plain Old Telephone Service) and television. Residential applications of wireless service (portable phones and cellular mobile telephone) are also addressed. The study includes cable television but excludes broadcast television. Residential data communications are accomplished over POTS service lines via facsimile (FAX), touch tone key pads, and computer modems.	

For residential users, transmission of information (voice, data, video) can take many forms.



Plain Old Telephone Service (POTS)

Wireless Service

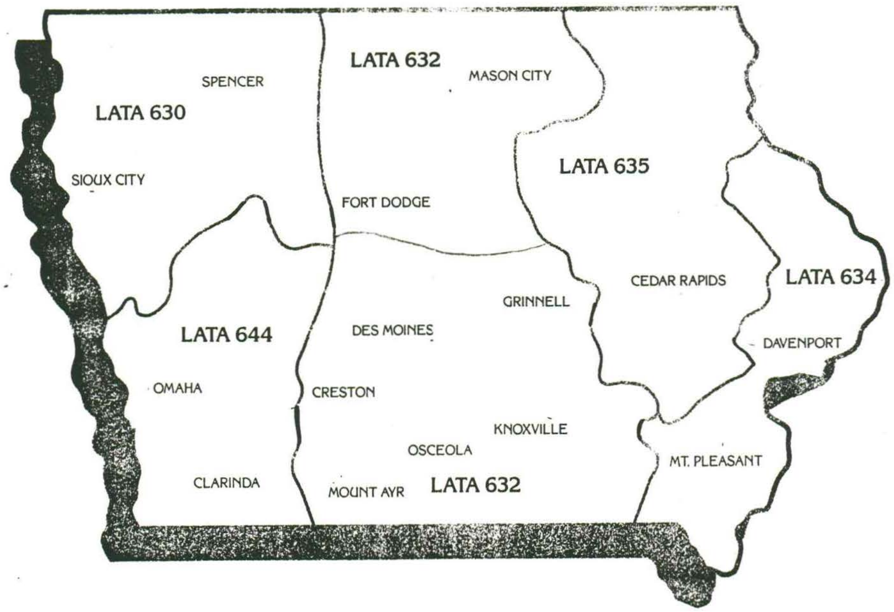


Cable TV

Under the 1984 agreement to break up AT&T, the Bell companies were prohibited from carrying telephone traffic across Local Access and Transport Area (LATA) boundaries. Subsequently, all other local telephone companies or Local Exchange Carriers (LECs) have followed this rule. Calls between LATAs (interLATA calls) are handed off to an Inter-Exchange Carrier (IEC) at an Inter-Exchange Carrier Point of Presence (POP) and then carried to the IEC's POP in the distant LATA. The call is then carried to the calling party by the Local Exchange Carrier operating local service in the distant LATA. There are approximately 150 LECs and 4 major IECs operating in Iowa. US West and GTE are the largest LECs while AT&T, INS, MCI and Sprint are the major IECs.	

Public switched voice service (POTS) is classified as local and long distance according to the distance traveled and the number of communications carriers involved in a call.

- Local - Calls within the same community
- IntraLATA - Roughly equivalent to calls within the same area code.
- InterLATA - Roughly equivalent to calls between two area codes



Custom calling features have been in place for well over a decade. They are administered from the phone company's central office switch. Over 37% of U.S. households subscribe to at least one custom calling feature and average 1.8 features per customer. E911 (or Enhanced 911), allows law enforcement and emergency services agencies to automatically identify a caller's location and phone number when a 911 call is placed.	Voice messaging (or voice mail) is a service that enables subscribers to send and receive messages at any time and anywhere by using a touch tone phone. The mailbox "owner", through the use of a touch tone phone and an access code, can access the mailbox, listen to messages, erase old messages, and/or redirect messages to other subscriber's mailboxes. The service can be provided either by customer premises-based equipment (i.e., PBX) or by a local or long distance carrier through the switching equipment.

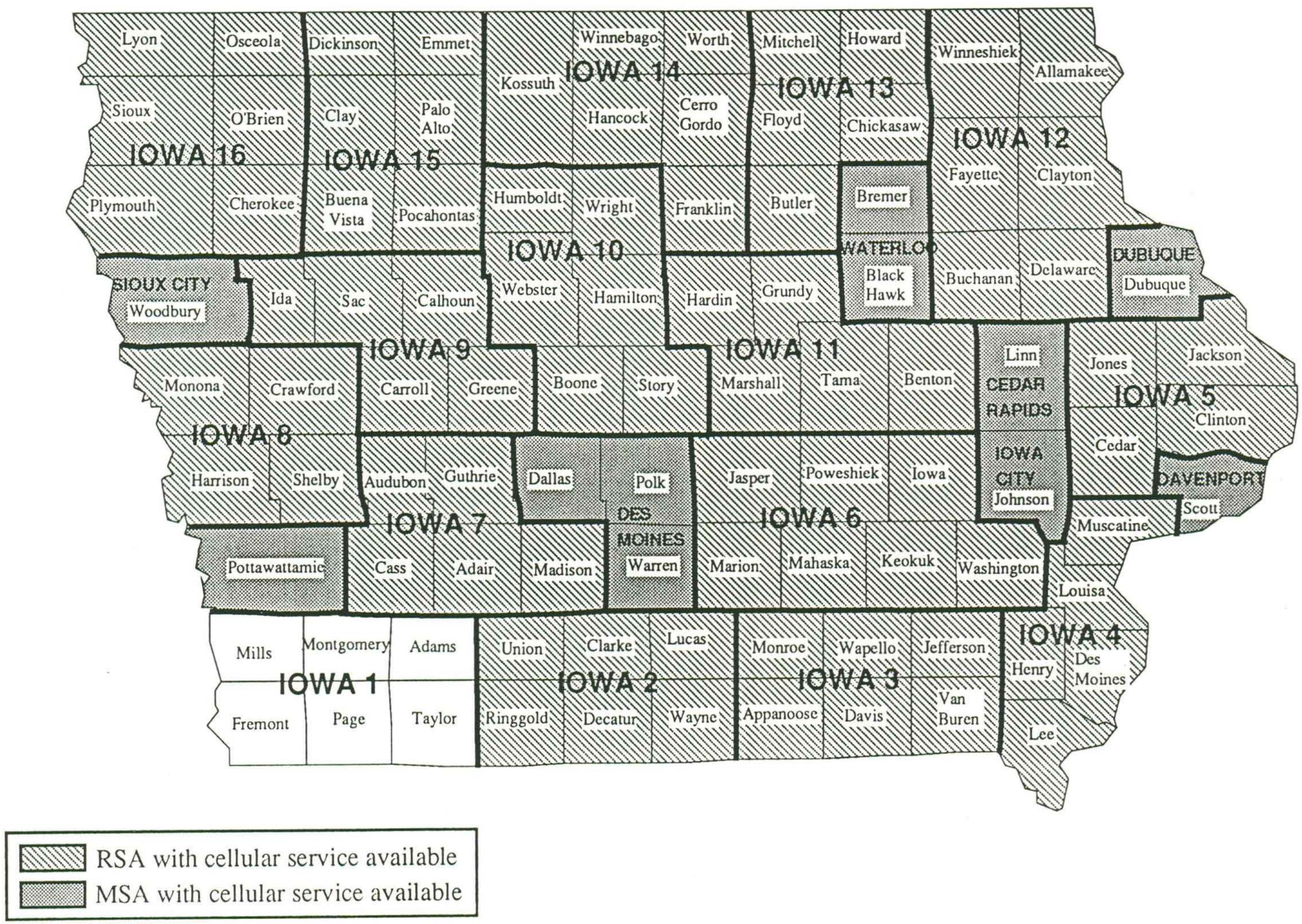
Switching and signaling technologies also enable telephone companies to offer additional features and services to residential POTS customers.

- Calling Features:
  - Example:
    - -- Call Waiting
    - -- Call Forwarding
    - -- Three-Way Calling

- Enhanced Services:
  - Example:
    - -- E911
    - -- Voice Messaging
    - -- Calling Cards

Cellular mobile telephone service was first offered in Iowa's 7 Metropolitan Service Areas (MSAs) and is now being deployed in most of Iowa's Rural Service Areas (RSAs) U.S. Cellular and US West Cellular are the state's largest cellular service providers. Cellular service can handle voice or data and supports advanced features such as *SP emergency calling, voice mail and call forwarding. Paging services offer a lower cost alternative to cellular service and are available as local, regional or national services. Pagers vary from simple tone pagers to alphanumeric models.	

Residential users can also receive voice and data through wireless communication networks.



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Cable television has become a necessity in many homes. Telephone company managers interviewed for this study reported that users forced to cut costs often disconnect telephone service in order to keep their cable TV subscriptions paid up. Cable TV systems are now used to distribute high quality audio programming and, in several instances, also offer telephone and data communications services - simple forms of interactive programming and pay TV foreshadow two-way interactive video services.	

Cable TV systems are highly mature and efficient networks to distribute large numbers of TV channels to a large number of homes.

- Iowa's Cable TV industry provides expanded choice of TV programming to 541,263 basic service subscribers in 712 communities via 515 cable systems
- Audio programming can also be delivered over cable networks
- CATV systems can provide telecommunications links
- U.S. telephone companies have tested the market through investments in foreign cable operators and through several experimental U.S. systems

The public switched network carries POTS and other dialed telecommunications traffic on circuits and switches shared in common by all users.

A private (or dedicated) network is normally for the exclusive use of a single institution. Typically, such networks consist of non-switched point-to-point private lines leased from the telephone company (LEC or IEC). Private networks are attractive to large users because:

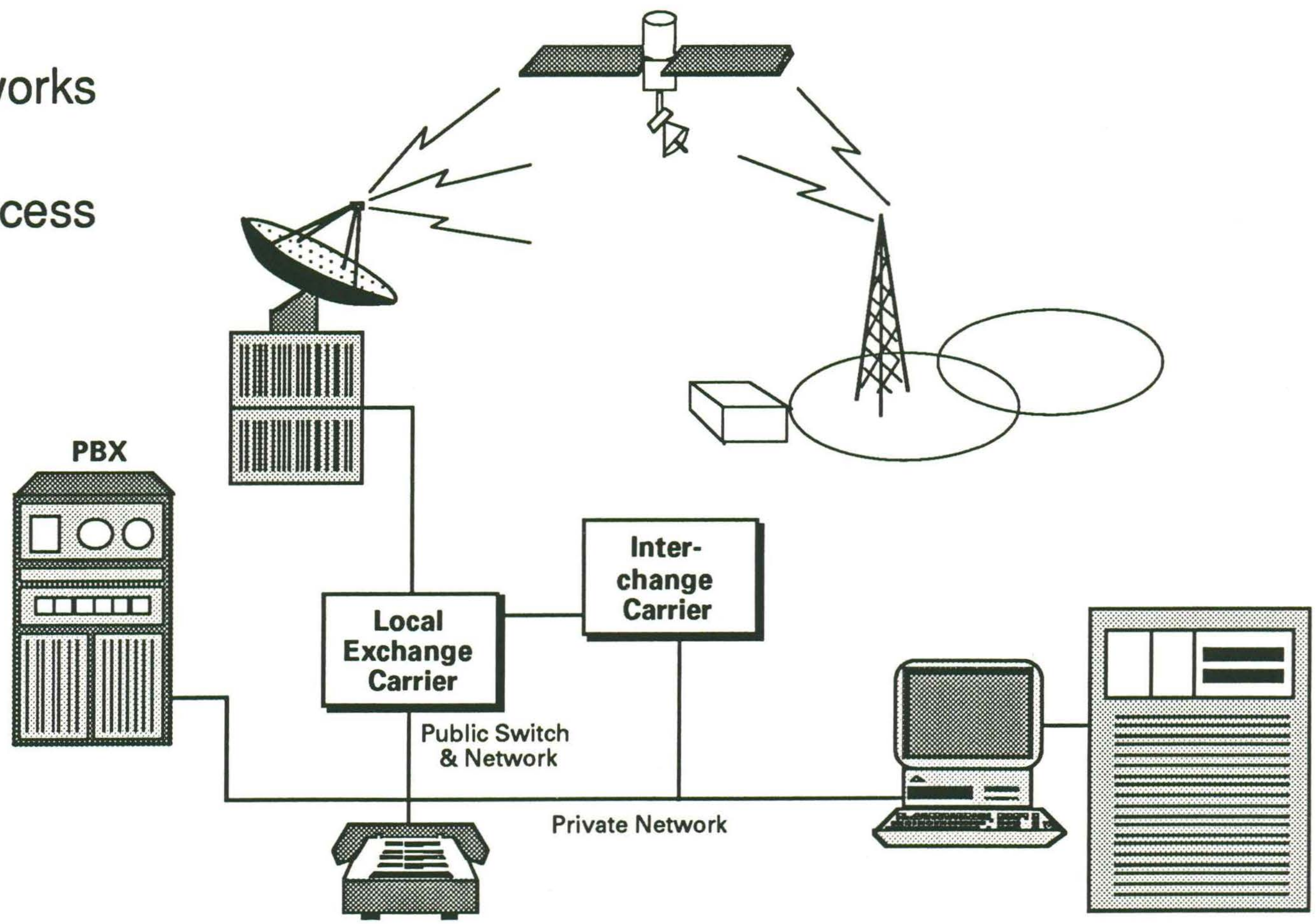
- They can save money by performing some communications functions such as multiplexing and switching themselves;
- High speed or special applications are required; or
- Security demands isolation from the public network (e.g., ATM systems).

A few technically sophisticated users (railroads, utilities, aerospace companies) may construct truly private networks by building and operating their own communications facilities.

A new class of alternative access or metropolitan fiber carrier has recently emerged. These companies offer high quality leased line services within major metropolitan areas (e.g., Metropolitan Fiber Systems of Chicago).

Institutional users such as businesses, government agencies, education institutions, and non-profit organizations have several means of satisfying their telecommunications needs.

- Public networks and switched services
- Private networks
- Alternate access



WATS stands for **wide area telecommunications service**. It offers quantity discounts to institutions that have high volumes of outbound calls. The 800 service is provided by either local or long distance carriers. It is a toll-free, inbound service for callers using the 800 number.

Centrex service provides call routing and handling service much like that of a PBX, but the services are administered by the telephone company's central office switching equipment.

Virtual Private Networks are the most sophisticated products that local and long distance carriers offer today. They are communications services that offer an alternative to private networks. Voice and data traffic are routed over a switched network under the control of the carriers' network computers. The computers are programmed to provide capabilities that are functionally identical to those offered by networks provided by private lines.

To the users, the virtual network is indistinguishable from a hardware-based private network. Changes in services are a matter of software or programming changes in the carriers' switches, as opposed to physical changes of the equipments needed for a dedicated private network.

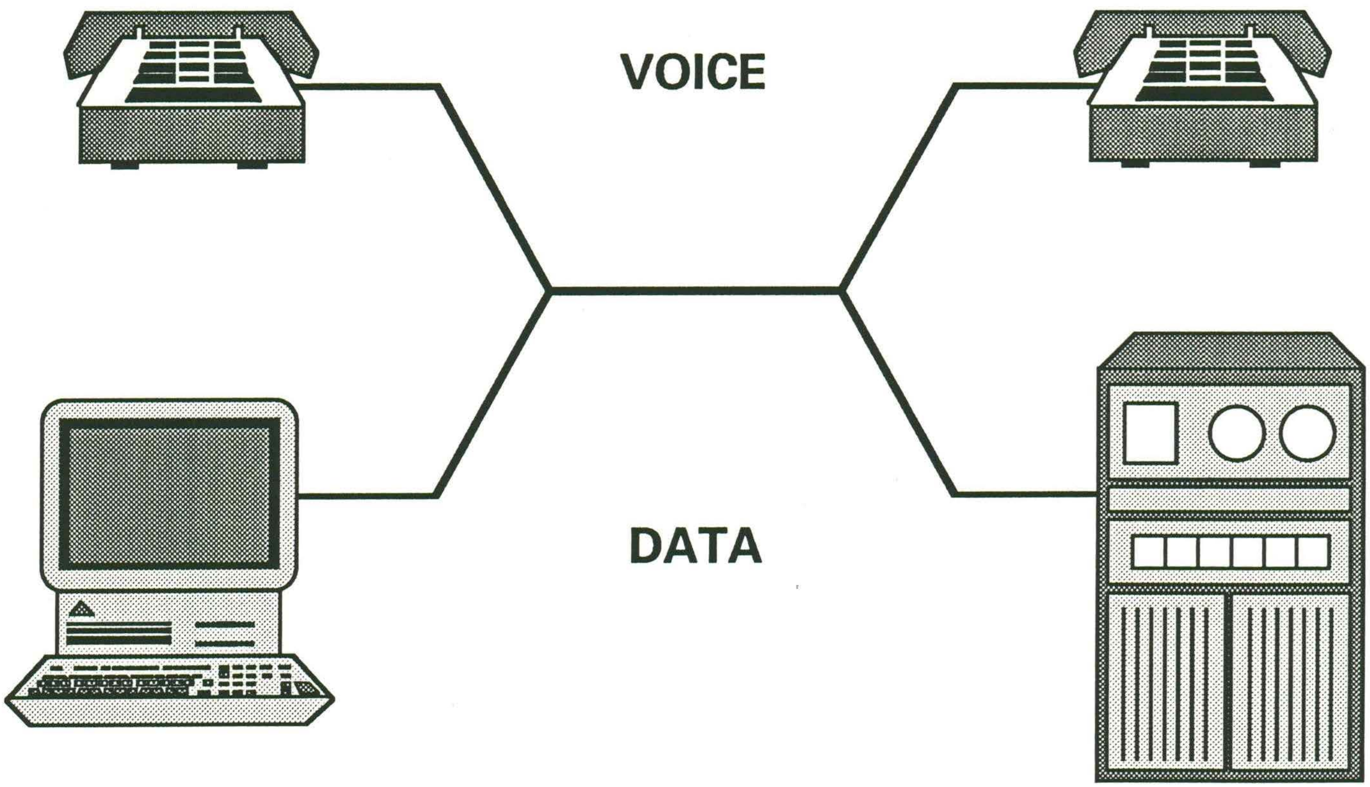
Public Packet Switching service transports data through the public network. With packet switching, messages are segmented into blocks of a pre-determined size called **packets** before they are transmitted. Data are transmitted in either analog or digital form with a variety of transmission speed. Depending on users' traffic pattern and communications requirements, public packet switching can be a less expensive alternative to private networks.

Switched (PSTN) connection can be an attractive alternative to private/dedicated connection since numerous services are available for either voice or data applications

- Voice
  - Example:
    - -- 800 and WATS services
    - -- Centrex
    - -- Voice Mail
    - -- Virtual Private Networks (VPN)
- Data
  - Example:
    - -- Public Packet Switching

Most private networks now use digital private lines leased from LECs, IECs and alternative access carriers. DDS was the first digital service. It is now being supplanted by T1 service. **Digital Data Services (DDS)** was introduced in the 1970's as the first digital service for private line communications. DDS arrangements accommodate high speed data throughput with very low error rates. DDS accomplishes its high performance level by the regeneration of digital signals, rather than signal amplification as in analog systems. The standard transmission rate for the DDS is 9.6 Kilobits per second (Kbps). **T1** is a standard digital transmission format for voice or data, over any medium at a 1.544 Megabits per second transmission rate. Most private network backbones are based on leased T1 lines, which are provided by most carriers. T1 circuits are very attractive to large volume communications users. They provide relatively error-free transmission, the flexibility for growth as user needs evolve, and the means to achieve an integrated digital network.	

A wide number of institutions have utilized digital private network services to address their voice and data telecommunication requirements.



Technically sophisticated companies and those who own their own right-of-way (railroads, utilities, governmental units) can build and operate their own telecommunications networks. Such systems may offer rapid payback (typically less than two years) to companies requiring high volume communications among a relatively small number of locations. Such systems are also attractive for applications requiring high reliability and security: Police, fire, railroad signal control, electric power distribution, gas distribution and emergency dispatching operations.	

Institutional users also enjoy the option of constructing their own communications facilities.

- Microwave Systems
- Satellite/VSAT
- Fiber Optic
- Private Two-Way Radio

Most image applications can be transmitted through different mediums. Video communication can be one-way (e.g., regular video broadcast) or two-way (e.g., video conferencing). The quality of the image can vary from high quality (i.e., HDTV or cable video) to compressed image (i.e., picture phone and teleconferencing), which is not suitable for entertainment.

The trend in business computing has been the proliferation of personal computers and workstations interconnected by local area networks (LAN) to form a system architecture where the ability to compute no longer resides in a central mainframe host, but is "distributed" to individual computing devices on a network.

ISDN has been in the news for over a decade. ISDN is not a service *per se*, but a collection of standards defining the methods of tying voice, data, and video communications together in a digital environment. The concept has been that ISDN will allow the transmission of information over public network facilities more cheaply than what was once only possible over expensive dedicated facilities. Unfortunately, ISDN has been slow to be adapted by carriers; meanwhile, several new technologies have leapfrogged the original narrowband standards of ISDN to become the standards of the future.

The original narrowband ISDN standards were written more than ten years ago. They fell behind the state-of-the art before ISDN products were introduced into the telephone network. New technologies in-the-spirit of ISDN will be discussed in the Assessment and Plans Section of this report.

The growth in "bandwidth-intensive" applications and changes in technology standards will influence institutions' decisions to use public, private or alternative networks.

- Image Applications
  - Videotext
  - One-way and two-way video conferencing
  - Image processing
  - Broadcast video

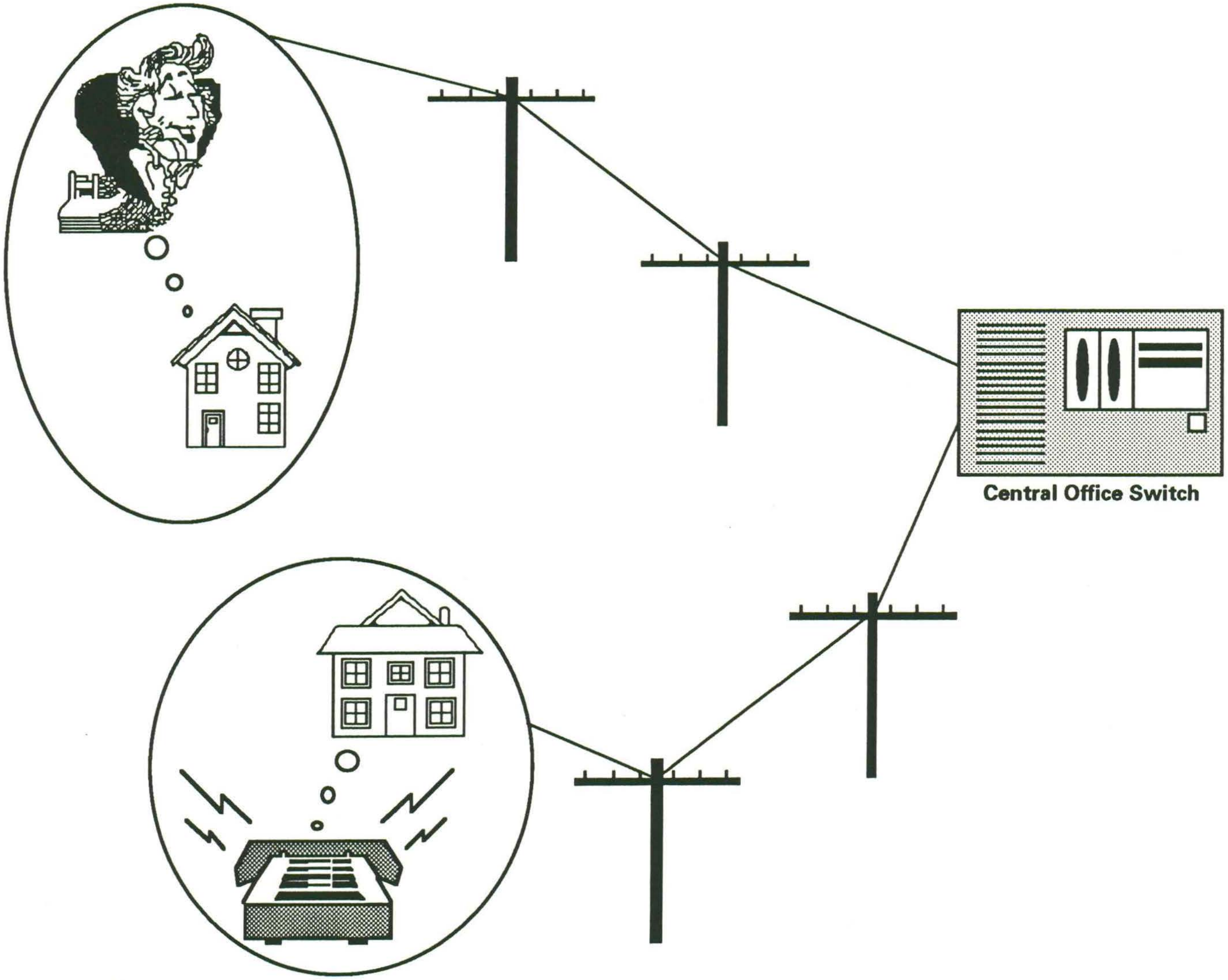
- Growth in "distributed computing"

- Integrated Services Digital Network (ISDN)

Communications Technology Taxonomy

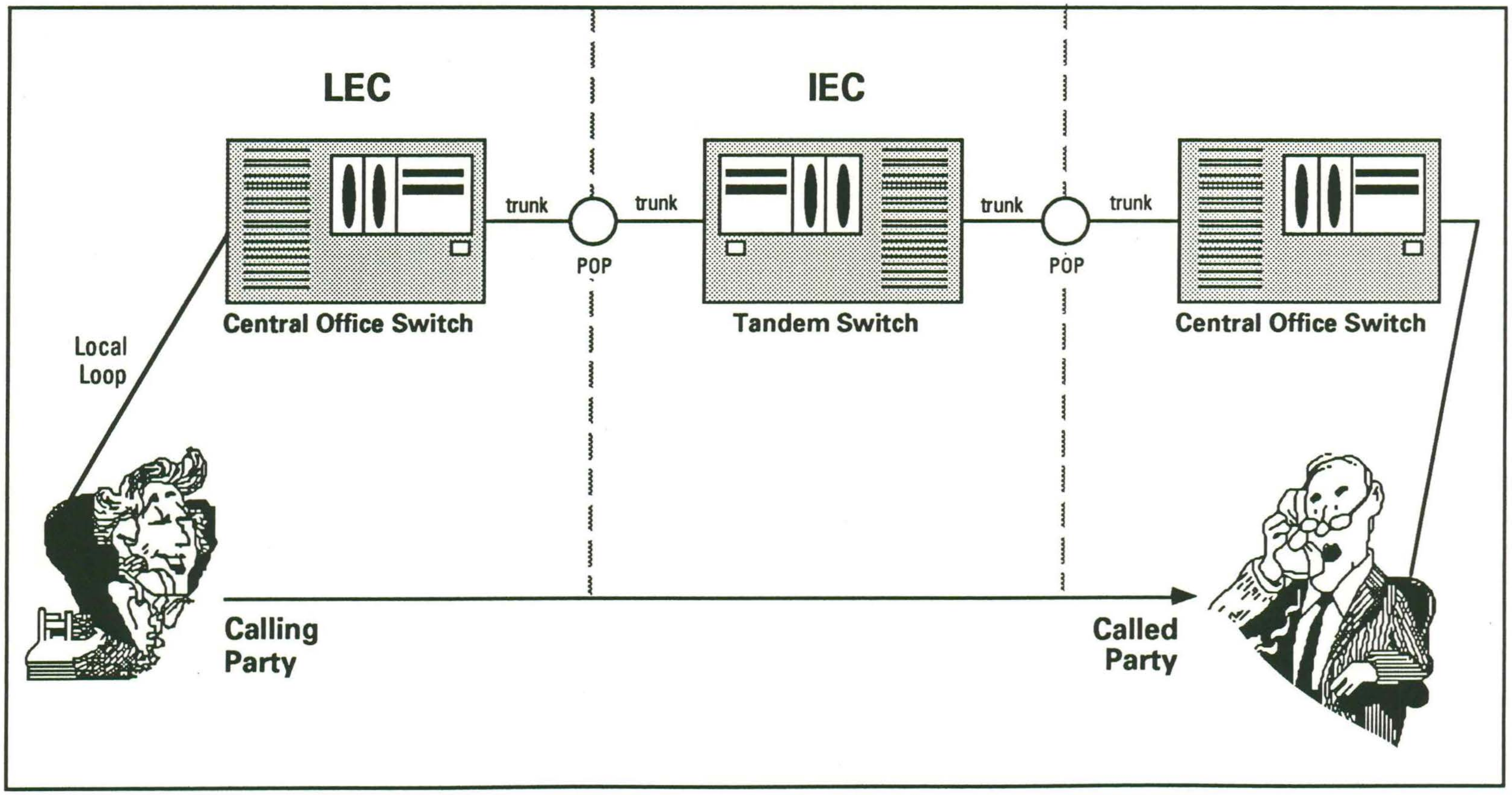
• A local phone call typically travels along twisted copper pairs to the telephone company central office. The switch automatically "switches" the call by connecting the calling party to the called party. The local central office switch performs a number of auxiliary functions in addition to completing the connection between the calling and called parties. These auxiliary functions are collectively referred to as signalling. Signalling includes generation of dial, ringing and busy tones, pulse or TouchTone dialing, recognition of busy and off-hook conditions and recording of billing information.	

A local POTS call is usually connected by the local central office switch (local exchange).



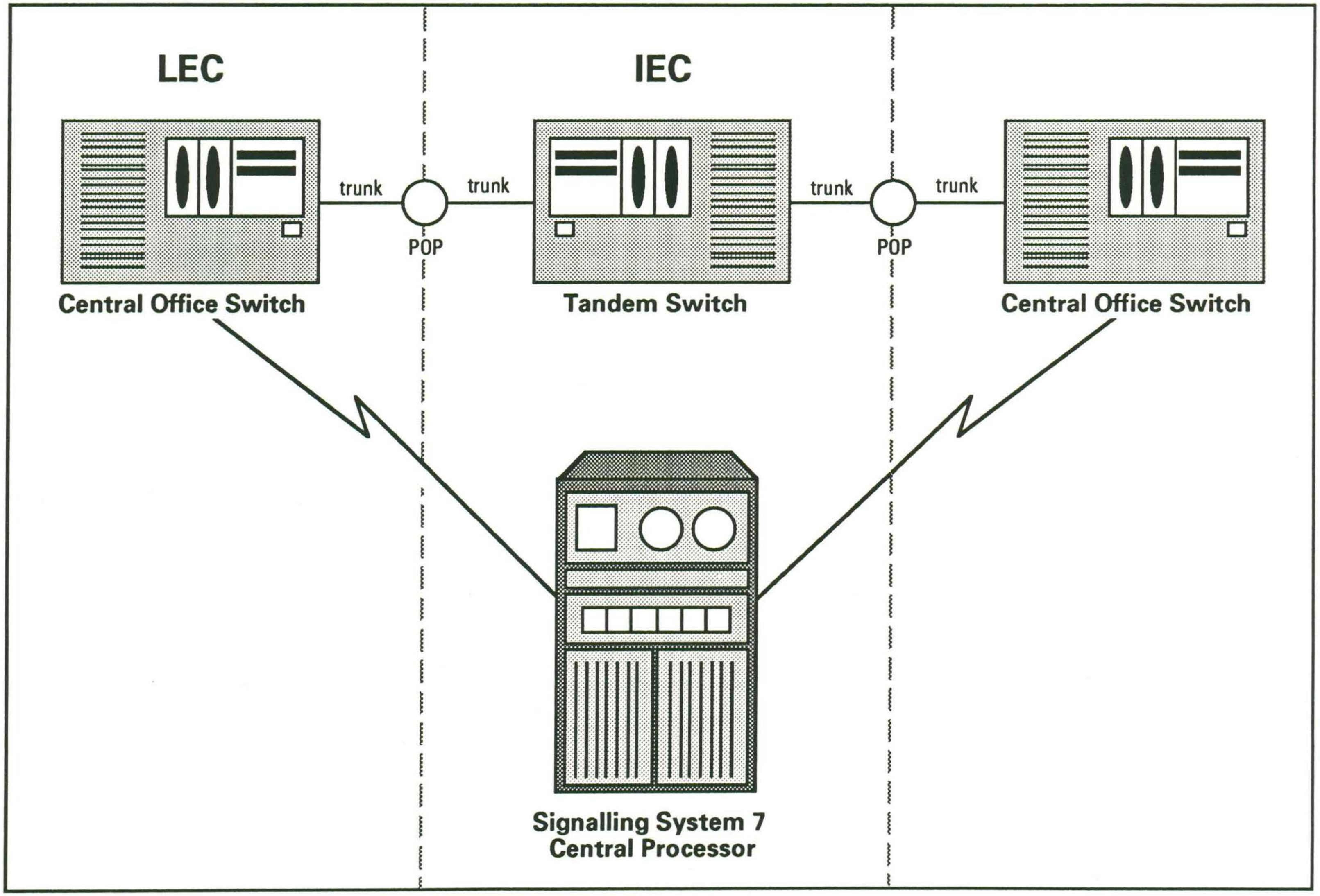
• Long distance calls are carried by LECs to the Point of Presence (POP) of an IEC. The IEC then carries the call to another POP on the far end. The LEC on the far end then carries the call to the called party. The POP is the gateway into the IEC network. Approximately one-half of the cost of a long distance call is due to the relatively short LEC links on each end of the long distance call. Institutional users can avoid these costs and, therefore, reduce telecommunications expense by nearly one-half by providing their own connections to the IEC POP. Trunks are the transmission lines that carry calls between switches. A tandem switch is a switch that connects switches to other switches.	

Long distance calls are carried between Local Exchange Carriers (LECs) by Interexchange Carriers (IECs).



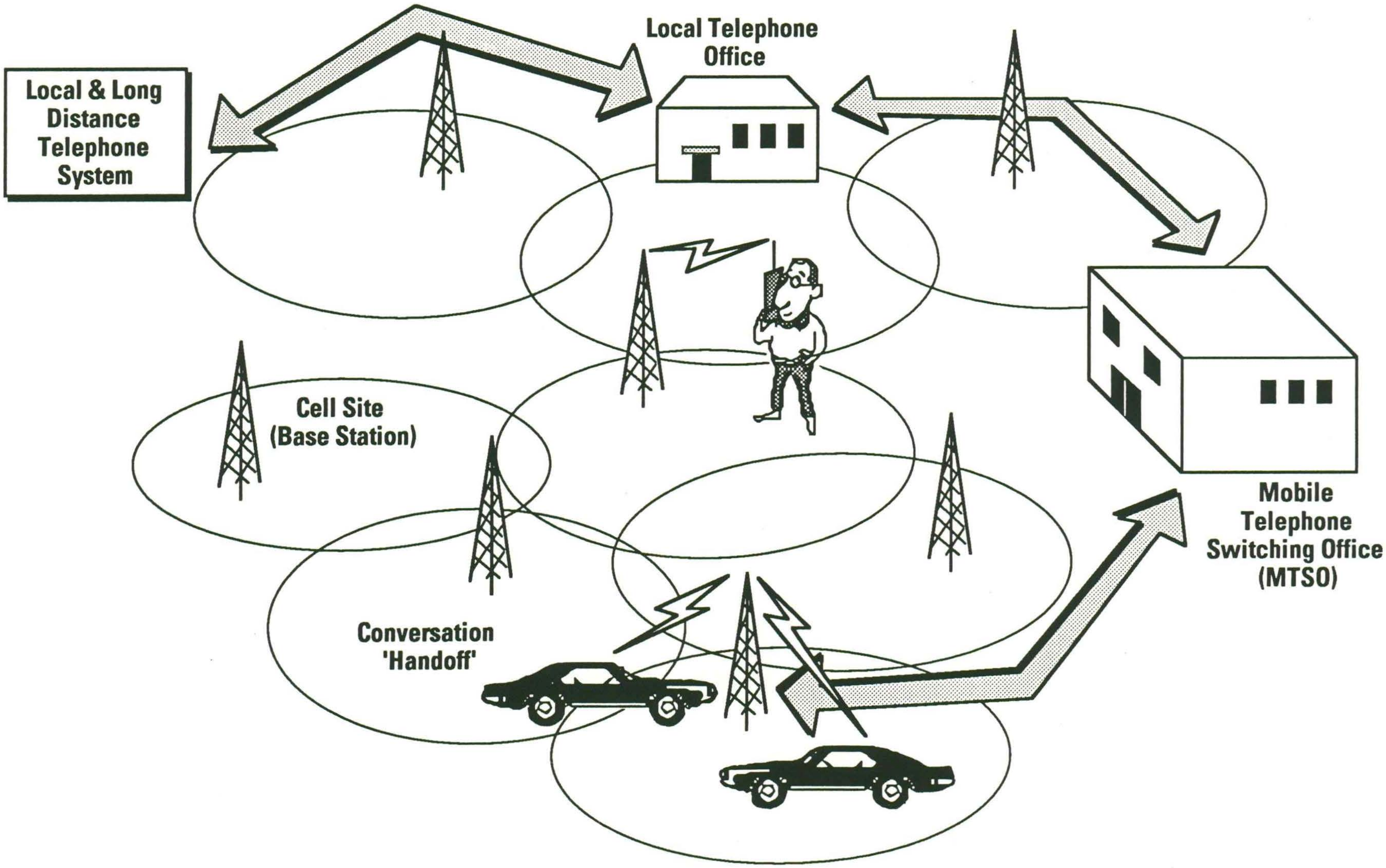
• Advanced functionality called intelligence is being introduced into the telephone network through the deployment of Signalling System 7 (SS7). Functions which were previously defined by electromechanical connections are defined by computer programs embedded in a centrally located SS7 Central Processor. This increases flexibility, makes new features possible and reduces network costs because software can be changed through keyboard commands versus older systems which were defined by hardwired connections. For example, 12 seconds now elapse between dialing and initiation of ringing on many Iowa long distance calls. Once SS7 is deployed, elapsed time will be less than 1 second.	

A new signalling system, Signalling System 7 (SS7) will provide advanced functionality (intelligence) to the telephone network.



• Cellular mobile telephone infrastructure consists of cell sites and Mobile Telephone Switching Offices (MTSO). Cell sites consist of radio receivers/transmitters, towers and radio antennae. The MTSO consists of telephone switches and computers. The computer maintains communications with the mobile telephone by determining which cell site will be used to communicate with the mobile unit. The MTSO also provides a connection to Public Switched Telephone Network (PSTN).	

Cellular mobile telephone systems hand off conversations from cell site to cell site as the mobile user travels along the highway.



• Transmission systems can be as simple as a pair of wires or as complex as a communications satellite system. Transmission systems networks resemble highway systems in that local distribution is simple and carries relatively light traffic (local roads) while long-haul systems are complex and carry high-traffic volumes (Interstate highway systems).	

Transmission systems transport calls from the telephone set to the local central office and from the local central office to other switches in the telephone network.

TRANSMISSION SYSTEMS

Facility Type	Typical Distance
Inside Wire	50 feet
Local Loop	2 miles
Local Interoffice Facilities	20 miles
Long Haul Facilities	1,000 miles

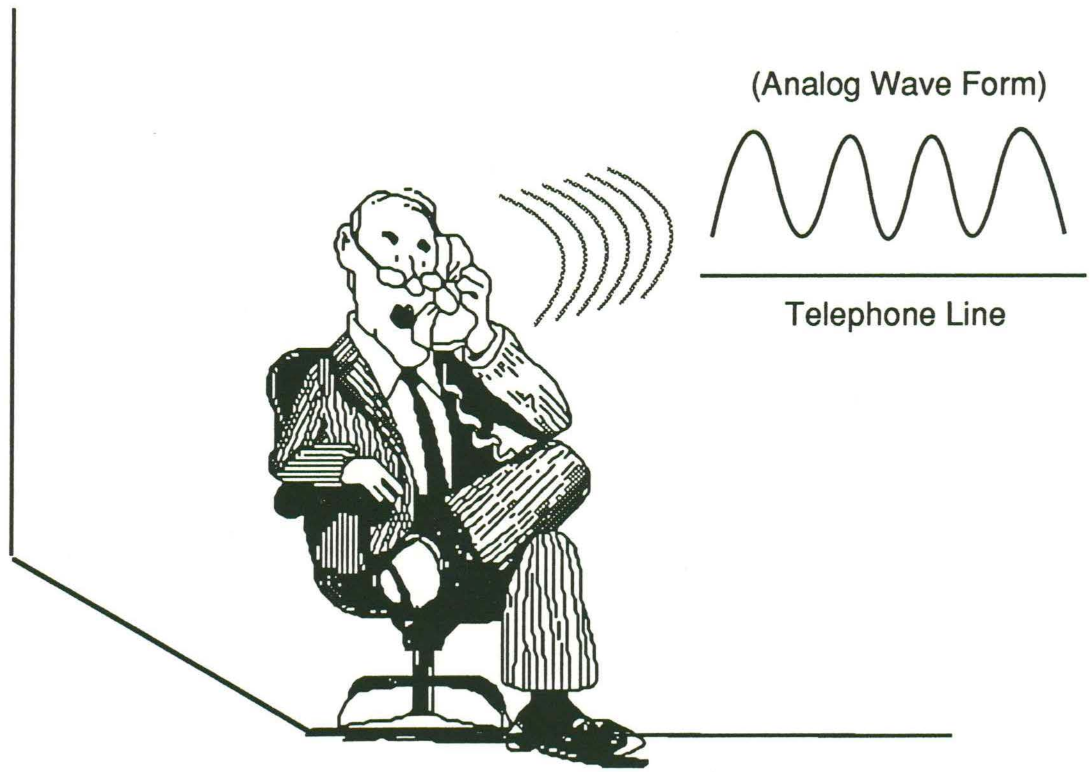
• The following pages discuss digital and analog transmission. The purpose is to establish a basis for discussing the need for replacement of analog transmission systems with digital transmission systems.	

There are two means of transmission:

- Digital
- Analog

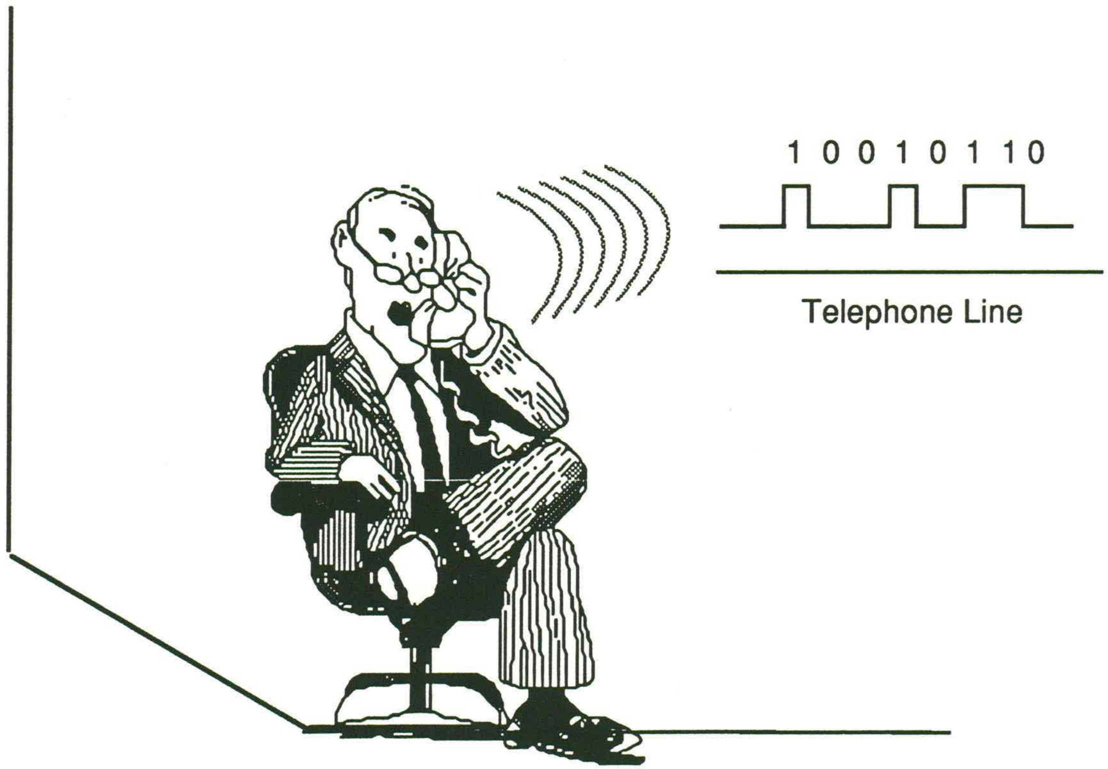
• Analog transmission employs an electronic analog of the sound pressures created by speech. Speech sound pressures can be translated into a varying electrical voltage by the vibrations of carbon granules in a microphone. The grooves in a phonograph record are a second example of a speech analog. The quality of analog transmission depends on the accuracy of each copy of the speech analog. Once many copies of copies are made (as in an overseas phone call), the speech may be nearly unintelligible.	

Analog transmission employs an electronic analog of speech.



• Digital transmission systems convert speech into a coded series of numbers — digitalization. Once the message is in digital form, it can be processed by special purpose digital computers. Computer processing provides better quality and lower cost than analog systems. System maintenance is easier and calls are clearer because digital systems introduce little additional error (noise) than that produced by the digitalization process itself. The quality of a compact disc recording compared to a dusty phonograph record graphically illustrates the quality advantage of digital communications compared to analog communications.	

Digital transmission is accomplished by converting speech into a coded series of numbers.



• The communications network will eventually utilize digital transmission exclusively. The following statistical section of this report summarizes the current status of analog replacement by digital communications in Iowa. The primary areas yet to be converted to digital communications are local central office switches and the local loop.	

Most phone calls involve both analog and digital transmission.

- Most calls are transmitted in analog fashion between home and the local central office.
- Nearly all connections among switches are digital today.
- The long distance network uses digital transmission exclusively.

Analog and digital transmission signals are carried over copper, fiber optic and free space transmission media. Each transmission media has an area of comparative advantage.

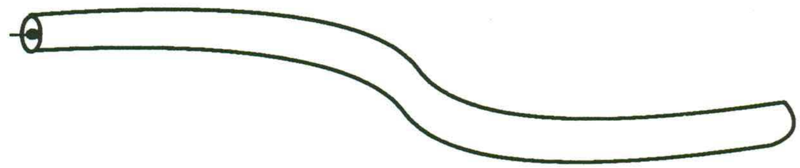
Copper cables are better than other media for distribution of communications signals within buildings. They are less expensive, easier to install, and more flexible. Furthermore, modern digital signal processing schemes make them suitable for very high speed computer communication in the 100 Mbps range. Copper coaxial cables provide bandwidth for broadcast television and high definition television (HDTV).

Radio transmission through free space provides support for mobile communications (cellular mobile telephone, broadcast radio and television, two-way radio, and radio paging) and transmission to remote locations and across difficult terrain (terrestrial microwave and satellite communications). Radio transmission provides analog and digital transmission equal in quality to other media. Since radio waves travel through free space, available frequency spectrum is limited and may not be available for all applications in all areas.

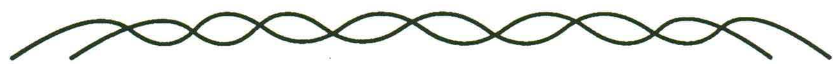
Fiber optic transmission can also carry analog and digital transmission signals. Fiber optic media can carry very high communications traffic volumes and is immune from electromagnetic interference. This immunity makes wire tapping difficult and protects the signal from noise. Fiber optic media is a secure and quiet media. This media weathers better than copper media and, thus, enjoys lower maintenance costs. However, fiber optic termination equipment is expensive. Therefore, fiber optic media is preferred in those applications where terminal equipment costs can be averaged out over long high volume cable spans. Terminal equipment cost is declining each year and will continue to do so. This decline will make fiber optic media the best choice for shorter cable spans in the future.

Transmission media is the physical medium over which the message travels.

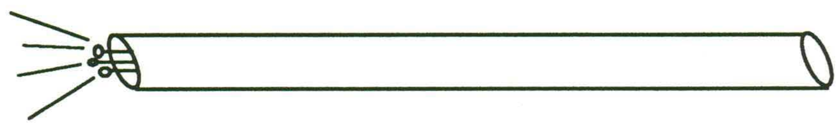
Coaxial Cable



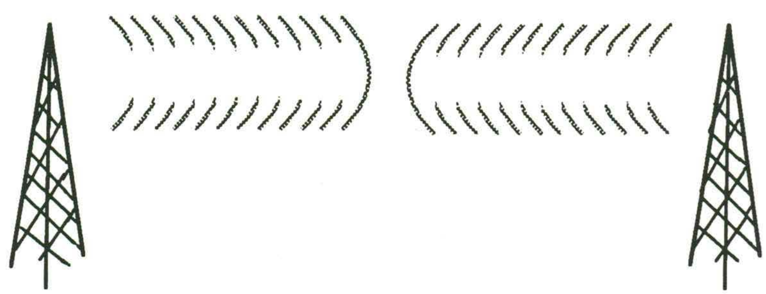
Twisted Pair



Fiber Optic Cable



Radio Waves



Telephone company local central office switches are of digital, electronic analog or electromechanical design. All IEC switches are digital. Institutional users find virtually no need for swtiched data communications services other than dial up modem applications which use POTS. Therefore, virtually all switched telephone traffic is for voice calls. Nearly all such calls are delivered to the customer in analog form.

Nonetheless, digital switching is attractive for handling analog voice traffic because switching is accomplished electronically with no moving mechanical parts. Moving mechanical parts are subject to wear and corrosion which causes high maintenance expense and quality degradation. In addition, electronic analog and digital switch functionality is defined by computer software (stored program controlled (SPC)) which is much easier to modify and enhance than are older hardwired electromechanical designs.

The table below classifies switching system generations by three categories of obsolescence:

- Physical obsolescence occurs when a system is incapable of performing its design functions.
- Economic obsolescence occurs when it is more costly to continue a system's operation than to replace it.
- Functional obsolescence occurs when a system is not capable of supporting new functional requirements (e.g. equal access or CLASS service).

Iowa's telecommunications network employs electromechanical, digital, and analog electronic switches.

	Obsolescence		
Switch	Physical	Economic	Functional
Electromechanical	Soon	Yes	Yes
Electronic Analog	No	No	Soon
Digital (1st generation)	No	No	Yes
Digital (2nd generation)	No	No	No

Deployment of Telecommunications Technology

The persons shown below were interviewed during the preparation of this report. Several more interviews are planned. In addition, some supporting documentation has not yet been produced by the vendors.	

Communications vendor plans were assessed through an interviewing program.

Name	Position	Organization
Mr. Russ Hegstrom	District Manager/Government Relations	AT&T
Mr. Robert Halford	General Manager	Clear Lake Telephone Company
Mr. Dwight L. Ponder	Senior Administrator/Exchange Planning	GTE
Ms. Shirley Nicol	Regional Manager/Regulatory Affairs/Tariffs	GTE
Mr. David Schmidt	General Manager	Heart of Iowa Telephone Cooperative
Mr. Robert J. Sherlock	Director of Engineering	Iowa Network Services
Mr. M. J. "Marlys" Jones	Manager Switching	US West Communications
Mr. Mark Dixon	Network Operations Supervisor	United States Cellular
Mr. R. Kent Meske	Market Manager	United States Cellular
Mr. Kenneth L. Lein	Manager	Winnegago Co-Op Telephone Association

Communications vendors' modernization plans are being driven by the need to reduce costs and support explosive demand for high volume nearly instantaneous communications contact everywhere. Digital switching and digital transmission systems are much less costly to maintain than their analog predecessors. Digital switching systems are also much less costly to build than were analog switching systems. Fiber optic transmission systems cost more to build than copper cable-based systems; but, in those situations where traffic volumes are high, fiber optic transmission systems produce lower unit cost.	Cellular mobile telephone systems have tapped a demand for people to be in continuous communications contact. Emerging personal communications network (PCN) will drive this need to a new plateau. Electronic messaging applications pick up where the overnight express companies leave off, permitting nearly instantaneous transmission of text, voice and images.

There are several forces driving advances in communications technology.

- Cost reduction
  - Current local phone link between home and switch is labor intensive and expensive to maintain.
  - Fiber is simpler and electronics based. It has low unit cost when traffic volumes are high.
  - Digital switches are less expensive than electro-mechanical switches.

- Personal communications
  - Demand for 24-hour communication access is rising

- Electronic messaging
  - Voice messaging
  - FAX
  - E-Mail
    - Services like Dow Jones News Retrieval, Prodigy and networks such as Internet are becoming popular.

Demand for interactive (two-way) video communications is emerging as is expectation of higher quality video. Computer processing power is becoming decentralized through the emergence of networked computing architectures. These new architectures create a need for high quality digital communication infrastructure.	

There are several forces .... continued

- Image processing
  - Transmission of X-rays and Magnetic Resonance Imaging (MRI) information is becoming necessary with rising health care costs.

- Demand for Video
  - Demand for cable and pay-per-view is rising

- Video Conferencing
  - Video conferencing technology is feasible and more affordable

- High Definition Television (HDTV)
  - Federal support for R&D initiatives

- Distributed Computer Processing
  - Distributed processing needs excellent communications infrastructure with lots of bandwidth

The Demographic and Telecommunications Database summarized in the following section provides a baseline for assessing Iowa's communications infrastructure. Iowa's progress can be measured relative to four industry modernization thrusts.

Iowa's Progress:

1. Digital switch and digital transmission equipment deployment: Nearly all Iowa interoffice transmission facilities are digital. DS1 (1.544 Mbps) and DS3 (45 Mbps) digital services can be provided on request throughout the state. Essentially all of the service regulated telcos employ local digital switches. US West's goal is for all exchanges to be digital or electronic stored program controlled by 1994 while GTE's goal is to operate all digital exchanges by 1998. These companies have published their digital switch conversion schedules.

2. Fiber optic cable: The IECs operating in Iowa operate almost exclusively on fiber optic cable. Much of the LEC access to the IECs is now on fiber (see statistical data). Smaller LECs, especially those that operate CATV systems, are likely to be among the first telephone companies in the country to offer fiber to the home.

3. Cellular mobile telephone companies now offer service in all Iowa MSAs and RSAs. RSA franchises were awarded in 1990. The cellular companies are now constructing additional cell sites to fill in coverage gaps which still exist in most RSAs. In addition, the vendors are adding advanced signalling functionality to their networks to make incoming calling easier and to eliminate confusion over billing practices.

4. Software control and configuration of networks -- a national program to make 800 numbers portable from IEC to IEC is driving industry conversion to SS7. SS7 is an international standard -- it seems likely that the entire world will eventually operate under this standard. SS7 reduces call set up time and makes "intelligent network" features such as Caller ID feasible.

   INS members will have access to SS7 in the second quarter of 1993, and all members will have deployed service by the end of 1994. US West expects to convert all of its offices that are SS7 capable in 1993. The remainder must wait until the switch conversion program is complete in 1994. While GTE will also put basic capabilities in place in 1993, many GTE offices will not be capable of using these features until the 1998 switch conversion program is complete.

There are four industry modernization thrusts:

1. Digital transmission and switching
2. Fiber Optic Cable
3. Cellular Mobile Telephone
4. Software control and configuration of networks

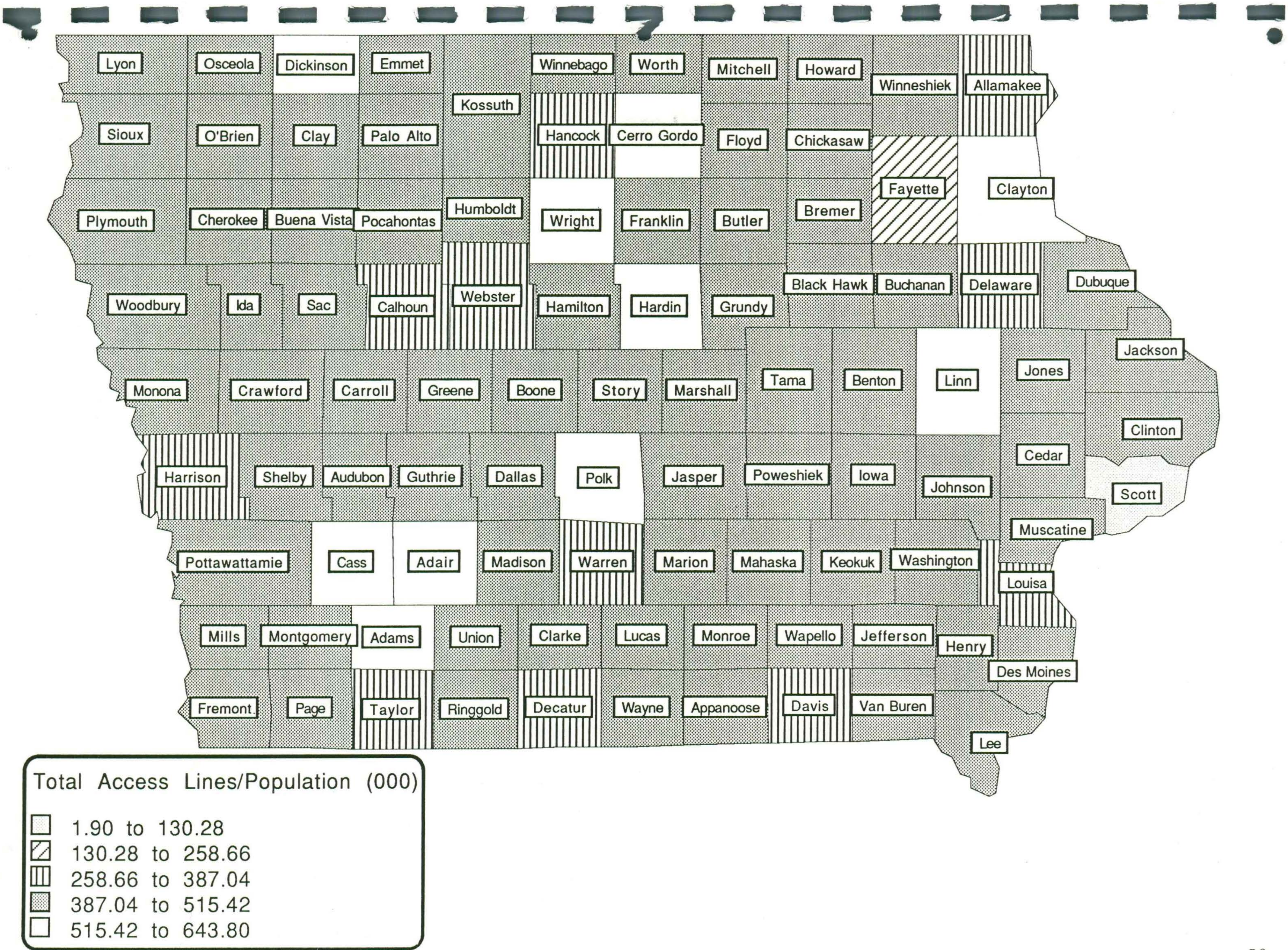
Summary of Database

Total Access Lines/Population (000s):

This map reports, on a per-county basis, the number of access lines currently being used by every 1000 people in the state of Iowa. This ratio ranges from a low of 1.90 to a high of 643.80. This range of values is divided into five equal portions, and the counties are then classified into five groups.

Information about the number of access lines was obtained from the reports filed for the year ending 1991 by all the telecommunication companies with the Iowa Utilities Board.

County population statistics for 1990 were provided by the State of Iowa.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Van Buren
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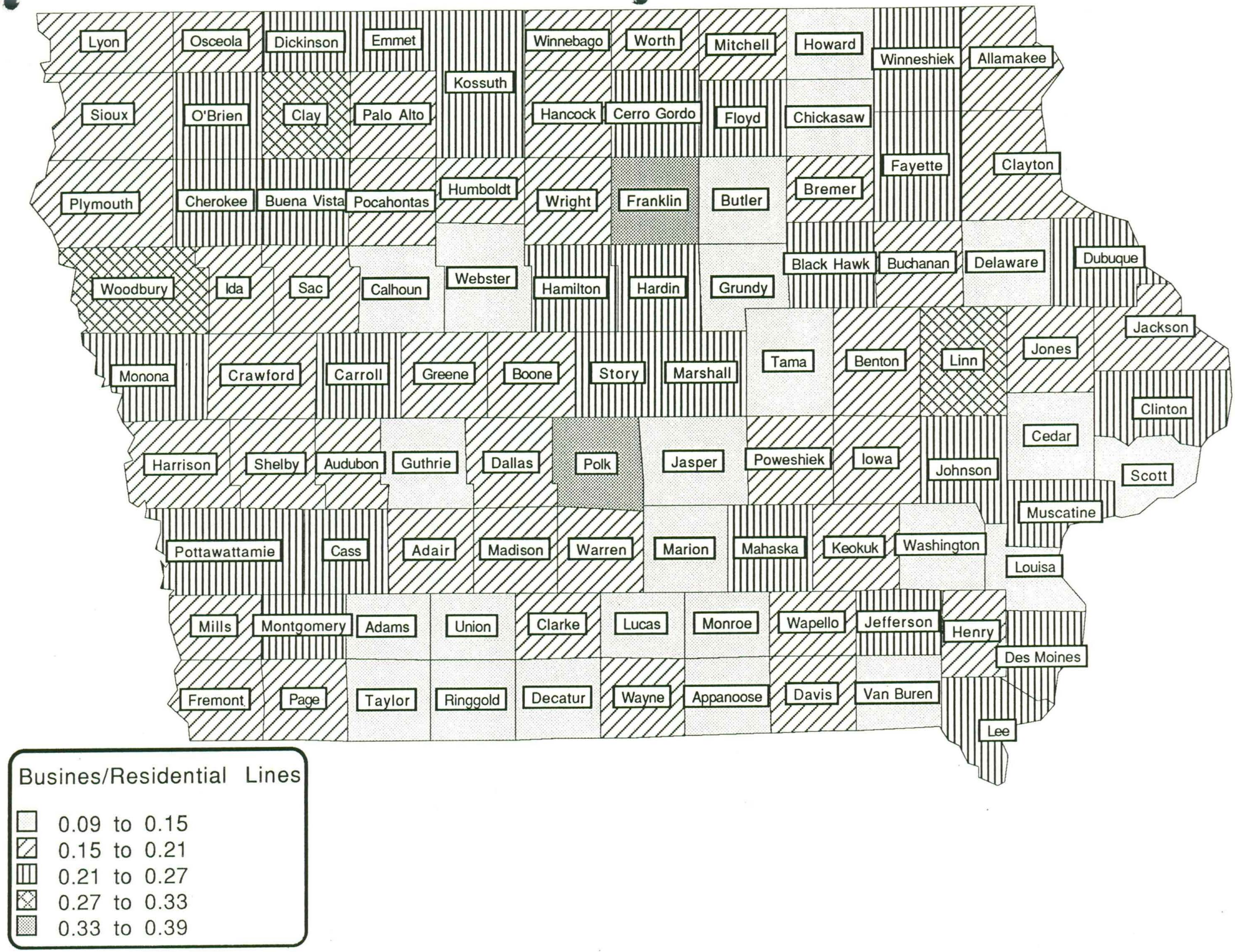
Total Access Lines/Population (000)
1.90 to 130.28
130.28 to 258.66
258.66 to 387.04
387.04 to 515.42
515.42 to 643.80

Business/Residential Lines:

This map reports, on a per-county basis, the ratio of business to residential lines. This ratio ranges from a low of 0.09 to a high of 0.39.

Information about the number of business and residential lines was obtained from the reports filed for the year ending 1991 by all the telecommunication companies with the Iowa Utilities Board.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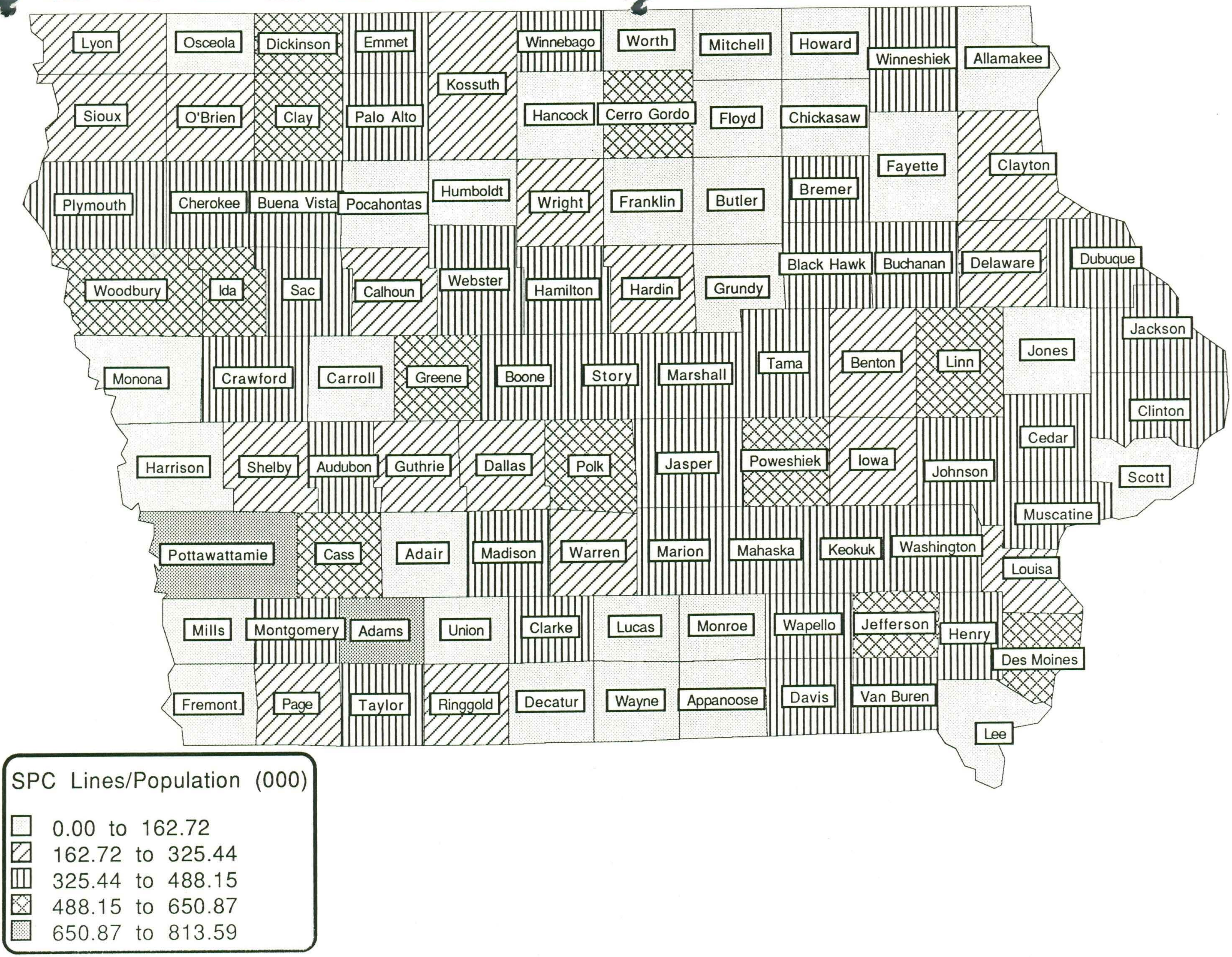
Busines/Residential Lines
0.09 to 0.15
0.15 to 0.21
0.21 to 0.27
0.27 to 0.33
0.33 to 0.39

SPC Lines/Population (000):

This map reports, on a per-county basis, the total number of lines serviced by Stored Program Control (SPC) switches per every 1000 people. Stored Program Control switches include both analog and digital switches.

Information about the number of SPC lines was obtained from the reports filed for the yaer ending 1991 by all the telecommunication companies with the Iowa Utilities Board.

County population statistics for 1990 were provided by the State of Iowa.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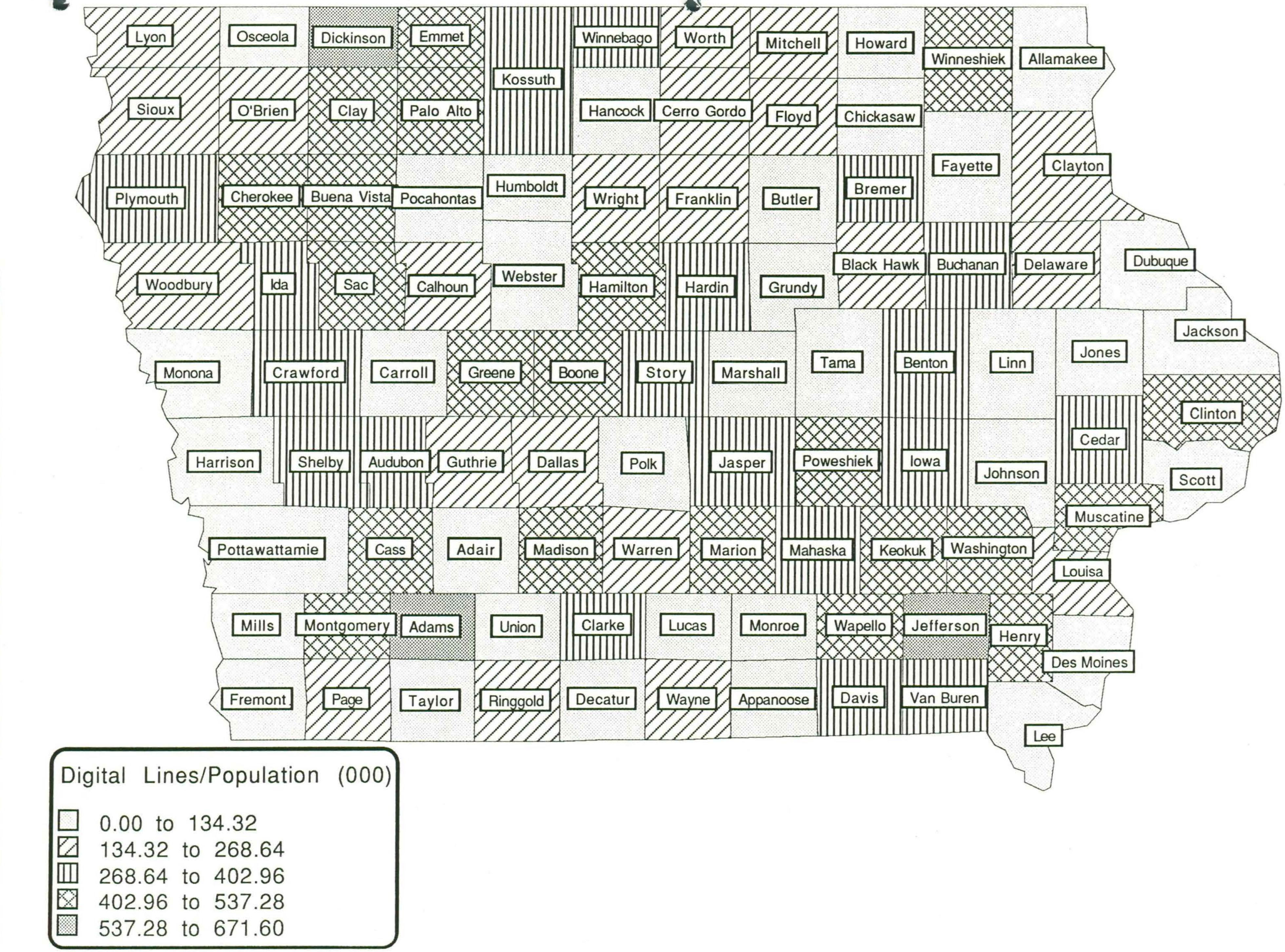
SPC Lines/Population (000)
0.00 to 162.72
162.72 to 325.44
325.44 to 488.15
488.15 to 650.87
650.87 to 813.59

Digital Lines/Population (000):

This map reports, on a per-county basis, the total number of lines serviced by digital switches per every 1000 people.

Information about the number of digital lines was obtained from the reports filed for the year ending 1991 by all the telecommunication companies with the Iowa Utilities Board.

County population statistics for 1990 were provided by the State of Iowa.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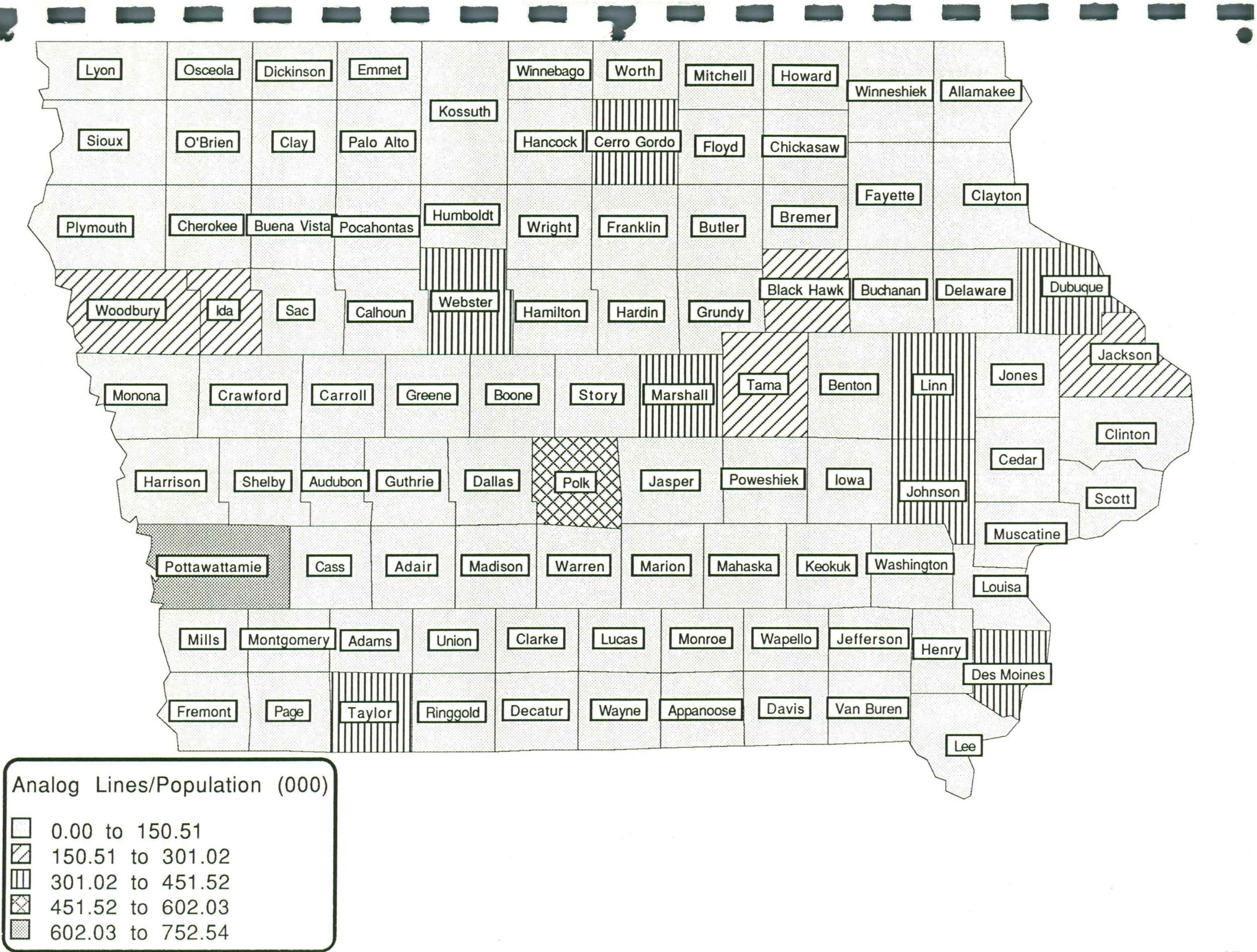
Digital Lines/Population (000)
0.00 to 134.32
134.32 to 268.64
268.64 to 402.96
402.96 to 537.28
537.28 to 671.60

Analog Lines/Population (000): This map reports, on a per-county basis, the total number of lines serviced by analog switches per every 1000 people. Information about the number of analog lines was obtained from the reports filed for the year ending 1991 by all the telecommunication companies with the Iowa Utilities Board. County population statistics for 1990 were provided by the State of Iowa.	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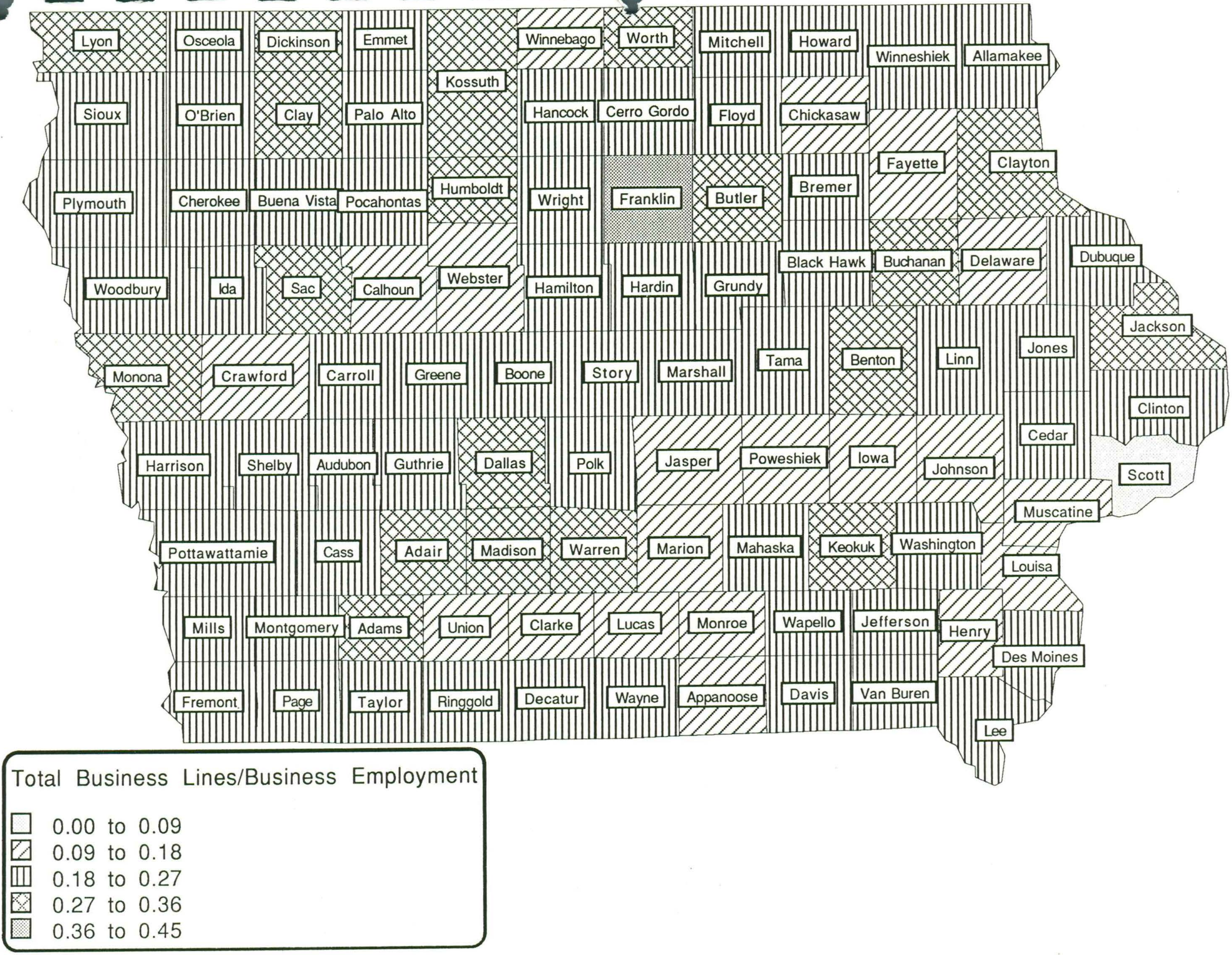
Analog Lines/Population (000)
0.00 to 150.51
150.51 to 301.02
301.02 to 451.52
451.52 to 602.03
602.03 to 752.54

Total Business Lines/Business Employment:

This map reports, on a per-county basis, the total number of business lines served as a function of the number of people employed by businesses in the county.

Information about the number of business lines was obtained from the reports filed for the year ending 1991 by all the telecommunication companies with the Iowa Utilities Board.

Business employment statistics for 1990 were provided by the State of Iowa.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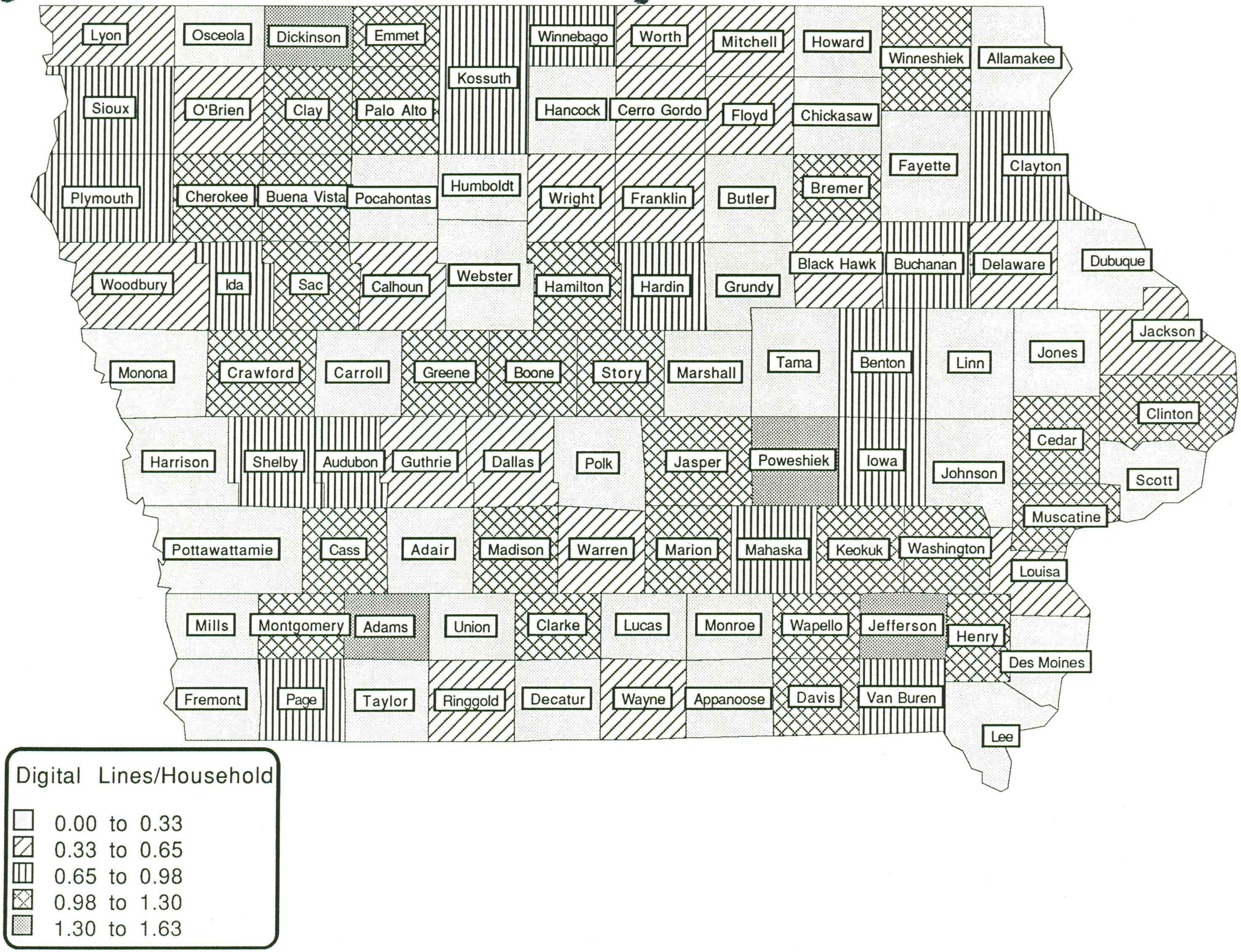
Total Business Lines/Business Employment
0.00 to 0.09
0.09 to 0.18
0.18 to 0.27
0.27 to 0.36
0.36 to 0.45

Digital Lines/Household:

This map reports, on a per-county basis, the total number of lines serviced by digital switches per household.

Information about the number of digital lines was obtained from the reports filed for the year ending 1991 by all the telecommunication companies with the Iowa Utilities Board.

Household statistics for 1990 were provided by the State of Iowa.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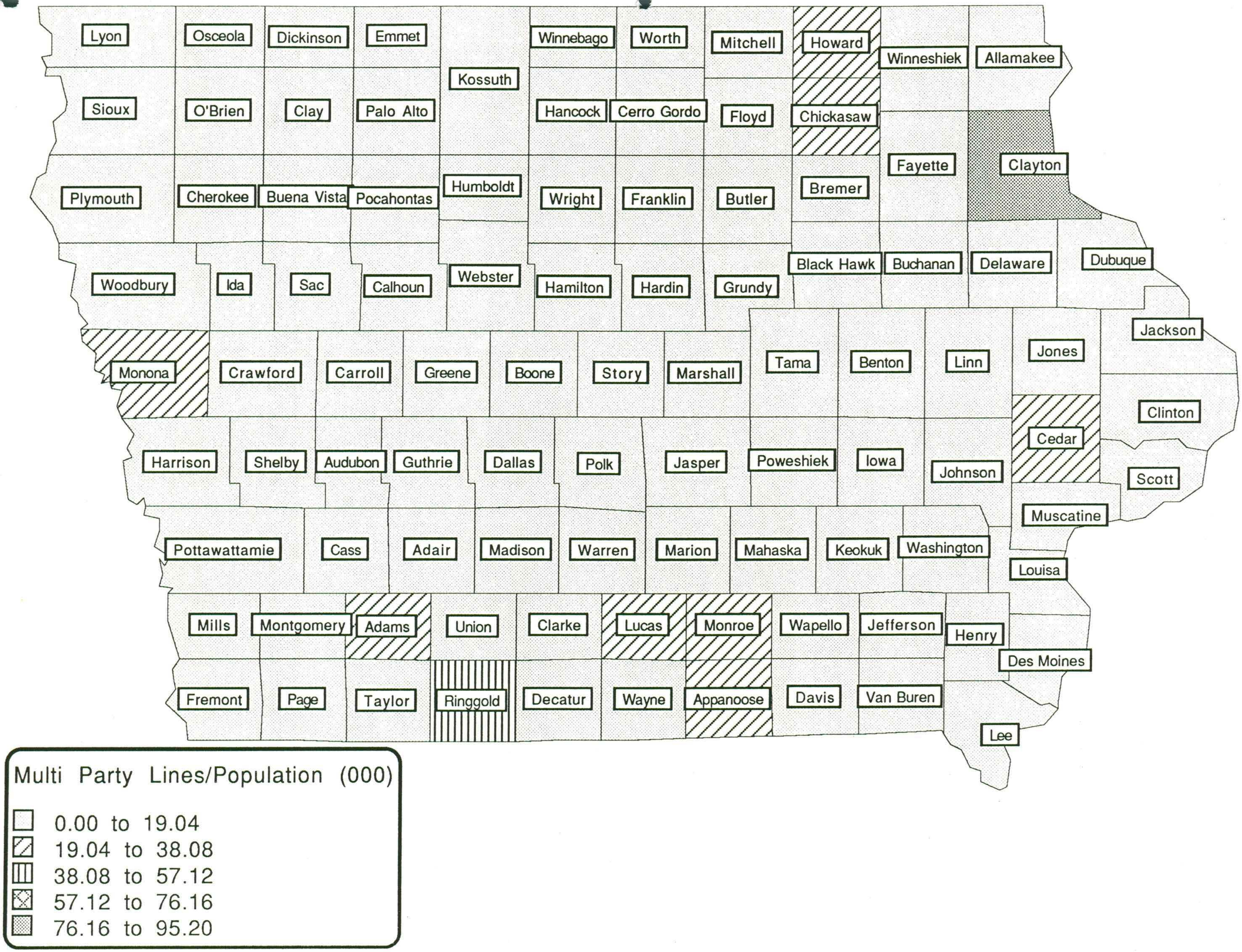
Digital Lines/Household
0.00 to 0.33
0.33 to 0.65
0.65 to 0.98
0.98 to 1.30
1.30 to 1.63

Multi-Party Lines/Population (000):

This map reports, on a per-county basis, the total number of multi-party lines currently in use per every 1000 people.

Information about the number of multi-party lines was obtained from the reports filed for the year ending 1991 by all the telecommunication companies with the Iowa Utilities Board.

County population statistics for 1990 were provided by the State of Iowa.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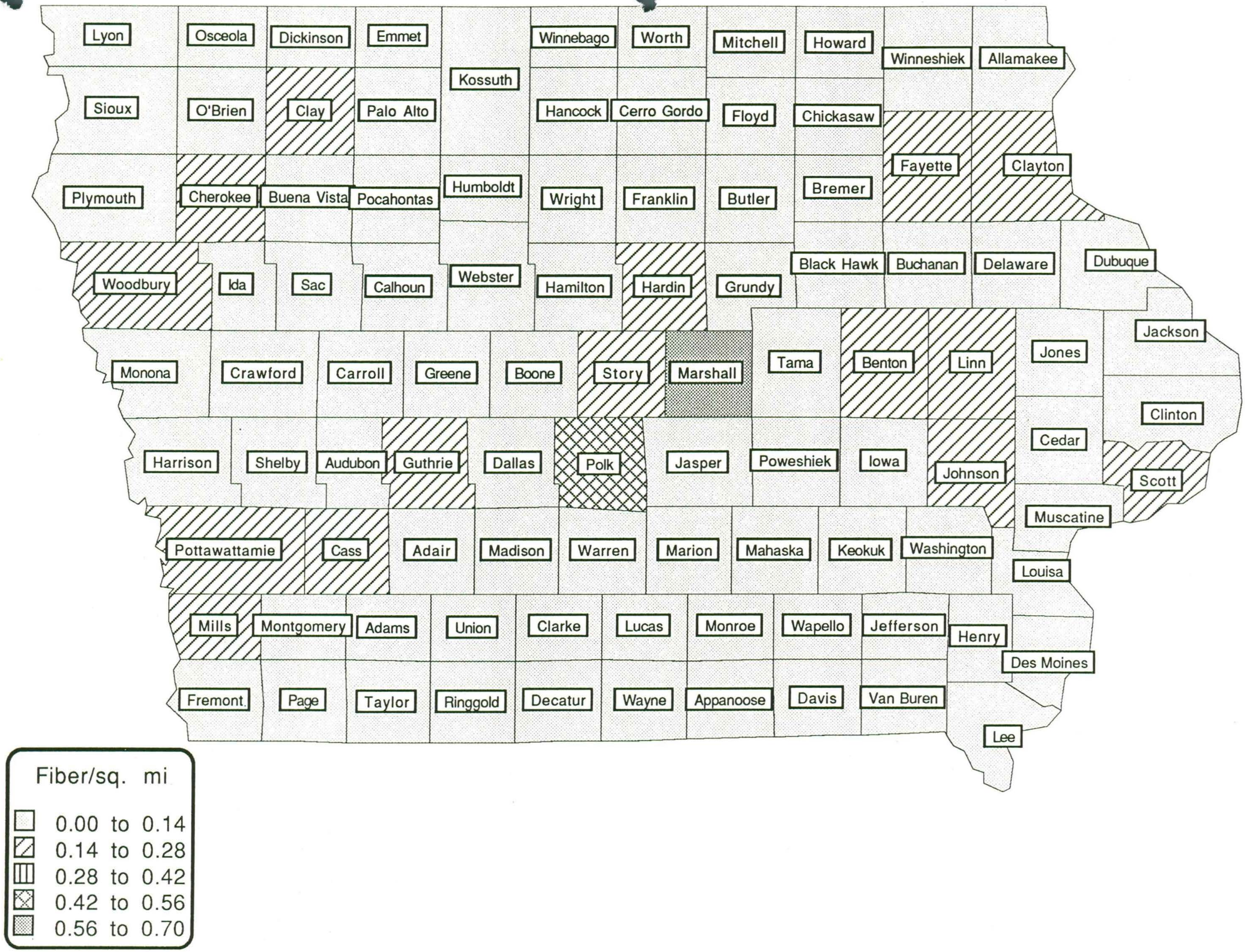
Multi Party Lines/Population (000)
0.00 to 19.04
19.04 to 38.08
38.08 to 57.12
57.12 to 76.16
76.16 to 95.20

Fiber/Square Mile:

This map reports, on a per-county basis, the total number of miles of fiber laid in each county as a function of the total area of the county.

Information about the number of miles of fiber was obtained from the reports filed for the year ending 1991 by all the telecommunication companies with the Iowa Utilities Board.

County area statistics for 1990 were provided by the State of Iowa.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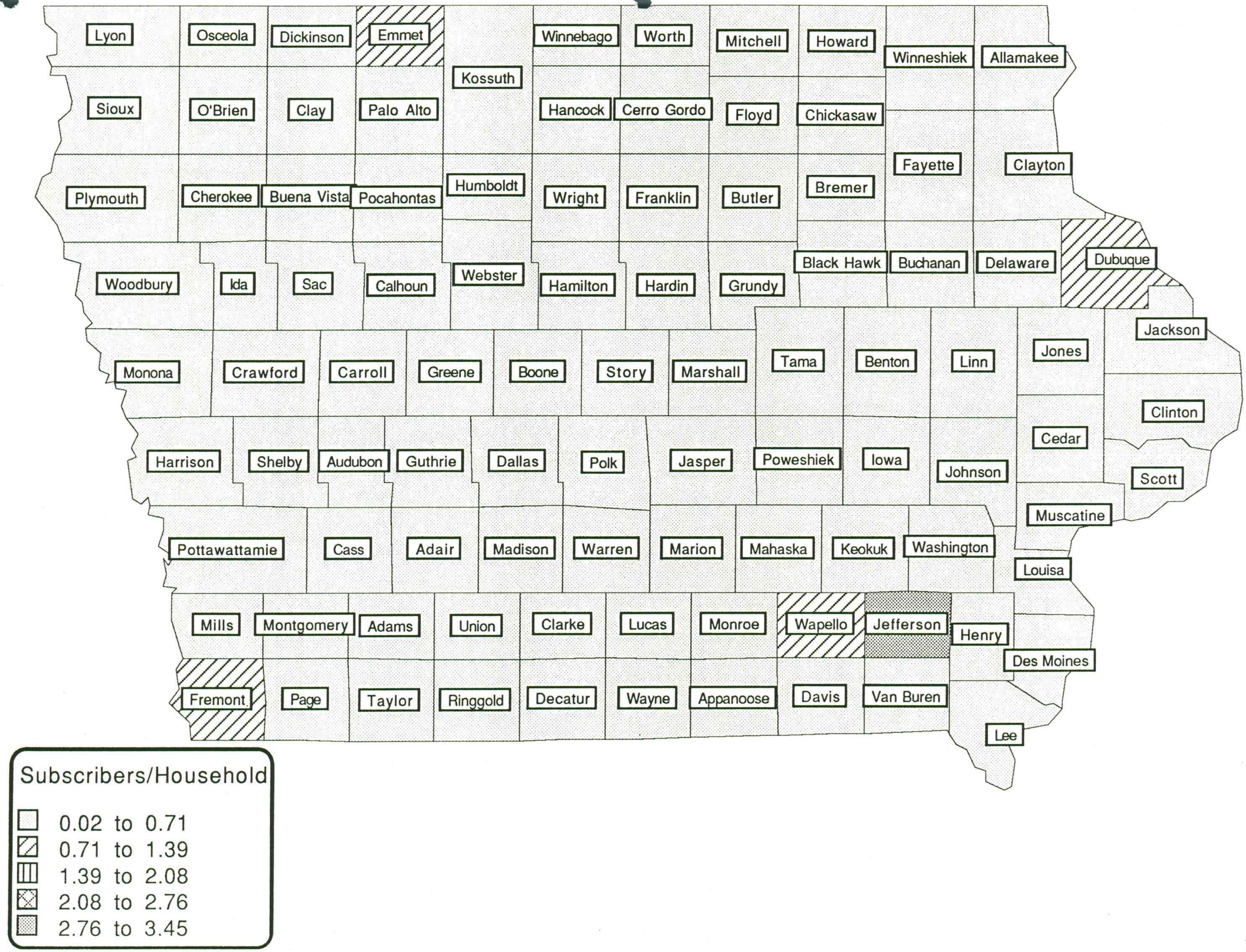
Fiber/sq. mi
0.00 to 0.14
0.14 to 0.28
0.28 to 0.42
0.42 to 0.56
0.56 to 0.70

Subscribers/Household:

This map reports, on a per-county basis, the ratio of total number of Cable TV subscribers to the number of households.

Information about the number of cable-TV subscribers was obtained from the FACTBOOK - Cable and Services 1990/91.

Household statistics for 1990 were provided by the State of Iowa.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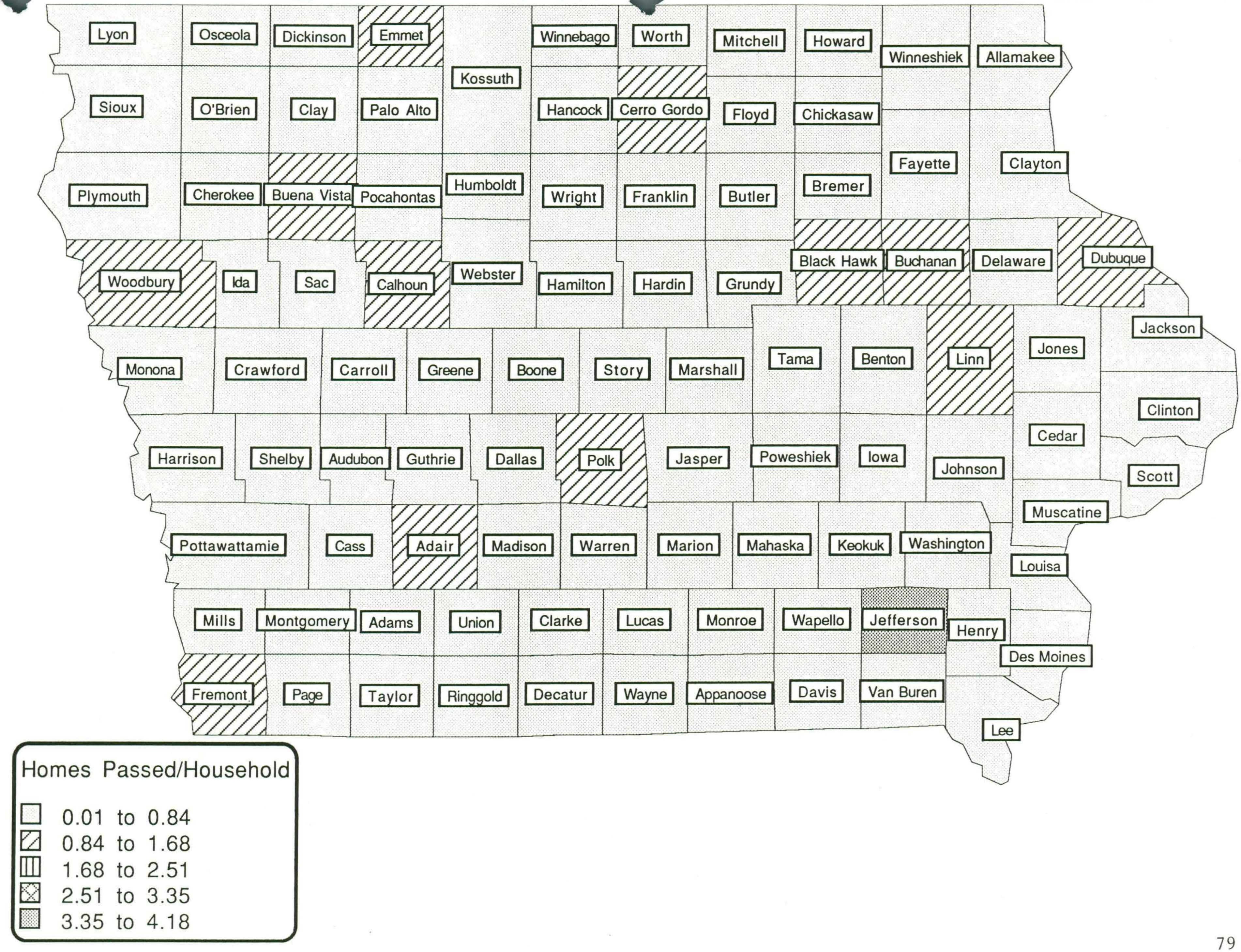
Subscribers/Household
0.02 to 0.71
0.71 to 1.39
1.39 to 2.08
2.08 to 2.76
2.76 to 3.45

Homes Passed/Household:

This map reports, on a per-county basis, the ratio of total number of households with access to Cable TV to the total number of households.

Information about the number of cable-TV subscribers was obtained from the FACTBOOK - Cable and Services 1990/91.

Household statistics for 1990 were provided by the State of Iowa.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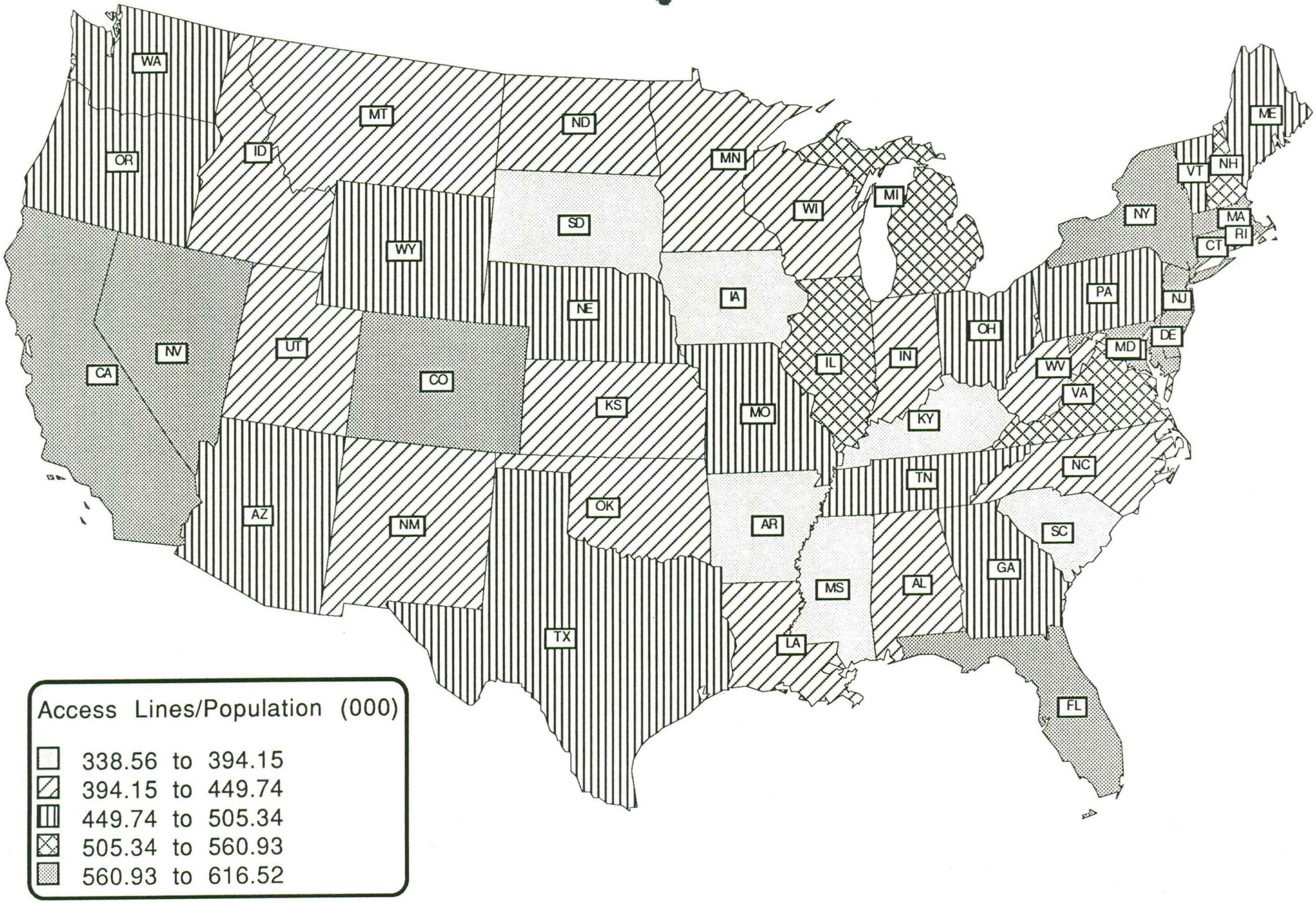
Homes Passed/Household
0.01 to 0.84
0.84 to 1.68
1.68 to 2.51
2.51 to 3.35
3.35 to 4.18

Access Lines/Population (000) - USA:

This map reports, on a per-state basis, the ratio of total number of telephone lines available in relation to the total population.

Information about the number of telephone access lines was obtained from the "Statistics of Common Carriers" 1990/91 edition, a Federal Communications Commission publication.

State population statistics for 1990 were obtained from US Bureau of Census reports.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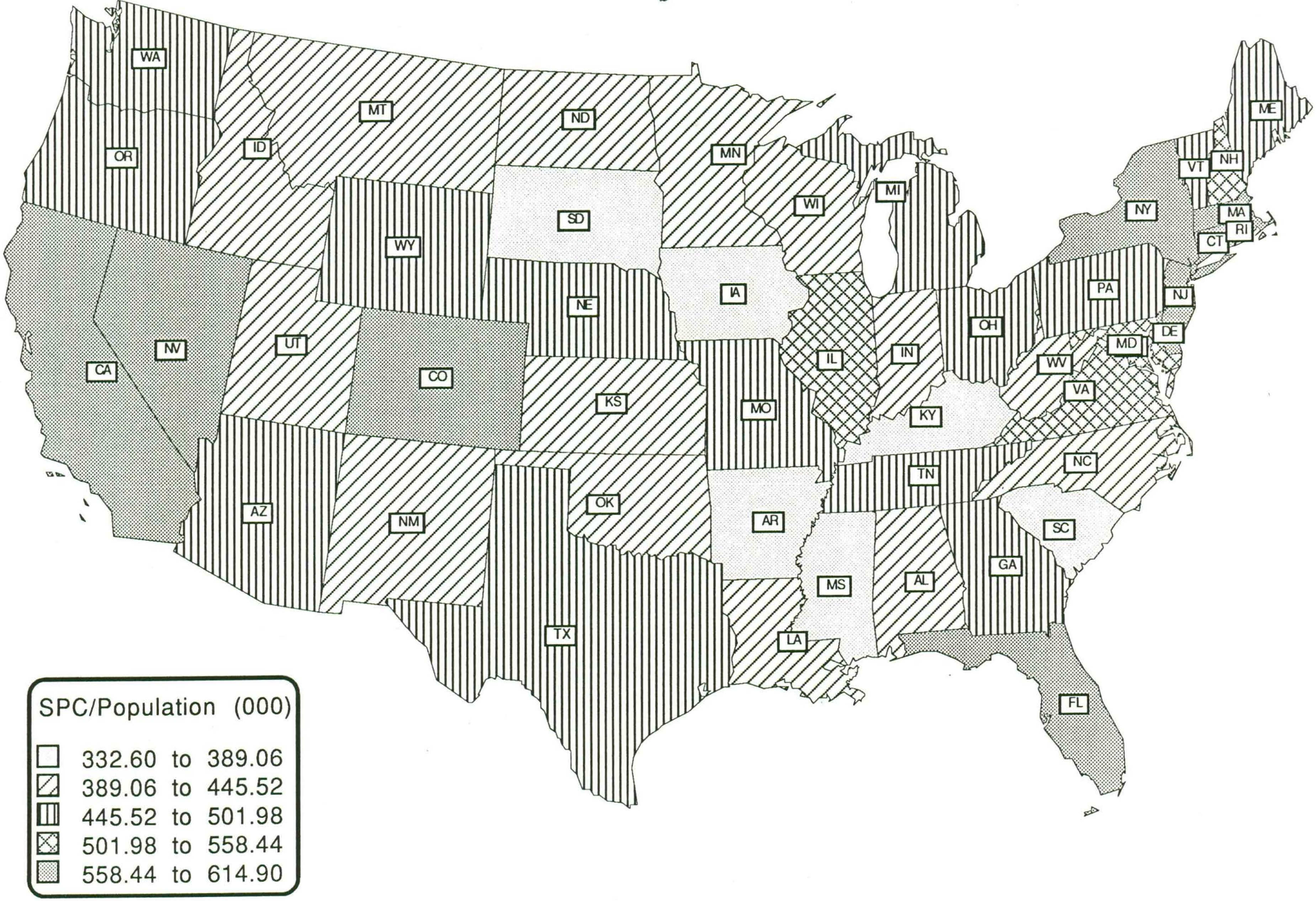
Access Lines/Population (000)
338.56 to 394.15
394.15 to 449.74
449.74 to 505.34
505.34 to 560.93
560.93 to 616.52

SPC Lines/Population (000) - USA:

This map reports, on a per-state basis, the ratio of total number of telephone lines served by stored program controlled (analog + digital) switches available in relation to the total population.

Information about the number of analog and digital telephone lines was obtained from the "Statistics of Common Carriers" 1990/91 edition, a Federal Communications Commission publication.

State population statistics for 1990 were obtained from US Bureau of Census reports.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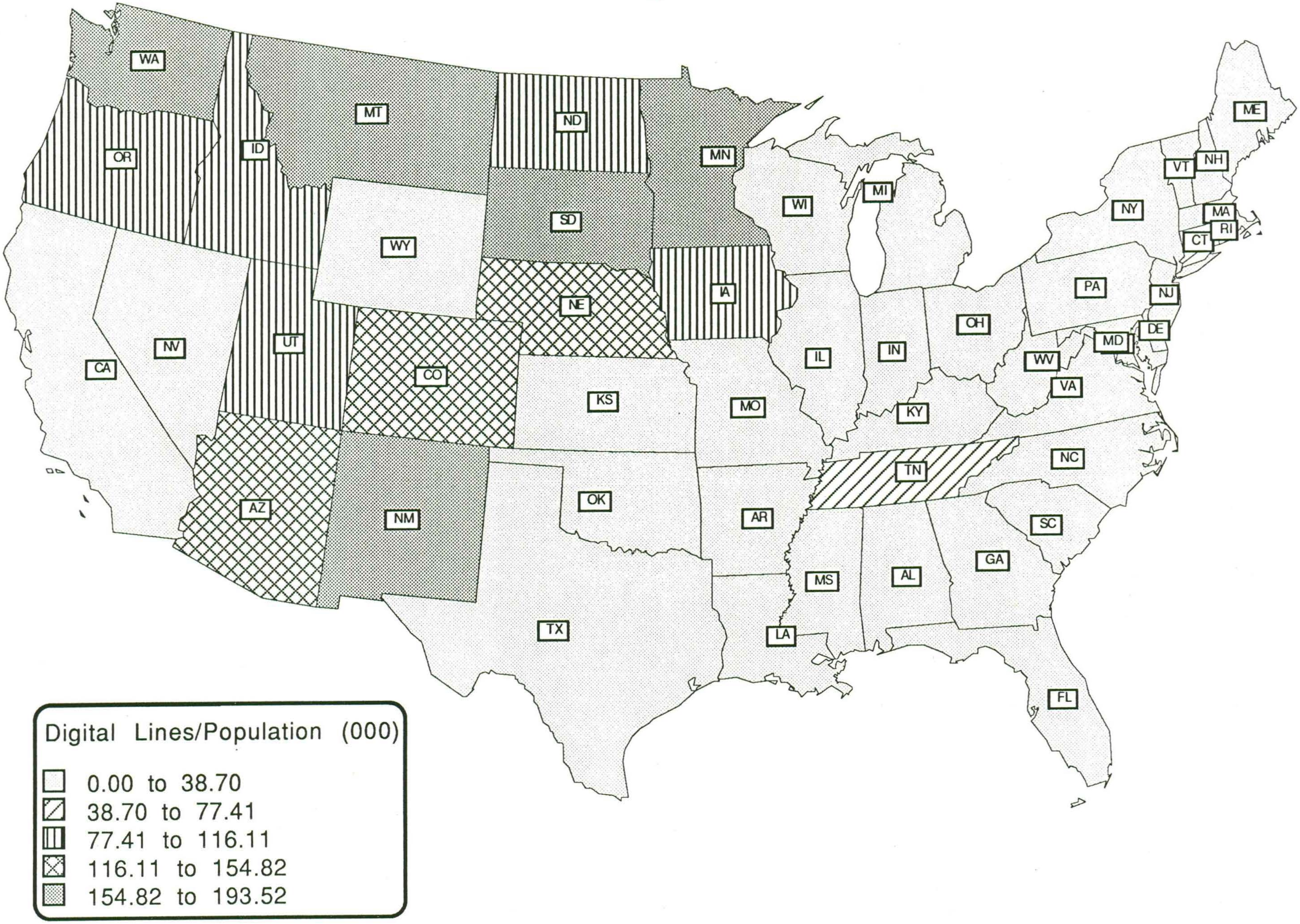
SPC/Population (000)
332.60 to 389.06
389.06 to 445.52
445.52 to 501.98
501.98 to 558.44
558.44 to 614.90

Digital Lines/Population (000) - USA:

This map reports, on a per-state basis, the ratio of total number of telephone lines served by digital switches available in relation to the total population.

Information about the number of analog and digital telephone lines was obtained from the "Statistics of Common Carriers" 1990/91 edition, a Federal Communications Commission publication.

State population statistics for 1990 were obtained from US Bureau of Census reports.



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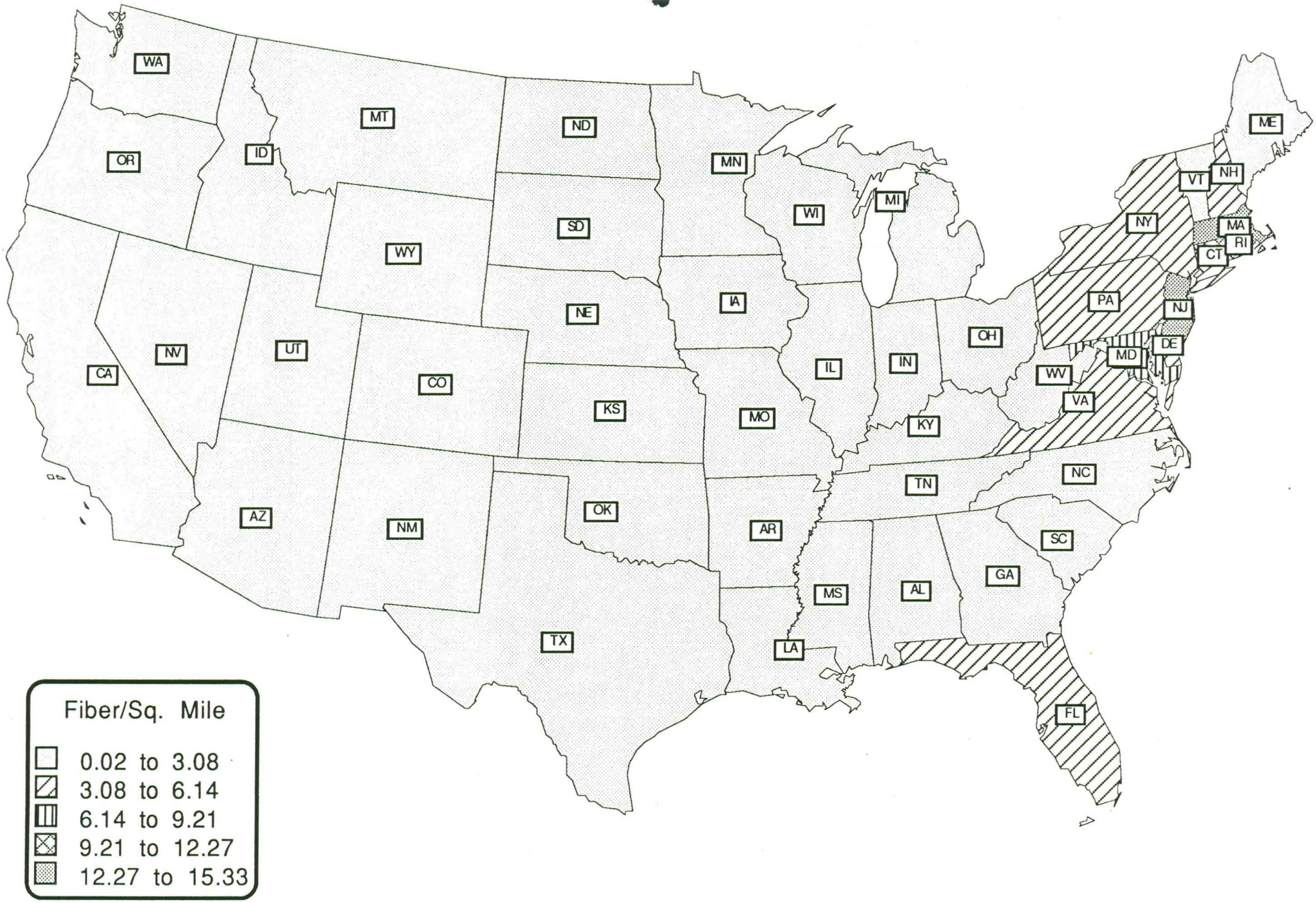
RI
MA
VT
NH
ME
Digital Lines/Population (000)
0.00 to 38.70
38.70 to 77.41
77.41 to 116.11
116.11 to 154.82
154.82 to 193.52

Fiber/Sq. Mi (USA):

This map reports, on a per-state basis, the total number of miles of fiber laid in each state as in relation to the total area of the state.

Information about the number of miles of fiber was obtained from the "Statistics of Common Carriers" 1990/91 edition, a Federal Communications Commission publication.

Area statistics for 1990 were obtained from US Bureau of Census reports.



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ME
Fiber/Sq. Mile
0.02 to 3.08
3.08 to 6.14
6.14 to 9.21
9.21 to 12.27
12.27 to 15.33

The enclosed floppy contains the file IOWADATA.WK1 a Lotus 1-2-3 spreadsheet. The data was culled from the filings of the individual companies with the Iowa Utilities Board. The data is not complete, but 90-95% of all exchanges in Iowa are currently included. Since companies do not file their subscriber data on a per county basis, the location of the exchange is used to determine the counties served. Thus, for example, the Des Moines exchange is assumed to serve only Polk county in which it is based.	

Column	Explanation
County Name	Self explanatory
Residential Lines	Total number of residential lines served by all the exchanges in the county.
Business Lines	Number of business lines served by all the exchanges in the county.
Multi-Party Lines	Number of multi-party (2, 4 or 6) lines served by all the exchanges in the county.
Analog Lines	Sum of the total number of lines available on all the analog exchanges in the county.
Lines Used	Of the available lines, number of lines used to provide business+residential services.
Digital Lines	Sum of the total number of lines available on all the digital switches in the county.
Digital Used	Of the available lines on digital switches, number of lines used to provide business+residential services.
E-M Lines	Sum of the total number of lines available on all the electro-mechanical (Cross Bar, Step etc.) switches in the county.
E-M Used	Of the available lines on electro-mechanical switches, number of lines used to provide business+residential services.
Fiber Miles	Number of miles of fiber (aerial + buried) laid by all the companies, as reported on a per-county basis.
Other Miles	Number of miles of copper cable laid by all the companies, as reported by the companies.

APPENDIX A

Appendix A
Economic Development Progress Report

This Appendix presents findings from interviews and six focus groups held with representatives of economic development organizations, businesses, farmers, schools and hospitals that were held in Iowa during the week of June 8 (see enclosed Tables).

These are not our conclusions but rather a summary statement of what we have learned thus far.

The objective of these meetings was to identify the prevailing trends of economic development, how these trends are perceived by different groups in Iowa, and what role telecommunications plays in various economic development initiatives.

Discussion of the role of telecommunications in economic development, business expansion and retention and farming activities focused on two questions:

- what is the direct impact of telecommunications on business expansion and retention?
- what is the indirect impact of telecommunications on economic activities by promoting high quality education, health, and public services, and thus improving the quality of life, a crucial component of economic vitality.

Economic Development Background

The economy of Iowa will continue to grow over the next few years. The dual character of the economy is advancing. The sectors or business activities that capitalize on Iowa's indigenous resources, are critical to the future of Iowa's economy.

The key driving forces for the success (or survival in the case of small communities) include the ability to use available technology, to mobilize the educated labor force across Iowa. The superior quality of work and family life is part of this key success factor.

Telecommunications are not the highest priority for economic development; they are integral for economic advancement but are not critical to keeping a community alive, attracting new businesses, or operating a highly successful farm. The telecommunications infrastructure and existing services in Iowa are not factors that would influence in a major way businesses in their location decisions, since everyone assumes the existence of basic, (i.e., long distance phone access, fax and computer data transmission capabilities).

In the opinion of several Iowan economic development professionals, further improvement of telecommunications services to support the state's overall economic development efforts is necessary. In general, however, telecommunications resources in Iowa have been developing faster than other key elements of economic development process, and faster than users have been able to absorb.

The prevailing trends in economic diversification include:

- A higher degree of value-added agribusiness and food processing, light manufacturing, and business services;
- The growth of financial services, in particular the insurance businesses (Several insurance businesses that are headquartered in Des Moines have relocated their data processing operations to rural areas of the state.);
- The growth of other telecom-intensive industries, such as telemarketing, retail centers and distribution (four of the ten largest U.S. telemarketing companies have located in Iowa).

Agriculture remains the predominant industry in Iowa. The value-added aspects of agriculture, such as processing, and servicing are growing fast. Consolidation of farms into large units continues. At the same time, the number of small farms is growing. Within the next 15 years, a major shift toward younger age cohorts of farmers will occur.

There is a considerable inflow of professional people who previously left Iowa. They are settling down in large cities (Des Moines, Cedar Rapids, Council Bluffs), rather than in rural areas.

The process of consolidation of the rural areas (growth of some communities and dying out of others that lack aggressive leadership and the necessary attitude to survive) is a continuing phenomenon. Emphasis is being placed on a regional approach rather than community self-sufficiency concepts. This will require more quality and cost-effective communications.

Opportunities and Needs for Telecommunications Resulting from Current Economic Development Trends

<u>Agriculture</u>

Communications and telecommunications have become crucial to farming because of its growing complexity and specialization. Many farms are one-man operations that depend on communicating with the world (40% of farmers with sales below $100,000 and 50-60% of farmers with sales exceeding $100,000 subscribe to a satellite service Data Transmission Network, headquartered in Omaha).

For innovative, technology-minded farmers and niche farmers, two-way communications becomes indispensable. Without advanced telecommunication services, the innovative farmer would not be able to achieve large-scale profits. A large group of medium and small-sized farmers consider the costs of advanced telecommunications features to be an issue, and rely more on the Extension Service.

Manufacturing, Distribution and Business Services

To support the expansion of existing and retention of new industries and businesses, particularly for more rural areas and smaller towns, specific telecommunications such as direct long distance access, messaging, voice mail, dial forwarding, and computer data transmission should be available for reasonable costs.

Several interviewees stated that if a reasonably dynamic business located in a small town would benefit from advanced telecommunications technology, resulting in further expansion, such technology should be installed. (They referred to some phone companies' philosophy avoiding installation of advanced level of technology and services until "sufficient" demand exist.)

Because of its equal competitive advantages, Iowa has the potential to follow Nebraska/Omaha in establishing itself as another nation's "800" center (central time location, no accent, costs of labor), provided there is an adequate telecommunications infrastructure available for large telemarketing companies to come in rural areas in Iowa.

Quality of Life

There is a general perception of a need for advanced communications to keep the educated people in Iowa, especially in small communities.

More education is needed concerning the telecommunications infrastructure-- information on both state, county, city administration levels, as well as public service and business levels -- to educate decision makers about which capabilities and features communities already have, and how it can be used, as well as an understanding of how available services impact further economic development. (For example, the Association of School Boards is conducting a survey among its 412 district schools K-12 about telecom infrastructure availability to communicate with School Boards via fax and computer/modem. Now they send everything by third class mail and it sometimes takes six days).

There is a need for improved utilization of telecommunication capacity by the public and institutional sectors in rural counties and towns to enhance coordination, consolidation, utilization of resources, and networking. (Executive Director of the Benton Development Group is not able to hook up via modem with Des Moines state agencies -- he was able to do it in Colorado across the mountain range. It is not a problem of a phone company, he says). This would lead to improvements in service quality and cost-effectiveness.

Teleconferencing, and video and image transmission seem to be desired features by selected groups only for two purposes: to eliminate or decrease the travel time and to share the costs between users. Specifically it would be useful to:

- community schools in rural areas when there is a need to share a teacher (e.g., language teacher)
- hospitals
- medium-sized businesses

Some communities would like to see these features to enable its population to have a remote access to university education. ("Our adults are hungry to get advanced education and we can offer only community college courses.")

There is a need to overcome constraints resulting from changes in regulatory and market structure:

- Mergers of the large phone companies over the last two years have had a negative short-term impact on the users. Businesses felt constraints -- delays in new equipment installation, transferred responsibilities, closing of local service centers that used to deal with disruptions. Businesses want to see a dependable phone company.
- Some independents charge excessive fees as they are a monopoly provider/access carrier in their areas
- Existence of three or four long distance carriers prolongs time before a problem gets resolved (one company refers to another).
- When several long distance carriers operate in a small rural area, the individual carriers do not do sufficient volume to provide volume-based advantages.
- The potential for large companies to by-pass the existing telecom system by other communications, such as satellite and microwave (The largest rural retailer, for example, uses satellite to connect with its central offices in Arkansas.) puts the increased burden of funding the telecommunication infrastructure on small businesses and residents. Small and medium-sized businesses and most farmers are concerned about the costs of their telecommunications services. They are by-passing the acquisition of dedicated lines for computer data transmission ($300/month) by subscribing to an inexpensive satellite communications (DTN) for $20 monthly.

Focus Groups in Cedar Rapids and Carroll

Name	Position	Organization
FG1-Community Development		
James A. Sullivan	Business Development Representative	Iowa Electric Light and Power Company, Cedar Rapids
Richard Birrue	Executive Director	Benton Development Group, Benton
Walter C. Ferguson	Director	Cedar County Economic Development Commission, Tipton
Keith Kafer	Consultant	Kirkwood Community College, Economic Development Services, Cedar Rapids
FG2-Public Services Sector		
Michael Singer		East Central Iowa Council of Governments, Cedar Rapids
Richard Grass	Dean of Telecommunications	Kirkwood Community College, Cedar Rapids
FG3-Agriculture		
Richard L. Pankey	Director	Kirkwood Regional Economic Development Center, Cedar Rapids
Keith Chapman	Assistant Dean-Agriculture Technologies	Kirkwood Community College, Cedar Rapids
Steven J. Ovel	Executive Director	Economic Development/Government Relations, Kirkwood Community College, Cedar Rapids
John A. Halder	Program Manager	Rural and International Projects, Kirkwood Community College, Cedar Rapids
FG4-Business Sector		
C.J. Niles	Executive Director	Carroll Chamber of Commerce, Carroll
Jim Wilson		Times Herald; Development Group, Carroll
Brian Rupiper		American Home Shield
Fred Dolezel		Mid-Iowa Insurance
FG5-Public Services Sector		
Michael Johnson		City of Carroll
Kurt Jensen		Carroll School District
Roy Johnson		COG, Carroll
Paul Fricke		County Auditor Office, Carroll
FG6-Agriculture		
William K. Blunt	Assistant Marketing Manager	West Central Cooperative, Ralston
Dennis Molitor		Extension Service, Carroll
Paul Deshaw	Resident Manager	R.G. Dickinson & Co., Carroll

Interviews with Economic Development Representatives in IOWA

Name	Position	Organization
Interviews		
Philip L. Thomas	Marketing Manager	Iowa Department of Economic Development/Des Moines
Kent Sovern	Director of Legislative Services	League of Iowa Municipalities, Des Moines
Wayne Lueders	Communications	Iowa Association of School Boards, Des Moines
Keith Hefernon	Director	Iowa Farm Bureau Federation, Des Moines
Mark H. Douglas	President	Iowa Association of Business & Industry, Des Moines
Ruth Schwartz	Vice President of Education	Iowa Hospital Association, Des Moines
David Braser	State Director	National Federation of Independent Business, Des Moines

APPENDIX B

Appendix B
Regulatory/Public Policy Progress Report

We are in the process of completing the initial phase of fact gathering related to public policy and governmental regulatory issues. We have conducted 19 interviews in person and anticipate conducting at least 2 to 4 additional phone interviews. The list of persons who were interviewed in person follows:

Interviews with Regulatory Representatives in IOWA		
Name	Position	Organization
Nancy S. Boyd	Commissioner	Iowa Utilities Board
Emmit George	Commissioner	Iowa Utilities Board
John Ridgeway	Director of Marketing	Iowa Network Services
Jim Maret	Director	Consumers Advocate Office
Ron Nielson	Political Affairs Coordinator	CWA (Communications Workers of America)
Don Brown		CWA
Tom Graves	Executive V.P.	Iowa Cable Television Assoc.
Ruth Springer	General Manager	Minerva Valley Tel. Co., Inc.
Mike Anderson	Regional Director External Affairs	GTE
Kent Jerome	Secretary-Treasurer	Iowa Telephone Association
Kathleen Berry	Division Administrator	Dept. of Econ. Development
Bill McVicar	V.P. Gov. Relations	Vista (Rochester)
Wayne Alcott	V.P. Iowa	U.S. West
Ray Lawton	Executive Director	IUB
Allan Knief	Attorney	IUB
Sandra McKeefe	Tariff Specialist	IUB
Susan Allendar	General Counsel	IUB
Mark Jamieson	Telecommunication Specialist	IUB

We have also reviewed materials from the IUB and IDED and other sources describing and explaining the regulatory and public policy initiatives affecting the development of the telecommunications infrastructure and economic development in Iowa. We are in the process of gathering information from other states and the federal government that we believe will be helpful to our analysis.

Based on the information gathered thus far we believe the following issues as they relate to governmental policy and rate regulation will need further consideration:

- the carrier common line charge (access charges)
- pricing flexibility
- educational programs
- extended area service
- cost allocation
- rate deaveraging
- standards and definition of quality of service
- definition of basic service
- standards and definition of private network
- partnership between IDED and industry
- measured service
- creating a vision for telecommunication in Iowa
- interrelationships of rates charged by carriers to independents and INS
- E911 on statewide basis.

This list is not intended to be comprehensive and will probably change through the course of this study but is intended as an initial focus of the study based on interviews and reviewing materials.

Arthur D Little

Amsterdam
Brussels
Cambridge
Caracas
Copenhagen
Hong Kong
Houston
London
Los Angeles
Madrid
Mexico City
Milan
Munich
New York
Paris
Riyadh
San Francisco
São Paulo
Singapore
Taipei
Tokyo
Toronto
Washington
Wiesbaden