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IOWA COMMUNICATIONS NETWORK

✓ (Fiber optics)

DRAFT



TERRY E. BRANSTAD, GOVERNOR

DEPARTMENT OF GENERAL SERVICES
GERALD R. ANDERSON, DIRECTOR

December 10, 1991

Linda Robertson
State Law Library
State Capitol
LOCAL

Dear Sir;

The attached report is intended to bring you up to date on the plans for implementation of the Iowa Communication Network(ICN) as well as review of the key issues related to our operations.

Enclosed you will find a rather detailed *Progress Report* which briefly outlines the current status of the network and the current plans for implementation.

A *Project Overview* is included to provide you with a background on the history of the network. In addition I have included a copy of the *Ernst & Young Issue Analysis* as presented to the General Assembly as well as the relevant *legislation*.

Concluding the package are two reprints which I feel are most informative - *The Des Moines Register* article by Richard Doak and an editorial for the *Des Moines Business Record*.

We expect to begin offering ICN services just as soon as the various segments are completed and turned over to the state - some segments are expected to be in service yet this year with the network completed to all 99 counties by early 1994.

As you have additional questions please do not hesitate to contact by telephone (515) 242 - 6152.

Sincerely,

Dean Crocker, Marketing
Iowa Communications Network

IOWA STATE LAW LIBRARY
State House
Des Moines, Iowa 50319

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IOWA COMMUNICATIONS NETWORK

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IOWA COMMUNICATIONS NETWORK

• PROJECT UPDATE •

. . . Construction schedule

Construction began in late September with the goal of having the backbone (Part I & II) system ready for use in the fall of 1993. Starting across I-80, crews will begin installing the first 475 miles of fiber optic cable and repeaters before the ground freezes in 1991. Installation of the nearly 2600 miles of fiber optic cable is expected to be completed statewide in 30 to 36 months. The *preliminary* construction schedule for the state is attached.

By spring of next year, construction plans call for installation of fiber optic cable to be installed to the following Part I sites: The state universities at Ames and Iowa City, IPTV, Cedar Rapids (Area X), Ankeny (Area XI) and Council Bluffs (Area XIII). By fall 1992, the remaining twelve Part I regional centers or Community Colleges and the third state university at Cedar Falls as well as 39 Part II endpoints. In 1993 the network will be completed with connections to access points in the remainder of the counties.

. . . Network Cost

The cost of the contract for the first 10 years is \$89,527,277 included are network expenses for switching equipment (5.4%), maintenance (21.2%) and construction (73.4%). Bonds for construction and switching equipment will be issued and retired over a 20 year period using funds appropriated by the General Assembly. Last year \$5 million dollars was appropriated annually through 1996 for this purpose. In effect, this type of financing is a 'lease-purchase'.

. . . User costs

Costs to eligible user agencies will be based upon 'operating' expenses. These costs will include maintenance, bond interest, equipment to support voice and data traffic and ICN administration.

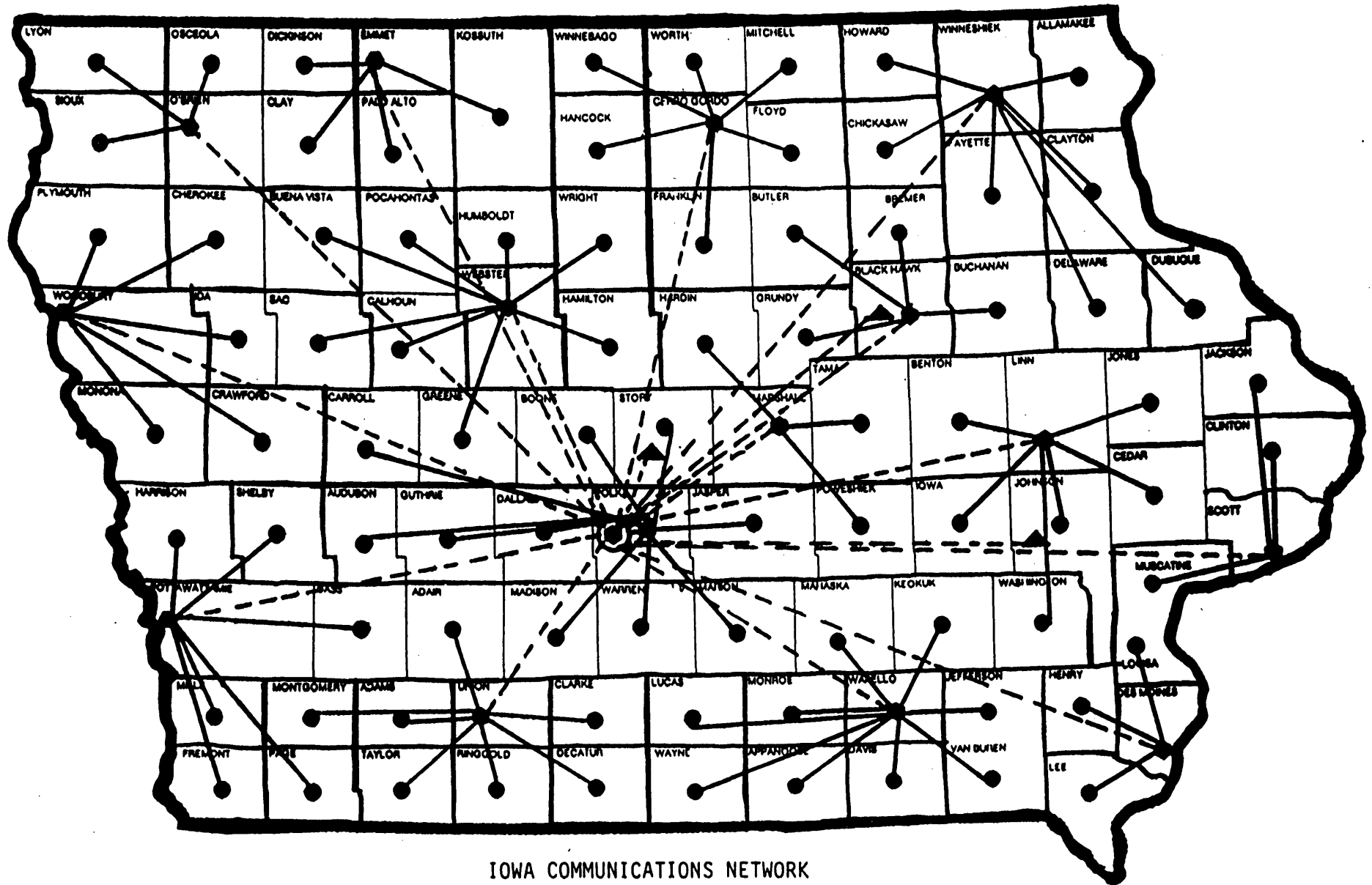
. . . Agency conversion

During the construction phase as various segments of the network are completed, state voice and data traffic will be transferred to the new system where possible. More extensive use of the system - i.e. video teleconferencing - must wait until switching equipment is installed and a temporary control center is established at Camp Dodge.

. . . ICN Control Center

A permanent ICN control center will be built as part of the State Emergency Operations Center (SEOC) and located in the new Iowa National Guard Armory to be completed at Camp Dodge by the fall of 1993.

IOWA COMMUNICATIONS NETWORK



IOWA COMMUNICATIONS NETWORK
BACKBONE

- Part I to regional hubs.
- Part II to county Point-of-Presence.
- Part III to be bid.

Today's Fiber Optic CAPACITY

Telephone Lines . . .

On a 'copper' pair	=	1 telephone call at a time
On a fiber optic pair (45 mbs)	=	672 simultaneous calls
On a fiber optic pair (2.4 gbs)	=	32,256 simultaneous calls

Video Broadcasts . . .

		<u>Classroom Grade*</u>	<u>Conference Grade**</u>
On two 'copper' pairs	=	0	1
On fiber optic pair (565 mbs)	=	12	336
On fiber optic pair (2.4 gbs)	=	48	1344

* Classroom Grade

requires two-way, full motion, full color and 45 Mbps capacity (DS3).

** Conference Grade

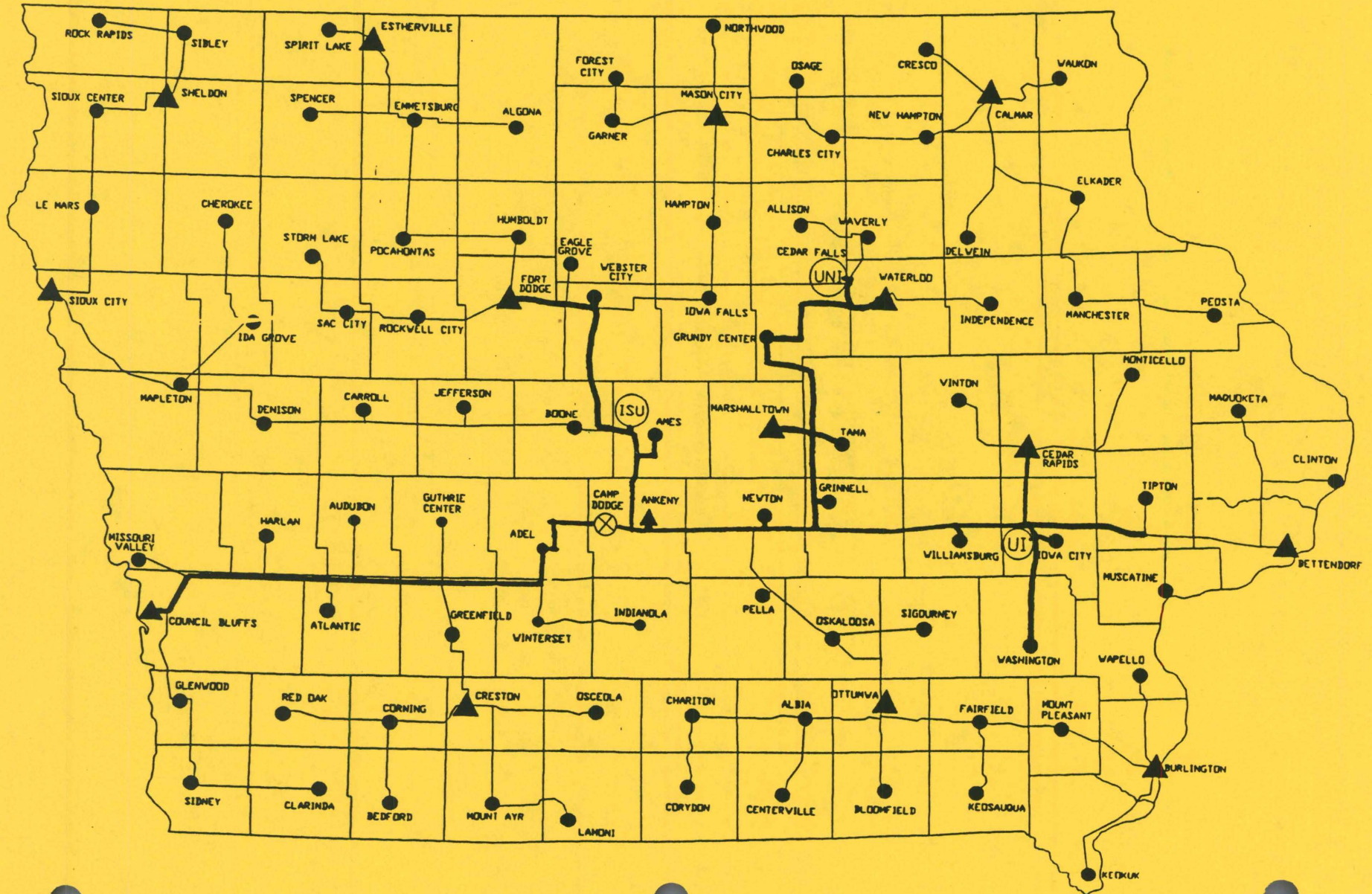
requires two-way, full motion, full color and 1.5 Mbps capacity (D1).



IOWA COMMUNICATIONS NETWORK

• *Implementation Schedule* •

IOWA COMMUNICATIONS NETWORK



ICN PROJECT SCHEDULE

Name	Scheduled Start	Scheduled Finish
I.P.T.V.	2/3/92	2/21/92
LUCAS BLDG.	2/10/92	2/28/92
I.S.U.	2/24/92	3/13/92
ADEL	3/23/92	4/10/92
ANKENY	3/16/92	4/10/92
AMES	3/30/92	4/17/92
COUNCIL BLUFFS	4/20/92	5/8/92
U. OF IOWA	4/20/92	5/8/92
CEDAR RAPIDS	4/20/92	5/15/92
WILLIAMSBURG	5/4/92	5/22/92
IOWA CITY	5/4/92	5/22/92
NEWTON	5/11/92	5/29/92
WASHINGTON	5/25/92	6/12/92
GRINNELL	6/1/92	6/19/92
MARSHALLTOWN	6/1/92	6/26/92
TAMA	6/8/92	6/26/92
FT. DODGE	6/22/92	7/17/92
HUMBOLT	6/29/92	7/17/92
WEBSTER CITY	7/6/92	7/24/92
POCAHONTAS	7/6/92	7/24/92
ESTHERVILLE	7/6/92	7/31/92
WATERLOO	7/20/92	8/7/92
U.N.I.	7/27/92	8/14/92
MASON CITY	7/20/92	8/14/92
GRUNDY CENTER	8/3/92	8/21/92
HAMPTON	8/3/92	8/21/92
GARNER	8/10/92	8/28/92
FOREST CITY	8/17/92	9/4/92
IOWA FALLS	8/24/92	9/11/92
BOONE	8/31/92	9/18/92
NORTHWOOD	9/7/92	9/25/92
CARROLL	9/7/92	9/25/92
JEFFERSON	9/14/92	10/2/92
SIOUX CITY	9/14/92	10/9/92
DENISON	9/28/92	10/16/92
CRESTON	9/28/92	10/23/92
GREENFIELD	10/12/92	10/30/92
GUTHRIE CENTER	10/19/92	11/6/92
AUDUBON	10/26/92	11/13/92
ATLANTIC	11/2/92	11/20/92
HARLAN	11/9/92	11/27/92
MISSOURI VALLEY	11/16/92	12/4/92
TIPTON	11/23/92	12/11/92
VINTON	11/30/92	12/18/92
BEDFORD	12/6/92	12/24/92
CORNING	12/15/92	1/2/93
RED OAK	12/21/92	1/8/93
WINTERSET	12/27/92	1/14/93
INDIANOLA	1/3/93	1/21/93
BETTENDORF	12/28/92	1/22/93
MUSCATINE	1/8/93	1/26/93
CLINTON	1/11/93	1/29/93
INDEPENDENCE	1/25/93	2/12/93
MAQUOKETA	1/25/93	2/12/93
WAVERLY	2/8/93	2/26/93
ALLISON	2/15/93	3/5/93
MONTICELLO	2/22/93	3/12/93
MAPLETON	3/1/93	3/19/93
ALGONA	3/8/93	3/26/93
SPENCER	3/15/93	4/2/93
EAGLE GROVE	3/22/93	4/9/93
SPIRIT LAKE	3/29/93	4/16/93
EMMETSBURG	4/5/93	4/23/93
GLENWOOD	4/12/93	4/30/93
CHARLES CITY	4/19/93	5/7/93
OSAGE	4/26/93	5/14/93
PELLA	5/3/93	5/21/93
CALMAR	5/3/93	5/28/93
NEW HAMPTON	5/17/93	6/4/93
CRESCO	5/24/93	6/11/93
ROCKWELL CITY	5/31/93	6/18/93

ICN PROJECT SCHEDULE

Name	Scheduled Start	Scheduled Finish
SIDNEY	6/7/93	6/25/93
OTTUMWA	6/7/93	7/2/93
SIGOURNEY	6/21/93	7/9/93
BURLINGTON	6/21/93	7/16/93
SAC CITY	7/5/93	7/23/93
BLOOMFIELD	7/12/93	7/30/93
ALBIA	7/19/93	8/6/93
CLARINDA	7/26/93	8/13/93
CENTERVILLE	8/2/93	8/20/93
STORM LAKE	8/9/93	8/27/93
FAIRFIELD	8/16/93	9/3/93
CAMP DODGE NODE	12/1/91	9/10/93
SHELDON	8/16/93	9/10/93
WAUKON	9/6/93	9/24/93
KEOSAUQUA	9/13/93	10/1/93
SIOUX CENTER	9/20/93	10/8/93
CHARITON	9/27/93	10/15/93
OSCEOLA	9/29/93	10/17/93
ELKADER	10/4/93	10/22/93
CORYDON	10/11/93	10/29/93
MANCHESTER	10/18/93	11/5/93
MT AYR	10/25/93	11/12/93
MT PLEASANT	11/1/93	11/19/93
WAPELLO	11/1/93	11/19/93
LEMARS	11/8/93	11/26/93
LAMONI	11/15/93	12/3/93
OSKALOOSA	11/22/93	12/10/93
OELWEIN	11/29/93	12/17/93
IDA GROVE	12/6/93	12/24/93
SIBLEY	12/13/93	12/31/93
PEOSTA	12/20/93	1/7/94
CHEROKEE	1/3/94	1/21/94
ROCK RAPIDS	1/10/94	1/28/94
KEOKUK	1/13/94	1/31/94

IOWA COMMUNICATIONS NETWORK

• *Financing* •

IOWA COMMUNICATIONS NETWORK

• FINANCING •

1. The total estimated construction cost of the project is \$85 million dollars.
 - Included are all costs related to construction of Part I (to merged area schools) and Part II (to county access points).
2. The project will be funded through a combination of state appropriations, federal grants and financing obtained by issuing certificates of participation.
 - Construction of the project is under way as of September 24, 1991.
 - Construction will be completed in phases with the entire system completed by mid-1994.
3. Financing will be completed through the issuance of 'Certificates of Participation'.
 - This amount will complete the funding of the construction of the project.
 - This amount will pay interest costs during the construction period as well as provide a 'reserve fund' required for the financing.
 - Underwriting firm is Goldman Sachs.
 - Bond Counsel is Dorsey & Whitney.
 - Financial Advisor is Fullerton & Friar, Inc.
4. We plan to repay all borrowed funds over a fifteen year period after the project is completed.
 - The financial advisor estimates that the state will be able to issue the certificates at a rate of less than 7%.
 - In addition, an estimated \$70 million will be paid in interest by the time the certificates are repaid in the year 2009.
5. The \$85 million dollars in construction cost is divided among the following components:
 - Fiber Optic Cable.
 - Electronics.
 - Construction.
6. Once operational, this system will serve the following users:
 - Educational:
 - Accredited public and nonpublic schools.
 - State Universities and private colleges eligible for tuition grants.
 - Administrative:
 - All state agencies and field offices - including the Iowa Lottery.
 - City, county and regional libraries.

IOWA COMMUNICATIONS NETWORK

• *Project Overview* •

IOWA COMMUNICATIONS NETWORK

• Project Overview •

What is the Iowa Communications Network (ICN)?

The ICN is a statewide 2600 mile fiber optic telecommunication system designed to provide voice, data and video services to public and private educational agencies as well as serve the administrative needs of state government.

What are the reasons for building the ICN?

- To cap the increase in cost to state government for voice, data and long distance communications.
- To provide the capability to increase service such as video conferencing at a nominal cost which may be able to reduce instate travel costs.
- To provide the capability to link together all Iowa educational institutions at a small fraction of the current rate for high quality distance learning.
- To provide a low-cost network for local, county, regional and state libraries to share information and services.
- To provide a dependable connection between state and county emergency operation centers.
- To provide a low-cost pathway for super computer access.

Who can use the Iowa Communications network?

The legislation creating the ICN, identifies two groups of users:

Private Agencies meaning accredited nonpublic schools and nonprofit institutions of higher education eligible for tuition grants.

Public Agencies meaning a state agency, a school corporation (public schools) as well as city, regional and county libraries.

How do you expect the network to be used?

In education, the biggest new application will be distance-learning. Elementary and secondary schools will be able to expand curriculum offerings. IPTV officials expect the universities, private colleges, area education agencies and local schools all to offer a variety of courses on the system.

Administratively, the state agencies now operate a leased communications network. Converting the state's computer data processing network of 8500 computer terminals will be a big task. Once operational, costs will be contained and new applications will be possible.

When will the ICN be completed?

We expect full use of the system on a statewide basis in the fall of 1993.

Question and Answers (continued)

How will the network operate?

The fiber optic cable connecting the capitol complex will connect each of the state universities, the 15 merged area schools and all of the 99 counties. Local telecommunications providers will then connect each user - whether it be at a lottery terminal, a state university, a library, a classroom or the field offices of a state agency.

When can we expect to use the system?

As soon as the fiber optic cable is buried in the ground and the electronics are installed to power the system. This means as a segment is completed it will become available for use by the state.

What is the implementation schedule?

In 1991, we expect to have over 300 miles of cable installed to the merged area schools in Council Bluffs, Ankeny, Cedar Rapids, Waterloo and Fort Dodge as well as the state universities in Ames, Cedar Falls, and Iowa City. During the winter months the electronics will be installed. At this point, state administrative traffic will begin to use the system.

In 1992, the remainder of the Community Colleges - which serve as the regional switching centers - will receive the fiber optic cable and electronics along with 35 high schools -the first group of 'county access points'. At this time, local schools will be able to begin sharing classes.

In 1993, the remainder of the counties will see the ICN installed.

Will other cities and towns be able to use the network?

Yes. Schools, state agency field offices, even the lottery terminals will connect to the nearest 'county access point' by way of a local telecommunications provider (i.e. the telephone company, cable TV, etc.) These providers will become active partners in delivering the ICN to the state.

What are the Benefits?

. . . for schools

The educational network will serve Iowa's fifteen community colleges, three Regents universities, and will provide access for the K-12 educational community as well as the state's independent colleges through connections or endpoints located in each county. The educational classes will be interactive, full color, full motion video giving students and the instructor the opportunity to be seen and heard at all points.

The primary opportunity for the network will be to provide "distance learning "...the capability of electronically moving the instructor to the student where he/she normally attends class, ... rather than physically moving the student. Learning opportunities will be available regardless of whether the students are in the adjacent county or across the state.

. . . for state agencies

Added benefits to state government and libraries will be in the form of efficient use of voice, data, and the addition of video teleconferencing. With shrinking budgets, fewer employees, and a growing demand for government and library services the network will provide a cost-effective tool to improve state employees' work and to help serve the public more efficiently. Just as the interstate highway system enables the delivery of raw materials to distant manufacturing locations, the network would pass information to and from state offices and libraries throughout the state, where it is more readily available and accessible to the public.

The network will be implemented utilizing the latest technology capable of providing the foundation for high capacity communication links that will connect computers and people - even the proposed supercomputers. It is anticipated the super computer digital highways needed will require the same bandwidth as an educational video signal.

As high definition television equipment becomes available in the marketplace the state is positioning itself to deliver on demand these very wideband digital signals. High definition technology will offer opportunities for instruction in medical field core subjects utilizing the concept of "distance learning". Surgical techniques, microscopic and borescopic examinations are examples of procedures of requiring high resolution detail.

High resolution graphics, computer aided design (CAD) and computer aided manufacturing (CAM) applications are also areas of interest to institutions of higher learning as well as various state agencies who are beginning to use such technologies today.

. . . emergency services

One additional benefit of this process was the opportunity to coordinate the planning and development of the ICN network with the planning and construction of the state's new Emergency Operations Center(EOC) being constructed as part of the new STARC Armory at Camp Dodge. The Federal Emergency Management Agency (FEMA) has shown support for the project because this represents the first opportunity for a state to implement an integrated plan for the 'Continuity of State Government' which coordinates emergency planning between all agencies in a building designed for this specialized purpose.

As a result, FEMA is looking at the Iowa plan as a type and model for future state emergency networks and emergency operation centers. The EOC will be housed in the basement of the new armory and will consist of the following elements: The ICN fiber optic hub, the state's backup computer site for disaster recovery, the state's backup data archival storage library, a Department of Public Safety communications facility, the National Guard emergency command and control section, and the Office of Disaster Services emergency operations section.

In the event of an emergency all of the state's primary emergency response activities: (public safety communications, national guard command and control, the Iowa Communications Network, the state's disaster recovery back up computer site, and the Office of Disaster Services), would be located under one roof in a very secure facility. This state emergency operations center (SEOC) will have the necessary support, backup power and alternate water sources to allow for extended operation under adverse conditions. FEMA has already committed \$1.7 million dollars towards the design and construction of this facility.

Question and Answers (continued)

The capability to tie all of Iowa's 99 county emergency warning and emergency operations centers together with the Office of Disaster Services is of great interest to FEMA and will make the project eligible for up to \$11,835,000 in additional matching funds should all three parts the ICN network be completed.

. . . additional benefits

Another benefit is the opportunity for the state to move existing telecommunications operations to the ICN. The state is currently spending \$5.1 million dollars for services which will be transferred to the new network when it becomes fully operational in late 1994. No estimates are available for the cost avoidance of new services such as video conferencing, or enhanced services such as image and graphic transmission, high definition television or the reduced costs for current services such as voice, facsimile transmission (FAX) etc.

IOWA COMMUNICATIONS NETWORK

• *Ernst & Young* •

Analysis of the Proposed ICN

**Presented to:
The Iowa General Assembly**

March 19, 1991

Analysis of Alternative Technologies

Issue	Are There Any Other Network Technologies That Could Provide A Superior Network?
Considerations	<ul style="list-style-type: none">• Satellite Networks Are Not Cost Effective For Two-Way Intra-State Use• Microwave Technology Is Less Cost Effective and May Not Provide Sufficient Capacity• Fiber Optic Transmission Systems Are Becoming The Dominant System Used By Carriers
Conclusion	Fiber Optic Transmission Is The Appropriate Technology For ICN

Analysis of Video Quality Issues

Issue	Is wideband video (45 Mbps) necessary to provide the educational value desired for ICN?
Considerations	<ul style="list-style-type: none">• Compressed video technology is improving steadily• All knowledgeable parties agree that compressed will not equal wideband video in the foreseeable future• All educators we consulted stated that wideband video is preferred, especially for K-12• The wideband video solution proposed by Kiewit is about twice the cost of a compressed video network over a 10 year period
Conclusion	Compressed video will not be as effective as wideband video for distance education in the foreseeable future

Conclusions And Recommendations

- **State Ownership Is Appropriate In This Case**
- **Wideband Video Appears To Be Necessary**
- **The Kiewit Proposal Represents A Good Value**
- **Revisit Key Issues Prior To Next Phase Of ICN:**
 - **Financial Analysis Period**
 - **Availability Of Services From Telephone Carriers**
 - **Phase 3 Technology Options**

Analysis of Kiewit Proposal

Issue	Does the Kiewit Proposal Represent a Complete and Reasonable Assessment of the ICN's Cost?
Considerations	<ul style="list-style-type: none">• Additional Management Costs Add a Net Present Value of \$22.5 Million To ICN• The Kiewit Financial Proposal Is Very Attractive Compared to Other Similar Networks• Potential Cost Offsets Exist That Could Amount To \$16.8 Million Plus \$5.7 Million Per Year
Conclusion	The Kiewit Proposal Provides an Excellent Value For This Type of Network

IOWA COMMUNICATIONS NETWORK

• *Current Legislation* •

DIVISION V

STATE COMMUNICATIONS

18.132 Purpose.

It is the intent of the general assembly that communications of state government be coordinated to effect maximum practical consolidation and joint use of communications services.

18.133 Definitions.

When used in this chapter, unless the context otherwise requires:

1. "*Director*" means the director of the department of general services or the director's designee.
2. "*Private Agency*" means accredited nonpublic schools and nonprofit institutions of higher education eligible for tuition grants.
3. "*Public Agency*" means a state agency, a school corporation, a city library, a regional library as provided in chapter 303B, and a county library as provided in chapter 358B.
4. "*State Communications*" refers to the transmission of voice, data, video, the written word or other visual signals by electronic means to serve the needs of state agencies but does not include communications activities of the state board of regents, radio and television facilities and other educational telecommunications systems and services including narrowcast and broadcast systems under the division of public broadcasting, department of transportation distributed data processing and mobile radio network, or law enforcement communications systems.

18.134 Powers-facilities-leases.

1. The department of general services may purchase, lease-purchase, lease, and improve property, equipment, and services for telecommunications for public and private agencies, including the broadcast and narrowcast systems, and may dispose of property and equipment when not necessary for its purposes. However, the department of general services shall not provide or resell communications services to entities other than public and private agencies. The public or private agency shall not provide communications services of the network to another entity at a cost greater than that charged to the agency pursuant to section 18.136, subsections 10 and 11. The department may arrange for joint use of available services and facilities, and may enter into leases and agreements with private and public agencies with respect to a state communications system, and public agencies are authorized to enter into leases and agreements with respect to the system for their use and operation.

Rentals and other amounts due under the agreements or leases entered into pursuant to this section by a state agency are payable from funds annually appropriated by the general assembly or from other funds legally available. Other public agencies may pay the rental costs and other amounts due under an agreement or lease from their annual budgeted funds or other funds legally available or to become available. This section comprises a complete and independent authorization and procedure for a public agency, with the approval of the department to enter into a lease or agreement and related security enhancement arrangements and this section is not a qualification of any other powers which a public agency may possess and the authorizations and powers granted under this section are not subject to the terms, requirements, or limitations of any other provisions of law.

18.134 Powers-facilities-leases. (con't)

All moneys received by the department from agreements and leases entered into pursuant to this section with private and public agencies shall be deposited in the state communications network fund. It is the intent of the general assembly that rental and other costs due under agreements and leases entered into pursuant to this section by state agencies be replaced by supplemental appropriations to the state agencies.

2. A political subdivision receiving communications services from the state as of April 1, 1986, may continue to do so but communications services shall not be provided or resold to additional political subdivisions other than a school corporation, a city library, a regional library as provided in chapter 303B, and a county library as provided in chapter 358B. The rates charged to the political subdivision shall be the same as the rates charged to state agencies.

18.135 Rules.

The director shall adopt rules relating to state communications in accordance with this chapter. The director shall also adopt and provide for standard communications procedures and policies to be used by state agencies.

18.136 State communications network.

1. Moneys in the state communications network fund are appropriated to the Iowa public broadcasting board for purposes of providing financing for the procurement, operation and maintenance of a state communications network with sufficient capacity to serve the video, data and voice requirements of state agencies and the educational telecommunications system. The state communications network consists of Part I, Part II, and Part III of the system.

2. For purposes of this section, unless the context otherwise requires:

a. "*Part I of the system*" means the communications connections between central switching and the regional switching centers for the remainder of the network.

b. "*Part II of the system*" means the communications connections between the regional switching centers and the secondary switching centers.

c. "*Part III of the system*" means the communications connection between the secondary switching centers and the agencies defined in section 18.133, subsections 3 and 4.

3. The financing for the procurement costs for the entirety of Part I of system, and the video, data, and voice capacity for state agencies for Part II and Part III of the system, shall be provided by the state. The financing for the procurement costs for Part II of the system shall be provided eighty percent from the state and twenty percent from the area schools for the areas in which Part II of the system is located. The basis for the state match is eighty percent of a single interactive video and interactive audio for Parts I and II of the system, and such data and voice capacity as is necessary. The financing for the procurement and maintenance costs for Part III of the system shall be provided eighty percent from the state and twenty percent from the local school boards of the areas which receive transmissions from the system. The local school boards may meet all or part of the match requirements of Part III of the system through a cooperative arrangement with area schools. The basis for the state match is eighty percent of a single interactive audio and one-way video for Part III of the system, and such data and voice capacity as is necessary. The local school boards and area schools may meet the match requirements for Part II and Part III of the system from funds they have already spent for their systems, from funds available in the school budget, or from funds received from other nonstate sources.

18.136 State communications network. (con't)

In the case of existing systems, in order to upgrade facilities to the specifications of the state communications network, the local school boards and area schools, in lieu of a cash match, may meet the match requirements from funds they have already spent for their systems provided that the state match does not exceed the lesser of eighty percent of the total cost of the upgraded system or eighty percent of the replacement cost of the system. The communications equipment used as a match shall not subsequently be used as a match by another educational entity for another part of the system. A local school board may request the school budget review committee to adjust the allowable growth for the school district so that the resulting increase in budget could be used for the match. A local school board may also elect not to become part of the system. Such election shall be made on an annual basis. State matching funds shall not be provided for Part III of the system until Part I and Part II of the system have been completed.

4. The department of general services shall develop the requests for proposals that are needed for a state communications network with sufficient capacity to serve the video, data, and voice requirements of state agencies and the educational telecommunications applications required by the Iowa public broadcasting board. The department shall develop a request for proposals for each of the systems that will make up the network. The department may develop a request for proposals for each definitive component of Part I, Part II, and Part III of the system or the department may provide in the request for proposals for each such system that separate contracts may be entered into for each definitive component covered by the request for proposals. The request for proposals may be for the purchase, lease-purchase, or lease of the component parts of the system, may require maintenance costs to be identified, and the resulting contract may provide for maintenance for parts of the system. The master contract may provide for electronic classrooms, satellite equipment, receiving equipment, studio and production equipment, and other associated equipment as required.

5. It is the intent of the general assembly that during the implementation of parts I and II of the system, the department of general services shall employ a consultant to report to it on the impact of changing technology on the potential cost and capabilities of the system. It is also the intent of the general assembly that the department of education shall study new techniques in distant teaching. These reports shall be made available to the general assembly.

6. Prior to the awarding of a contract under this section, the department shall notify the legislative council and the department of management of the department's intent to award a contract and of the cost to the state. The department of management and the legislative council shall determine if the anticipated financial resources of the state are adequate to fund the expenditure during the fiscal years covered by the contract, and if so, the department of management shall certify the determination to the department. Upon certification, the department may enter into contract.

7. The department of general services shall be responsible for the network system design and shall be responsible for the implementation of each component of the network as it is incorporated into the network system. The final design selected shall optimize the routing for all users in order to assure maximum utilization by all agencies of the state. Efficiencies achieved in the implementation of the network shall be used to fund further implementation and enhancement of the network, and shall be considered part of the operational cost of the network. The department shall be responsible for all management, operations, control switching, diagnostics, and maintenance functions of Part I and Part II of the systems operations, except as designated in subsection 8.

18.136 State communications network. (con't)

The performance of these duties is intended to provide optimal utilization of the facilities, and the assurance that future growth requirements will be provided for, and that sufficient network capacity will be available to meet the needs of all users. The telecommunications information management council, created by executive order of the governor, shall provide general oversight for these functions.

8. The Iowa public broadcasting board retains sole authority over the educational telecommunications applications of Part I of the system, and its authority shall include management and operational control, programming, budget, personnel, scheduling, and program switching of educational material carried by Part I of the system. The Iowa public broadcasting board, through its narrowcast system advisory committee, retains coordination authority over the educational telecommunications applications of Part II and Part III of the system. Area schools are responsible for scheduling and switching of educational materials carried by Part II and Part III of the system within their respective areas. Such responsibility may be accomplished by a chapter 28E agreement with the department of general services.

9. The procurement and maintenance of electronic equipment including, but not limited to, master receiver antenna systems, studio and production equipment, and broadcast system components shall be provided for under department of general services' contracts. The Iowa public broadcasting board and other educational entities within the state have the option to use their existing or replacement resources and agreements in the operation and maintenance of these systems.

10. In addition to the other evaluation criteria specified in the request for proposals issued pursuant to this section, the department of general services, in evaluating proposals, shall base up to two percent of the total possible points on the public benefit that can be derived from a given proposal due to the increased private telecommunications capacity available to Iowa citizens located in rural Iowa. For purposes of this subsection, an area of the state is considered rural if it is not part of a federally designated standard metropolitan statistical area.

11. The fees charged for use of the network shall be based on the ongoing operational costs of the network only.

12. The Iowa public broadcasting board, in consultation with its narrowcast system advisory committee, shall determine the fee to be charged per course or credit hour by the originating institution, and the fees shall be substantially the same for comparable courses.

13. Access to the network shall be offered on an equal basis to public and private agencies under subsection 8 if the private agency contributes an amount toward the match requirement comparable to its share of use for the part of the system in which it participates.

14. Notwithstanding chapter 476, the provision of chapter 476 shall not apply to a public utility in furnishing a telecommunications service or facility to the department of general services for the state communications network.

18.137 State communications network fund.

There is created in the office of the treasurer of state a temporary fund to be known as the state communications network fund. There is appropriated to the state communications network fund for the fiscal year beginning July 1, 1989, and ending June 30, 1990, the sum of five million dollars from the general fund of the state. There is appropriated from the general fund of the state to the state communications network fund for each fiscal year of the fiscal period beginning July 1, 1991, and ending June 30, 1996, the sum of five million dollars.

Notwithstanding section 8.33, unobligated and unencumbered moneys from the appropriation for a fiscal year remaining on June 30 of that fiscal year shall not revert to the general fund of the state but shall remain available for expenditure during the next following fiscal year. There shall also be deposited into the state communications network fund proceeds from bonds issued for purposes of projects authorized pursuant to section 18.136, matching funds received from the area schools and local school boards, funds received from leases pursuant to section 18.134, and other moneys by law credited to or designated by a person for deposit into the fund.

Notwithstanding the requirements of section 18.136, subsection 1, for the fiscal year beginning July 1, 1990, and ending June 30, 1991, thirty-one thousand dollars of moneys in the state communications network fund maybe expended for the state's share of the cost for the design of a disaster recovery facility to be built in conjunction with the Iowa Communications network facility and emergency operation center. The department of general services may increase its fees for data processing in order to collect an additional amount not exceeding two hundred thousand dollars during the fiscal year beginning July 1, 1991, to pay for the state's share of the cost of construction of the disaster recovery facility.

The Iowa public broadcasting board shall use the net increase in the federal match awarded to the Iowa public broadcasting board as a result of this appropriation in order to meet the needs of the educational telecommunications system. These funds shall be deposited in a separate account within the state communications network fund, and shall be administered by the Iowa public broadcasting board for purposes of the fund.

**Iowa Communications Network
Related Legislation**

The following sections of the Iowa Code were amended in 1990 as follows:

SF 2280 added the following new subsections:

Section 60 was added as a new subsection:

It is the intent of the general assembly that the department of general services shall not provide or resell communications services to agencies other than accredited nonpublic schools, nonprofit institutions of higher education eligible for tuition grants, state agencies, school corporations, city libraries, regional libraries as provided in chapter 303B, and county libraries as provided in chapter 358B

Section 303.79 was amended by adding the following new subsection:

11. If the narrowcast system advisory committee determines that an expansion of the number of sites utilizing distance learning would benefit the implementation of the state educational telecommunications system by demonstrating its capabilities to a greater number of individuals, the advisory committee may recommend that the board establish a demonstration program. Notwithstanding section 18.136, the board may allocate not more than one hundred thousand dollars from the state communications network fund for each of the fiscal years beginning July 1, 1990, and July 1, 1991, to be used to equip additional classrooms.

SF 2423 added the following new subsection:

Chapter 322 section 7 is amended as follows:

Notwithstanding the funding restrictions, requirements relating to the development of a request for proposal, and certification by the department of management under section 18.136, of the moneys appropriated in section 18.137, notwithstanding the certification requirement, \$600,000 may be used, if necessary, by the public broadcasting division of the department of cultural affairs, to match federal funds awarded prior to the enactment date of 1989 Iowa Acts, House File 744, for the implementation of an educational telecommunications system, and \$650,000 shall be allocated to merged area VII for use as state matching funds for federal funds applied for prior to June 5, 1989, for technology equipment. Moneys allocated to merged area VII shall be counted as part of the state match for the state communications network under section 18.136, subsection 3.

SF 2433 added the following new subsection:

To the department of defense, the sum of five hundred thousand dollars for construction of a STARC armory at Camp Dodge to house national guard units and to use the basement area to continue state government activities which include the state alternate emergency operations center, the Iowa communications network primary "HUB", and associated disaster service divisions required to maintain continuity of state government.

IOWA COMMUNICATIONS NETWORK

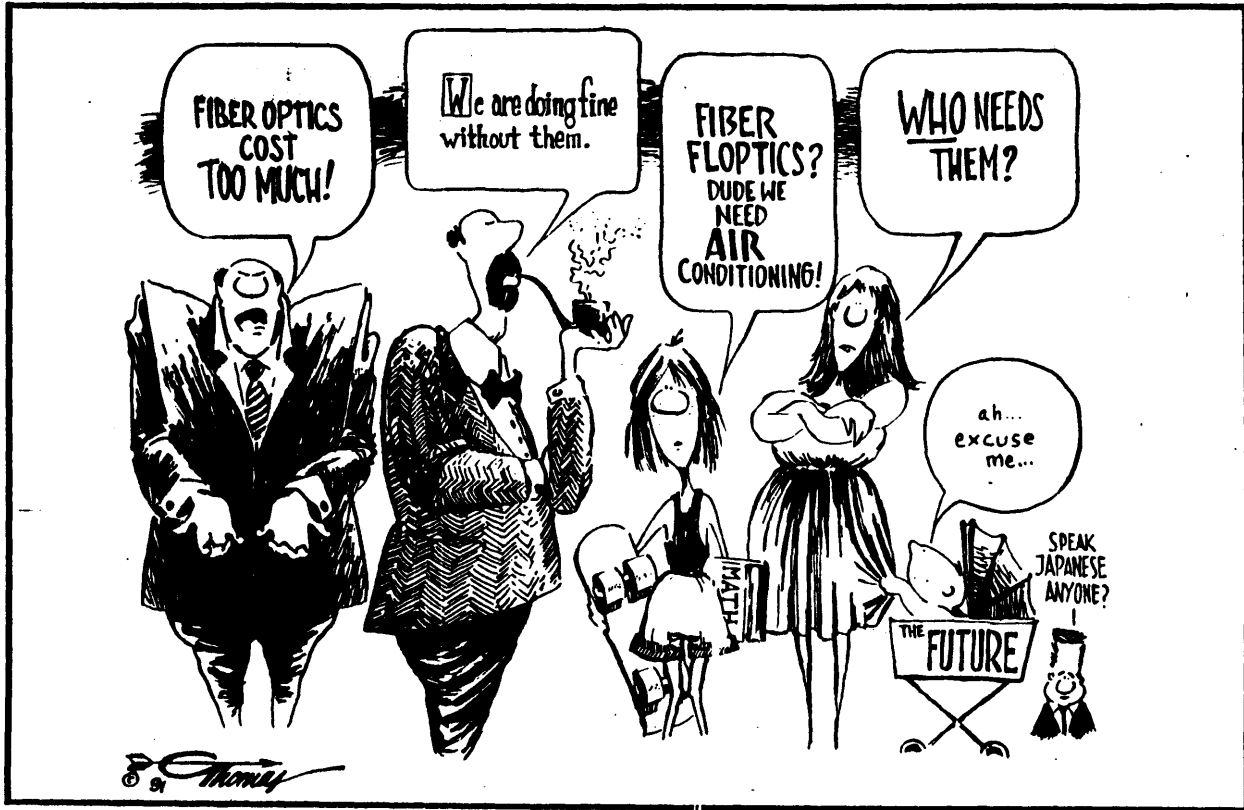
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OPINION

OCTOBER 28 - NOVEMBER 3, 1991

BUSINESS RECORD

5



ROB



Rob Dillard

That time-honored bugaboo and party killer known as "budget constraints," has reared its ugly head once again and doused a beautiful dream.

Four years after its germination as a wild idea, and just when the first trenches were being dug to enclose it, Gov. Terry Branstad's pet project, a fiber-optics network that would link the state's high schools and col-

leges, seems about to wash away.

The state's auditor, Richard Johnson, wants to call off the construction crews before they advance much further in unrolling 2,600 miles of optical fiber.

The state's treasurer, Michael Fitzgerald, doesn't seem to have the foggiest notion where to find the estimated \$300 million to complete the project, or even the \$85 million needed to get it through its first phase.

Now, one of the institutions billed as being a primary beneficiary of the high-tech communications system, Des Moines Area Community College, says it can't afford to be a part of it. The college's president, Joseph Borgen, says the school would spend more than \$400,000 next year alone for construction, classroom equipment and operations if it opted to join the network.

It's easy to understand why cash-strapped college administrators and government officials might be waffling in their enthusiasm for the Iowa Communications Network.

Budget constraints turn everyone into shortsighted monitors of the bottom line. It's impossible to dream about the futuristic magic of fiber-optic cable when you're having nightmares about laying off valued employees.

Besides, no one can fully grasp what linking the state's three universities to some 15 community colleges and eventually to 84 other sites around Iowa would mean for tomorrow's students and educators.

How would those strands of glass fiber stretching for hundreds of miles to the far corners of Iowa catapult the state to most-admired status in the areas of education and economic development?

Supporters of the network tell us that crucial information would be transmitted along the optical cable at the rate of 500 million bits per second. Imagine a classroom of students in Red Oak obtaining resource material from the University of Iowa in the blink of an eye.

It's a scenario worth pondering, but such meditation gets cut short if that classroom's air conditioning has gone on the blink. How is it possible to contemplate the future when the

present is so uncomfortable? So, budget priorities get shifted in order to start the air blowing again, and suddenly, no piece of information seems important enough that it needs to reach the students at the speed of light.

Those starry-eyed optimists who want to throw caution and money worries to the wind, and continue construction of the Iowa Communications Network point to how it would arm the state's teachers for the challenges of preparing Iowa's young people for the 21st century.

It is message, however, apparently hasn't been communicated effectively to the teachers themselves. Last spring, their organization, the Iowa State Education Association, concluded that Iowa's teachers needed to catch up with today's telecommunications technology before they started daydreaming about tomorrow's.

What teachers need, the association reported, are a few more basic desk-top computers and some telephones that work, not some futuristic, abstract fiber-optics network. "The politics of technology should not be permitted to control decisions about the use of technology," ISEA leaders wrote in their report to the Legislature.

At the same time, some teachers admit that they know nothing more about the capabilities of the network than what they have read in the newspapers. Which means they know absolutely nothing about the Iowa Communication Network's potential because none of us do. All they've read is that it's a sacred project for Branstad, one that he's not willing to abandon despite the state's budget woes.

Just because we all have a rather fuzzy vision of what the fiber-optics network would do and how it would benefit the state doesn't mean the project should be dropped. Especially since Kiewit Network Technologies of Omaha already has begun to honor the \$73 million contract the state awarded it to install the first phase.

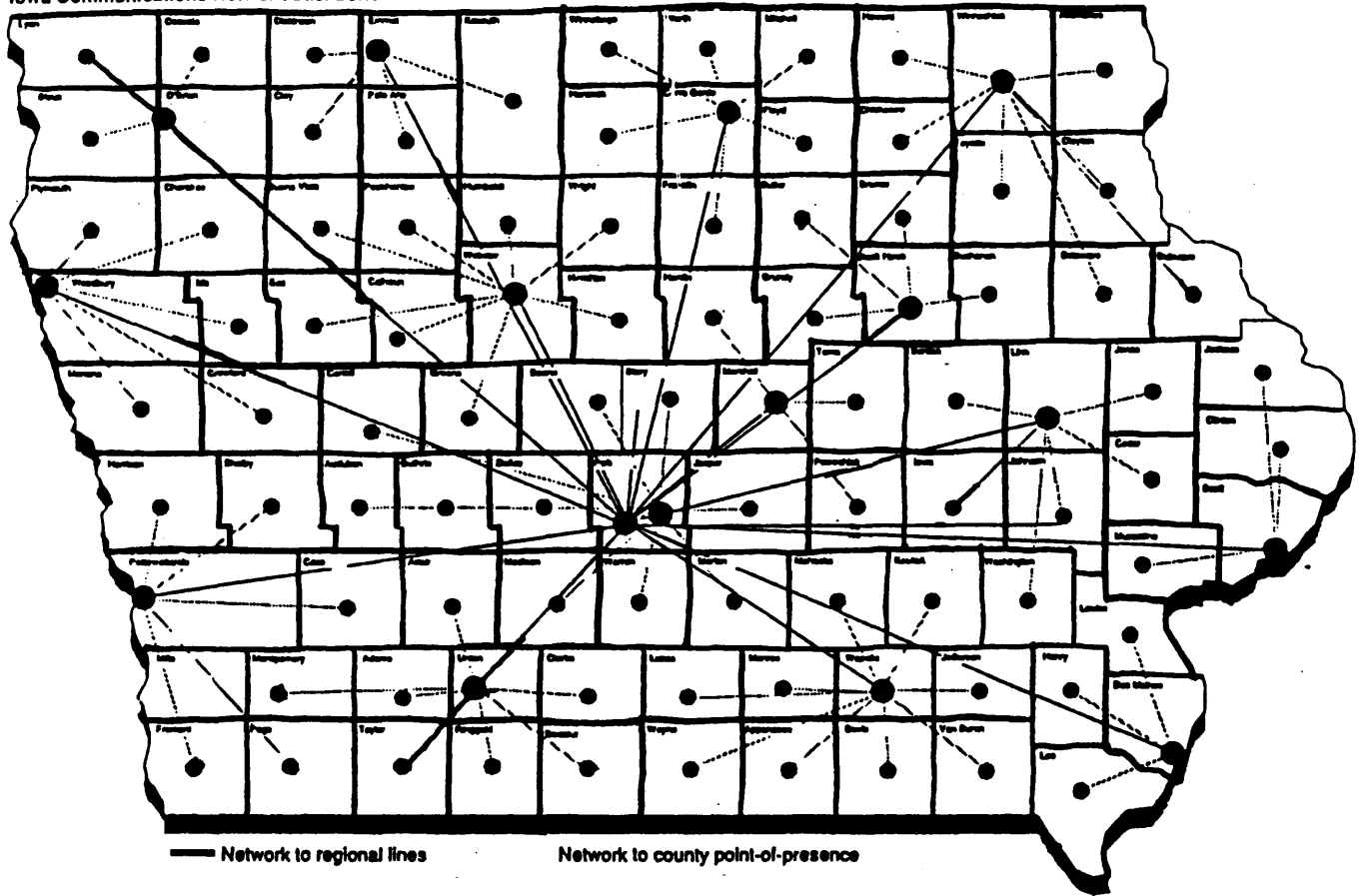
It would be supernatural for someone to have a clear vision of where telecommunications technology is leading us. Twenty-five years ago, when I was sitting at my manual typewriter in an eighth-grade typing class, my pinkies refusing all entreaties to get involved in the lesson, no one hinted that today I would be in front of a computer screen, my words no longer typed, but rather processed.

To boldly bolt into the future requires a leap of faith. The Japanese, undoubtedly the world's most successful visionaries, have decided to take this leap with a boost from fiber optics. The Japanese government has allocated \$200 billion to install a fiber-optics network in Japan.

Iowa has an opportunity to demonstrate that it, too, is a bold visionary. This is a time for long-term investment in the state, not short-term penny-pinching. The latest news indicates that school enrollments are up because young families seem to be moving back to or staying in Iowa. Let's make sure that 20 years from now they don't regret that decision. ■

Iowa Communications Network backbone

The Register



This is a schematic illustration of the proposed fiber-optic backbone of a state communications network. The network would originate near Des Moines, go to the 15 area community colleges, then branch out to at least one location in each county.

What is the road to Iowa's future?

'Information superhighways' can keep state in the main flow of progress

By RICHARD DOAK



Iowa used to be notorious for mud roads in which a Model T Ford could sink down to its hubs. In a wet spring, farm families were stranded. Sometimes entire communities were cut off from the outside world. Thus isolated, Iowa was in danger of becoming a rustic backwater. But that didn't

happen. Under the slogan "Get Iowa Out of the Mud," the state spent decades paving highways and farm-to-market roads.

Iowans pulled themselves out of the mud, symbolically and literally. Iowa connected itself with the world.

Now a number of Iowans are wondering whether the time hasn't come for an updated version of that campaign — a new effort to keep Iowa in the main flow of progress.

A new campaign, though, wouldn't be as simple as paving roads. It would involve, among other things, burying cables that encase hair-thin strands of pure glass through which lasers would send endless streams of digital pulses.

Fiber-optic cables, plus other emerging communications technologies, will form the highways of the future — superhighways of information that are expected to change the way Americans live. (See the accompanying article for some possible examples).

The building of information superhighways sometimes is compared to the building of the railroads during the 19th century or the Interstate highways in the 20th. It may mean a watershed economic change.

If that is so, what should Iowa be doing?

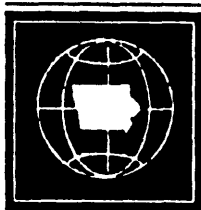
Some Iowans are working for creation of a state fiber-optic network they believe will help put this state in a position to be among the first to reap the benefits of the new communications age.

They even propose a new slogan: "Iowa — in touch with the world."

Others share the sentiment of the slogan, but disagree strongly with the method.

The disagreement is likely to become one of the most fierce debates in this year's Legislature.

Richard Doak is deputy editor of the editorial pages.



Iowa: In touch with the world

ture — a debate as fundamental to Iowa's future as any in a long time.

In the forefront

Iowans involved in telecommunications who were interviewed for this article seemed generally to agree that it is important for this state to be in the forefront of communications technology. As Dennis Nagel, chairman of the Iowa Utilities Board, put it, "We're not blessed with the advantages that some states have, like climate and natural resources, so we don't get the development that some other states get almost by default."

But he noted that Iowa does have some strong points, such as its educated people. "That puts us in a good position for the telecommunications-based information industries, which are likely to have strong growth."

Moreover, if telecommunications superhighways become a reality, it is possible that new businesses can thrive in rural communities. After all, with access to instantaneous communication, small Iowa towns may still be rural but they'll no longer be remote. A business in Lone Tree, Ia., could have access to a data bank in Singapore, for instance, just as easily as a business in Los Angeles could.

Getting Iowa ahead of the game on state-of-the-art telecommunications, and staying there, may be one hope for reviving some of Iowa's declining communities.

On the other hand, communities that are bypassed by modern communications superhighways will suffer in the '90s and beyond just as surely as towns that were left nowhere near an Interstate highway did in the '60s.

Many questions

Back in the days of the get-out-of-the-mud campaign, it was fairly clear what should be done and who should do it. Roads should be paved, and government should do it.

With telecommunications, the answers are not so clear. There are questions whether a fiber-optic network would be a wise investment, or whether future technological breakthroughs will make it unnecessary. And there are questions whether the state government should build a fiber network, or whether the job of telecommunications should be left to the telephone companies.

There are 161 phone companies in Iowa that provide local-exchange service. Iowa has more phone companies, by far, than any other state. Most are small companies serving small towns. The map of telephone service areas in

Iowa looks like a jigsaw puzzle with many tiny, jagged pieces.

Small-town phone service conjures the image of crank-telephones and party lines, but that's a false picture. By all accounts, most small phone companies in Iowa have done a remarkable job in providing their customers with advanced technology.

Often, the small companies have been ahead of the big companies that serve the state's larger cities. An example is in Kalona, where the board of the cooperative telephone company has discussed the possibility of stringing fiber-optic cable to all 1,575 customers within the next five years. That would be a bold move at a time when many experts aren't even sure when, or if, the average phone customer will ever have a need for the huge capacity of fiber.

Ray Marner, general manager of the Kalona company, said he believes that high-speed data transmission, high-resolution television, computer networking and other aspects of the new information age are closer than people may realize. Marner said his company's goal is to provide phone users in Kalona, Ia., with access to telecommunications services equal to any in the world.

The Kalona company long has tried to be among the first with new technology, in the belief that it benefits both the company and the community. Marner explained that his board of directors is made up of local businesspeople who have a stake in the community and are "willing to be on the cutting edge."

Kalona must be doing something right. It gained population during the last decade, bucking the trend of most Iowa small towns. Marner said there are no empty stores on its main street, and the phone cooperative has never experienced a decline in the number of customers.

Small towns need a surprising amount of telecommunications services. Retailers often need long-distance computer links to order from wholesalers and control inventory; livestock markets and feed stores need access to the latest market information; physicians need the ability to consult long distance with medical centers; banking is conducted electronically; the lottery terminal in the local convenience store is linked to a statewide network.

Marner said it is important that phone companies in small communities provide their cus-



possible threat to his ability to do that in the future — state government's proposed fiber-optic network.

If a state-owned network takes traffic away from local telephone companies, he said, the loss in revenue will undercut the companies' ability to keep their equipment up to date and serve their communities.

That perceived threat is one of the arguments against the proposed Iowa Communications Network, whose fate the Legislature will decide this session.

School links

Former state Senator Calvin Hultman said he was sitting at his kitchen table in Red Oak one morning when he received a phone call from the county extension agent. Iowa State University was installing some satellite downlinks around the state, and Hultman was asked for support in getting one for Red Oak.

Hultman recalls thinking that if it were possible to bring extension services to Red Oak via satellite downlink, why wouldn't it be possible to do even more. "It's very hard to build a university in Red Oak, Ia.," said Hultman, "so why not bring the university to Red Oak through telecommunications?"

The then-Republican leader of the Senate wasn't alone in thinking about the possibilities of telecommunications in education. Indeed, some efforts were under way, notably at Kirkwood Community College in Cedar Rapids, which was becoming a pioneer in "distance learning."

Modern distance learning is a far cry from the old instructional television that essentially amounted to broadcasting TV lectures to a passive audience. Today's educational telecommunication is "two-way interactive."

That means students in a remote classroom not only see and hear the instructor over a television monitor, they can also ask questions and engage in discussion.

Some systems have two-way audio connections and one-way video. Better systems have both video and audio two-way, so the instructor can see the students as well as hear them. In the best systems, the two-way video is in big-screen color with high picture quality.

The capacity and quality of fiber-optic transmission makes it especially well suited for two-way interactive hookups, but there are other technologies.

Kirkwood uses two-way microwave "Telelinks" between the main campus in Cedar Rapids and remote classrooms in Vinton, Williamsburg, Washington, Iowa City, Tipton, Monticello and Anamosa.

Kirkwood can originate or receive classes from any of the locations.

Linda Schatz, director of narrowcast telecommunications with Iowa Public Television in Johnston, is hoping that the kind of things Kirkwood is doing in eastern Iowa, and more, soon can be done statewide.

"It's amazing to go out and see what's happening," she said. Working people in towns a long way from a community college, for instance, are upgrading their education without having to travel. "It provides an opportunity in a local area that they just wouldn't have gotten any other way."

telecommunications network, it might be possible, for instance, for a "class" in high-school Russian to consist of two students in Red Oak, three in Keokuk, one in Decorah, one in Sioux Center, three in Cherokee, five in Marshalltown, all in two-way audio-visual contact with the teacher in Iowa City. With fiber optics, it is possible in theory for hundreds of such classes to be conducted simultaneously throughout Iowa during any given school day. Classes could originate in any school in the state and be shared with any number of other schools.

One hope for an educational network is that it will be a way for students in small-town school districts to take classes in foreign languages, sciences, advanced math and otherwise have access to as many course offerings as students in large schools.

In addition to transmitting grade- and high-school classes, an educational network might become a means for universities to offer post-graduate work to remote locations, for professionals to receive their continuing education, for research supercomputers at the universities to be linked.

Hultman became a prime mover of the idea of a statewide educational telecommunications network and succeeded in getting authorizing legislation in 1987. The backbone of the system was to be a fiber-optic network centered at Iowa Public Television near Des Moines. A legal challenge to the bidding, however, prevented the letting of a contract, and there were other obstacles.

The project was stalled, but during the wait its potential grew broader.

A wide mission

The mission of the proposed state fiber network now has been widened to include other telecommunications needs of the state, not just education.

"It's the most exciting project I've been involved with in 40 years in state government," said Glen Anderson Jr., director of communications in the state Department of General Services.

The state of Iowa now spends about \$5 million a year leasing phone lines for various communications needs, ranging from the state lottery to the National Guard to the far-flung operations of the Department of Transportation. There are many field offices that need frequent contact with Des Moines, such as welfare and Job Service offices.

The thinking is to meet those needs through the state's own fiber network, but that would be only a beginning as Anderson sees it.

He sees the possibility of setting up remote terminals at truck plazas where truckers entering Iowa could obtain the necessary permits, and pay for them electronically. Maybe hunting and fishing licenses could be issued through terminals, not much different from lotto terminals.

There are great possibilities in linking all of the state's libraries and maybe the county courthouses. "State government and subdivisions spend one heck of a lot of money transporting people for hearings," said Anderson, referring to such things as job appeals to which state hearing officers must travel. With two-way video teleconferencing, neither the hearing officer nor the parties might have to travel far from home, he suggested.

could make Iowa a national leader in telecommunications, and suggests there may be possibilities for benefits such as using telecommunications to export education.

"Iowa could become an educator to the world," he said.

As for the argument that the state network will undermine the strength of local telephone companies, Anderson contends that eventually the network will result in more traffic, not less for local phone companies. That's because local lines would be needed to link to schools, businesses, libraries, etc., with the end points of the state network.

Most of the real and theoretical uses for a fiber network, however, lie in the future. In the meantime, burying fiber-optic cables will merely provide a skeleton. The ultimate value of a network depends on how many end points there are, what equipment is attached at the end, and to what use the equipment is put.

One criticism of the proposed Iowa network is that the state may be plunging ahead with faith, without clear ideas of exactly how all that vast capacity of fiber will be put to use.

The present proposal, scaled back from an earlier version to save money, calls for a network with 105 end points, including at least one in each of the 99 counties. An earlier version had 356 end points.

The system would interconnect the 15 community colleges, three state universities, Iowa Public Television headquarters at Johnston and be capable of future expansion.

The Legislature last year appropriated \$100 million for the first phase of construction. Bids were taken in December.

The state invited proposals either for a system the state would lease from phone companies or one that the state would own outright. There were no bids for a leased arrangement and the Department of General Services was prepared to accept the bid from Kiewit Network Technologies of Omaha to construct a state-owned network for \$76.9 million.

The Legislative Council, however, requested a delay in awarding the contract until April. Opposition to the network from telephone companies has heightened, and the state's deficit woes make the network a candidate for elimination. So the project is on hold again.

But while the Legislature may wait, the revolution in telecommunications will not.

The technology that could change your life

FAX MACHINES, home video, voice mail, cellular phones, automated teller machines, electronic shopping and the like may be only primitive hints of the things to come when every home and business in the nation is fully connected to a communications superhighway.

The future is impossible to predict, but the situation might be likened to the 1880s and 1890s when cities were first being wired for electricity. At that time, about the only household use for electricity was to illuminate light bulbs. Few could have foreseen the invention of dishwashers, air conditioning, television, microwave cooking, computers and all the other gadgets that changed the way Americans live and work. All flowed from that first step of getting homes and businesses wired.

So it might be today with the rewiring of the nation for super-communication. It's hard to imagine exactly what will flow from the rewiring of America. But it's a fairly good guess that the changes will be revolutionary.

Many things will have to happen before the communications wonderland that futurists predict could actually come about, but three developments appear to be the keys.

1. FIBER TO EVERYONE: The capacity of fiber-optic cable to carry information is only beginning to be plumbed. In theory, a single strand is capable of carrying 3 million television channels, says Charles Jackson, vice president of National Economic Research Associates, of Washington, D. C. "We're in the Stone Age of using it."

Nobody wants 3 million television channels, but that capacity to move many streams of data simultaneously might be put to many other uses. Fiber optics open possibilities that are limited only by the imagination, say the experts.

Imagine fax machines that can transmit a page in full color and with vivid detail as rapidly as one of today's high-speed copy machines can print a copy.

Imagine two-way television conversations between parties anywhere in the world being as common as today's conversations over the back-yard fence.

Imagine computers on opposite ends of the continent being linked through a fiber-optic network and having their power magnified by being able to communicate between one another with almost the same speed and complexity as a computer can now process information internally.

Imagine a surgeon in Iowa City assisting an operation in Spencer via high-resolution X-rays and long-distance robotics. Imagine an Iowan traveling in Australia being able to dial into the fiber network and watch the KCCI-TV evening news from a hotel room in Sydney, or watch a Hawkeye basketball game, or read the electronic edition of The Des Moines Register.

Fiber-optic cable is widely used for long-distance phone service. Cable-television companies are switching to fiber for trunk lines. Phone service to neighborhoods and to most businesses, however, remains through copper wire, which is fine for voice and low-volume data transmission, but not for video or the high-volume of data that gadgets of the future may require.

The Nippon Telephone and Telegraph Corp. has announced a goal of having every phone customer in Japan served by fiber optics by 2015, an investment of \$126 billion. Planners estimate that when the work is completed nearly a third of Japan's gross national product will come from goods and services made possible by the fiber-optic network.

A debate rages as to whether the United States should set a similar goal, at a cost estimated upwards of \$400 billion.

G.A. Keyworth II, research director for the Hudson Institute has written, "The single most important thing the United States could do right now to promote a business climate favorable to U.S. industry is to make it practical for consumers and industry to invest in the next essential element in our economic infrastructure — and to speed the wiring of this country with a fiber-optic communications network — an electronic pipeline."

But that view is not unanimous. Some experts believe that emerging "data compression" technology will make it possible to stick with existing copper wire instead of switching whole-

sale to fiber. Other technologies, such as satellite communication, also have their partisans.

2. DIGITIZATION: The compact disc is music gone digital. Your CD player is an information processor that reproduces sound using the same digital code that computers use.

The CD is an example of "digitization." All manner of communication — music, voice, text, numbers, video, still photography, maybe someday even touch and smell — can be digitized. Then it can be sent any distance almost instantly through wires. Fiber-optic wires are especially well suited for the task.

This possibility gives rise to visions of a "one-wire" home of the future, where virtually all information flowing in or out of your home would pass through a single wire, linked to a vast fiber-optic information network.

Information now arrives in your home a variety of ways. The newspaper comes to the doorstep; magazines and letters through the mail. Radio is broadcast through the air; television is broadcast or arrives through a coaxial cable. Voice comes through the phone on a twisted pair of copper wires. Photographs are chemically processed and brought home to paste in the album. Videos come from the rental shop. Books are checked out of the library.

Conceivably, all of these things could come to your home via digital transmission through one wire linked to a fiber-optic network. Among the possibilities that have been mentioned:

A full-length movie like "Gone With the Wind" could be transmitted to you in one second, and stored in the home memory unit for viewing at your convenience. Beats fighting traffic to get to the video-rental store.

No need to go to the library, either. A two-way hookup allows you to browse through the card catalog, then check out a digitized book. The entire text of the Bible could be transmitted into your memory unit through fiber in 1/16th of a second. An encyclopedia would take half a second.

A digitized encyclopedia might not resemble today's version, however. Text could be combined with video and sound, perhaps with three-dimensional images. Look up World War II, and see it unfold before your eyes.

Still photography, too, can be digitized. Prototype digital cameras already are being used. Imagine taking snapshots of the kids, plugging the camera into the fiber network and sending the photo instantly to Grandma in Phoenix. It'll be waiting in her memory unit when she comes home from golf.

The rest of your mail could be sent and received that way, too.

3. HIGH-DEFINITION TELEVISION: High-definition television (HDTV) isn't just about sharper pictures. When it arrives, HDTV is supposed to be able to deliver a wide-screen television picture that has the vividness of a 35-mm slide, plus the stereo sound quality of a compact disc. Cost of such a television is estimated at \$4,000 to \$6,000.

It's hard to envision many families lining up to pay that kind of money to get a sharper picture of "The Simpsons," but the experts say that's not what HDTV is all about.

James W. Curlin, manager of communications and information technologies for the congressional Office of Technology Assessment, says the first uses of HDTV might not be for entertainment, but rather for research and technology — such as in computer-aided design and medical imaging.

When HDTV does arrive in the home, however, it won't simply bring a clearer picture. It will bring a clearer picture that is produced by a supercomputer.

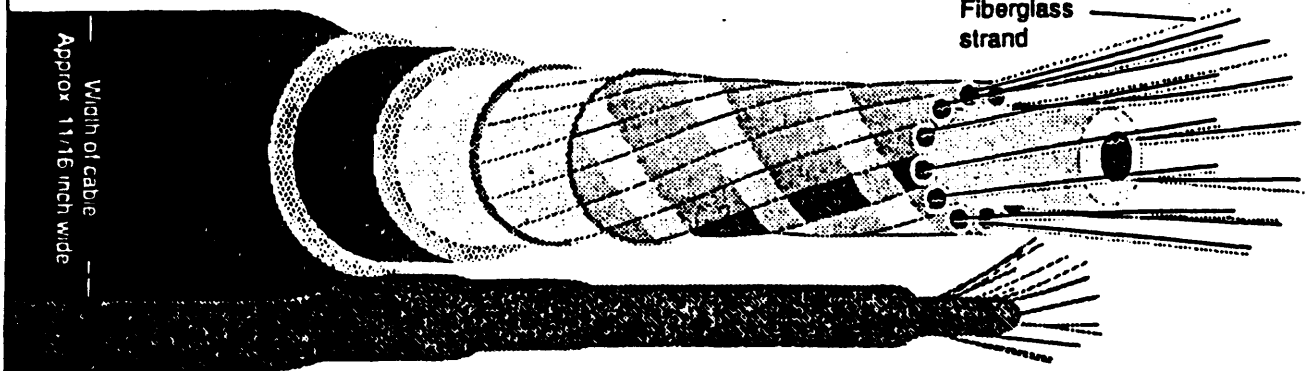
Curlin explained that the guts of an HDTV set will be a powerful computer. Any family that has an HDTV will have what amounts to a high-speed mainframe in the home — a computer that could be put to many other uses in storing and processing information besides showing television images.

"Possibly the central computer for the household is an HDTV," said Curlin.

Take that household supercomputer, combine it with a telephone, link the resulting "information appliance" to a fiber-optic network — and let the imagination soar. — Richard Doak

Fiber-optic cable

Cable similar to this would form the backbone of a proposed Iowa Communications Network. The strands of glass encased in the cable are so thin they're barely visible to the naked eye, yet are capable of carrying vast quantities of data. One pair of strands will be able to carry 632 phone calls simultaneously, according to state officials. With upgraded equipment at the terminals, each pair of strands could carry 32,000 phone conversations at once.



Some developments fiber-optics might make possible:

■ Video communications

Two-way television used for remote classroom teaching, teleconferences, perhaps to conduct hearings and court proceedings.

■ Fax machines

Facsimile transmission in full color, vivid quality and as fast as a high-speed copy machine.

■ High-definition television (HDTV)

Transmission of signals that permit a big-screen television to have a picture as sharp as a 35-mm slide and the sound quality of a compact disc.

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