Draft
Final Report and Recommendations

Nebraska Network Work Group

Nebraska Information Technology Commission

http://www.nitc.state.ne.us/nitc/network/

Prepared By The

Office of the Nebraska Information Technology Commission

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NOTE: Staff of the NITC prepared this draft report. It has not undergone formal review and adoption by the Nebraska Network Work Group. Part or all of the content is subject to corrections and other changes.

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"Our ability to move information quickly and accurately through electronic means is critical to the success of education, business, agriculture, health care, government, libraries, communities, and other areas of interest in a global society."
(Nebraska Statutes, Section 86- 512)

Executive Summary

The NITC established the Nebraska Network Work Group in February 2002 "to evaluate the feasibility of the development of a digital network and related support functions to serve education, communities, and state government that could be accomplished through a statewide consortium." Membership on the work group included representatives of higher education, K-12 schools, Education Service Units (ESUs), telehealth providers, libraries, local government, state government and the NITC Technical Panel. Agendas, minutes, and supporting material are available on the website for the work group: http://www.nitc.state.ne.us/nitc/network/.

The work group published an Interim Report dated April 30, 2002, which documented existing networks, reviewed networks in nine states, and presented a set of preliminary findings. A copy of the Interim Report is available on the work group's website.

There are 10 state agencies, plus higher education institutions, that operate nearly 30 statewide or regional networks in Nebraska. These numbers do not include many entities that operate local or campus networks within a small geographic area. In addition to these numbers, eleven regional distance education consortia provide video and data services to more than 240 high schools. More detailed information on existing networks is available on the work group's website.

Taxpayers have invested considerable money for regional and statewide networks serving state agencies, K-12 education, and post-secondary education institutions in Nebraska. A partial survey of several major entities indicates total expenditures of at least $23 million per year for data and video networks. Specific examples include:
- State agencies spend $7.2 million per year on data networks and $130,000 per year for video networks. K-12 spends approximately $6.5 million on telecommunications costs for long distance telephone, Internet service, and connectivity prior to e-rate discounts. Included in this amount is eleven regional distance education consortia spending over $4 million per year to provide video services to more than 240 high schools. The initial investment to build the distance education networks was $17.5 million of state lottery funds, plus some federal funding. The Legislature recently appropriated an additional $3 million of state lottery funds to complete the system to another 45 high schools.
- NETC spends $1.8 million per year on NEBSAT Network 2 and NEBSAT Network 3 satellite systems, which serve a wide range of educational users. (Explain user base) The primary use of these systems is course delivery by institutions of higher education.
- The University of Nebraska budgets $8,000,000 per year for voice, data, and research networks.

Because each regional or statewide network was designed to address a specific need, they insure a high level of responsiveness to their users. They also represent a broad base of technological expertise among the several entities that provide network operations and management.

Despite these important advantages, the current approach to creating networks is fragmented, costly, and sometimes inefficient.   There is little opportunity for achieving economies of scale, and establishing new regional or statewide networks is difficult, expensive and time-consuming. Ad-hoc connections serving one-time events are impractical. Completely decentralized operations also lead to very thin levels of technical support, duplication of effort, and incompatible technologies. These problems with networks and network management cause several critical shortcomings:

- Underutilization of networks;
- Less than optimum value from investments;
- Lack of interconnectivity and interoperability, especially among video networks;
- Lack of market power when negotiating for services, and
- Problems staying current with technology.

Other states have created special organizations that provide statewide networking services to educational and other entities. As part of this feasibility study, the Nebraska Network Work Group examined statewide networks in nine states. Of the nine states, three networks (North Dakota, South Dakota, Iowa) are either owned or leased and managed by the state. Three networks (Missouri, Kansas, Indiana) operate as non-profit consortia of higher education entities serving additional partners. Two networks (Colorado, Wyoming) are partnerships between a large-scale provider/manager (Qwest) and are monitored by state government. One network (Oklahoma) is a state-led partnership between state government, education entities, and local telecommunications providers.

Although no single network represents a complete model for Nebraska to follow, their activities provide examples of the types of opportunities that exist with a statewide approach. All networks provide data services, and most support synchronous video courses and video conferencing. Some provide IP (Internet Protocol) telephony services. Data services typically include Internet access, which qualifies for discounted pricing through a single access point. Some states sponsor statewide access to Internet2 for educational entities. Most use IP as the protocol for their network applications. Software running on these networks allows point-to-point connections for synchronous video courses or conferencing without the need for central intervention, and scheduling software is able to differentiate between the priority assigned to scheduled courses, ad hoc events, and impromptu desktop videoconferencing. Other types of network services in these nine states include:

- E-mail for teachers, administrators and students;
- Web hosting for schools, students, and classes;
- A statewide student information system;
- LAN consulting and other technical support;
- Directory services for authentication and security;
- Security operations.

Each of the nine states surveyed for this study has some type of network operations center – some large and some small. Most network organizations offer technical support during the workday, and some provide full 24 x 7 technical assistance. Four of the states file a statewide e-rate application for federal Universal Services Funds to subsidize the K-12 portion of trunk lines (backbone) and access charges.

The work group examined possible uses of a shared statewide network in Nebraska. Some members of the work group cited plans for providing rich content resources for teaching and learning, increasing the level of collaboration among Nebraska's K-12 and higher education communities, and creating a conduit for educators to access tools for using technology effectively in the classroom. Other representatives on the work group are implementing telehealth systems. Future state agency requirements include a health alert network, deploying a digital drivers license system, better communications for homeland security, and the Department of Roads' Intelligent Transportation System (ITS).

The business case for change in Nebraska is summed up by the need for:
- Interoperability of systems providing video courses and conferencing;
- Increased collaboration among all K-20 educational entities;
- New educational opportunities;
- Competitiveness with surrounding states;
- Greater efficiency for participating entities;
- Better utilization of public investments.

The NITC directed the Nebraska Network Work Group "to evaluate the feasibility of the development of a digital network and related support functions…." This charge suggests that a single network serving all of the needs of "education, communities, and state government." might be possible. The work group sees this as a long-term goal. Technical considerations, security needs, practical constraints and even funding restrictions may preclude a single shared network from serving all potential participants, at least initially. In particular, network managers responsible for critical applications that operate in a stable production environment are unlikely to surrender control, unless there is a guaranteed level of service and security. The sophisticated technology necessary to manage quality of service is expensive. It would also be a fiscal hardship for all existing networks to shift immediately to a single shared network, given current incompatible equipment and long-term contracts for telecommunications services.

A more rational approach, especially for the short and mid-term, is to begin sharing a network for certain types of applications or communities of interest. In particular, the education sector is furthest along in recognizing the need for greater collaboration and the benefits of a shared network that links them together. Libraries also have a mission that makes them logical participants of a shared education network. Certain education institutions, health care providers, and community promoters (who recognize the importance of access to health care) have an interest in developing telehealth networks, which may need to interconnect to other synchronous video networks. The federal government has mandated that each state create a health alert network, which may overlap with portions of a larger shared network.

A single shared network is not essential to achieving major benefits. It is enough if individual networks are managed in a way that is consistent with a statewide vision and strategy for the future. In particular, significant aggregation of bandwidth can occur, even if some networks continue to operate on circuits that are carefully segregated. Greater interoperability is also feasible, while building on existing investments.

The NITC has begun to articulate a vision and strategy for networks in Nebraska. It sponsored the initial TINA study and endorsed an effort to aggregate telecommunications purchasing and bandwidth. In February 2002, the NITC adopted the Technical Panel's recommendation for video and audio standards.

The Nebraska Network Work Group makes several recommendations to the NITC, which would expand on these past efforts. The recommendations are intended to be feasible and practical steps that recognize current fiscal realities. Some of the recommendations include:
- Adopt a vision statement that calls upon all entities to work together to achieve " an efficient, reliable, and scalable telecommunications infrastructure, widespread communications networks, and sufficient network support functions."
- Promote statewide purchasing and bandwidth aggregation of telecommunications services.
- Implement a telecommunications backbone (core routing network).
- Implement an IP-centric intranet to improve K-20 collaboration and to serve other participants.
- Determine the best option for providing interconnection of synchronous video networks.
- Decide a long-term strategy for network management and support services.

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Recommendations

Vision
1. The NITC should adopt and communicate the vision for telecommunications networks serving the state. A proposed vision statement is below:

   Government, educational institutions, public purpose entities, and the private sector should work together to insure that Nebraska has an efficient, reliable, and scalable telecommunications infrastructure, widespread communications networks and sufficient network support functions.

Statewide Purchasing and Bandwidth Aggregation
2. All state agencies, educational institutions, and political subdivisions that manage regional and statewide networks should aggregate their acquisition of telecommunications services, by using a centralized telecommunications purchasing entity. The initial focus should be on data and video services, but should not exclude cooperation on other telecommunications services, if beneficial to participants. Aggregation of demand is essential, in order to achieve competitive pricing, provide standardization, increase quality of service, and orchestrate network improvements. Initial participation in aggregation efforts should focus on those entities ready and willing to commit in the near term to a provider selection process. In the long term, broader participation will generate greater benefits for all involved. This recommendation recognizes that statutorily independent entities must be able to document advantages of participation to governing boards. These advantages include potential economies of scale, greater interoperability, and the opportunity for widespread collaboration. This recommendation proposes a relationship with the central telecommunications purchasing entity that permits solicitation of pricing by individual participants, even though all contracts should be held by the central telecommunications purchasing entity for the benefit of all.
3. The Nebraska Division of Communications (DOC) should be the central telecommunications purchasing entity for purposes of aggregating demand. The DOC is best positioned to serve this function, because it has existing statutory authority to serve all public entities and because several state-led initiatives will create opportunities for leveraging future expenditures on telecommunications.

Telecommunications Backbone Concept (Core Routing Network)
4. The Technical Panel's Network Architecture Work Group, sponsored by the Division of Communications, should design the technical requirements for a common network backbone serving all users. The first attempt, NETCOM Request For Proposal (RFP), did not result in a contract award. A revised RFP is planned. At a generic level, it will encompass core aggregation points in the state, but not to the degree as contained in the original proposal. These sites will be interconnected via high capacity links to strategically-located intelligent devices that will provide the appropriate routing, management, service levels, destination identification, and other high level telecommunications services associated with network operations. There will be other locations that will be points of aggregation, but not necessarily part of the core routing network. These sites will also not approach the number or magnitude as originally proposed. It is anticipated that with the appropriate support and encouragement, this second RFP will be distributed prior to the end of calendar year 2002.
5. The central telecommunications purchasing entity (DOC) will work with all qualified vendors (pursuant to Section 81-1120.19) to implement a core routing network in an acceptable economical manner that meets the technical design specifications.

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6. K-12 entities, higher education institutions, and other interested parties should begin planning a shared Nebraska statewide IP-centric intranet to meet existing needs and provide a scalable path for future growth. Participation should be focused initially on those operational entities that can contribute monetary or operational resources, but the design should accommodate future expansion and the potential needs of non-educational entities with closely related interests including libraries and telehealth systems. As a practical matter, the primary goal initially is to provide connectivity among all educational entities.

7. Some communities of interest may have additional requirements that are best served by network application layers that are isolated from other networks, although all would benefit from using the same core routing network (backbone). For example, a shared IP-centric intranet may not meet some of the requirements of state agencies. Operational entities for these communities of interest should collaborate in planning the technical requirements, network management, quality assurance and security needs.

Governance

8. The Technical Panel of the NITC should assume the lead role in recommending network policies, standards, and guidelines. The Technical Panel of the NITC should establish work groups as needed to facilitate coordination of different network activities. The Technical Panel should sponsor a work group to address Recommendation 12 regarding a Nebraska statewide synchronous video network.

9. Under the auspices of the NITC, an interim work group composed of stakeholders should coordinate implementation of a shared Nebraska statewide IP-centric network (Recommendation 6). The work group should include stakeholders, with some representation of the Community Council, Education Council, and State Government Council. The work group should address technical requirements, network management, quality assurance and security needs.

10. Long-term functions of the network and a mechanism for constituent input could be delivered in a variety of ways. Issues to be decided include funding strategies, pricing and services to be offered, resolving technical problems, and establishing service levels. Funding options should encourage collaborative mechanisms for multiple independent entities to use existing resources as well as other available sources. The interim work group would research the advantages and disadvantages of different models and make a detailed recommendation to the NITC.

   a. Distributed Model

   Stakeholders would divide up the tasks of running the network and applications and share responsibilities using existing staff and resources. The group would meet as needed to resolve differences and reach consensus on future service changes. Each participant in the network would deal with the purchasing entity individually.

   b. Centralized Model

   Stakeholders would designate a central entity to support the network and applications. The central entity would make decisions on behalf of the stakeholders and solicit input when needed. The central entity would be an existing state agency or educational institution and would be responsible for interacting with the purchasing entity.

   c. Cooperative Model

   Stakeholders would form a group under 501(c)3 and/or the Interlocal Cooperation Agreement Act that would be the oversight group for the management of the network and implementation of multi-jurisdictional applications. The resulting collaborative would receive oversight by a stakeholder board and have the ability to enter into purchasing agreements with application providers, purchase telecommunications services from the purchasing entity and other providers, and hire staff.

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11. Entities that operate regional or statewide networks, in addition to aggregating demand through the central telecommunications purchasing entity, should coordinate future network plans with the Technical Panel.

Possible Value-Added Services (list of options)
12. The Technical Panel, as a continued extension of its video standards activity, should establish an implementation work group to determine how to provide a Nebraska Statewide Synchronous Video Network. The network should incorporate the facilities of K-12 interactive distance learning consortia, higher education, telehealth, National Guard video network, and the Nebraska Video Conferencing Network (NVCN). The work group should include representation of the Community Council, Education Council, State Government Council and affected entities. It should define the technical requirements for interconnecting all synchronous video networks and meeting the scheduling needs of different participants. Issues to be addressed should include business case, scheduling, traffic prioritization, security, quality assurance, cost-sharing, and existing contractual arrangements of regional networks. Specific steps might include:
    a. Create a working group to continue the activities of the Video Standards Work Group to prepare an implementation plan for adherence to the new video/audio standards;
    b. Conduct informative and working sessions to determine the needs, issues, and participants regarding interoperability within and outside the state;
    c. Encourage participants to improve educational opportunities in the state via continued evolving video distance education;
    d. Identify a "core sponsor" for video distance education in the state that will be the focal point to coordinate all of the activities associated with enhancement of services and interrelationships that will be critical for continued success;
    e. Evaluate options for providing support services.
13. The Education Council should evaluate, recommend and prioritize possible value-added services that would utilize the Nebraska statewide IP-centric intranet. A list of options includes, but is not limited to:
    a. Combine Internet 1 traffic for block purchasing, as part of the aggregated purchase of telecommunications services.
    b. Offer consolidation of statewide services such as e-mail, caching servers, streaming video, active directories, intrusion detection, filtering, and disaster recovery.
    c. Offer aggregation, group purchase, and serving of electronic datasets for K-12 schools, higher education and public libraries.
    d. Coordinate application to UCAID (Internet 2) enabling all Nebraska K-12 and private/public higher education institutions to become Sponsored Education Group Participants (SEGP) for advanced Internet 2 applications.
    e. Offer a statewide e-rate application for all telecommunications services provided to K-12, libraries, and telehealth.
    f. Provide cooperative purchasing and serving of course management tools such as Blackboard or WebCT for K-12 and Higher education.
    g. Provide technical support and consulting for digital content development and synchronous/asynchronous video delivery from informal education entities such as the Homestead Monument, Edgerton Explorit Center, University of Nebraska State Museum, Henry Doorly Zoo, Ashfall Fossil Beds, Smithsonian Institution, and other locations.
    h. Provide security functions, such as directory services for authentication and authorization.

Fiscal Impact

Fiscal impact is difficult to determine because of the critical differences in performance and operational requirements among the existing networks, the wide range of options and the large number of entities affected. Some of the recommendations are still at a high level, without sufficient detail for accurate cost estimates. The organization of this fiscal impact assessment is centered on specific recommendations. Total fiscal impact depends on whether the recommendations are implemented.

- Statewide aggregation of telecommunications demand. In theory, this recommendation should allow for potential economies of scale and where applicable, future cost avoidance. The aggregation concept is not unique to Nebraska. States that have implemented similar solutions have seen cost savings as high as 20%, based on information gathered by the Telecommunications Information Needs Assessment (TINA) study. Efforts to aggregate telecommunications in Nebraska have shown mixed results in terms of realizing any savings. Another consideration is that implementing advanced technologies and establishing a network operations center have the potential to make use of any savings from aggregation.
- Purchasing processes. Administrative functions such as order taking, billing, and problem resolution may require additional staff and support costs depending upon the volume and whether the telecommunications industry provides these functions.
- Backbone (Core Routing Network). The cost of developing the core routing network will depend on bandwidth, number of core aggregation points, and other technical requirements. Until the revised NETCOM RFP is distributed and the subsequent proposals are submitted, it is not possible to estimate potential economies of scale for a statewide core infrastructure. Some extenuating circumstances affecting such a network would be: level of service; locations of core aggregation points for both the core network and the ingress sites; the number of interconnection links and bandwidth demand at the various local access points; the ability of the service provider(s) to accommodate ubiquitous access for identified participants; capability for seamless interconnections across individual companies' operating areas; the ability for a centralized entity to exercise control of and operate/manage the network while at the same time negotiate for and obtain stabilized service rates over a mutually acceptable period of time. The exact time frame for the remaining network design, development of the RFP, and the appropriate time for distribution has not been determined.
- Network Management. Capacity management, load balancing, quality assurance, network problem resolution, and other technical network support functions are activities associated with a network operations center. Currently, there are multiple centers located in various participants' locations across the state. It is desirable to suggest that a working group established under the guidance of the Technical Panel analyze and assess the needs of all of these centers and initiate activity related to the establishment of a coordinated effort involving backup procedures for emergency activation if needed. These functions may require additional staff and specialized equipment. Responses to the first NETCOM RFP provided some estimates of setting up a network operations center. The work group of the Technical Panel should develop cost estimates as it prepares different options and recommendations for a long-term solution for network support functions. A closely related issue is defining a division of labor between a central network operations center and existing entities that provide network support services. Costs of network management would be included in the rate structure for telecommunications services.
- The Education Council should analyze the fiscal impact, determine priorities, and identify funding options of possible value-added services that would benefit educational entities.

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Funding Model

A charge-back system appears to be the only feasible funding model, because it allows participants to tap the full range of potential funding sources. Under the current fiscal conditions of the state, redirecting existing expenditures on telecommunications circuits and services appears to be the most prudent source of funding to be used for implementing the core routing network. This would include all funding sources that are currently tapped for paying telecommunications bills, such as general funds, cash funds, federal grants, local tax funds, state aid amounts, and e-rate reimbursements. Users should also pay for any value-added services that are not shared by all participants. Potential cost savings or cost avoidance may occur through more aggressive volume purchasing of Internet 1 service.

Rates charged to participants must meet federal, state and local rules, regulations and statutes for cost allocation. K-12 and libraries presently qualify for e-rate discounts of about 60% through the federal Universal Service Fund. Close attention to USF regulations is essential in order for eligible entities to continue receiving this benefit.

There are several major state and federal initiatives that will stimulate overall spending on telecommunications networks in the near future. The Public Safety Wireless system, Homeland Security, the Health Alert Network, Intelligent Transportation System, and the National Guard video network are examples of projects currently being discussed or planned that will significantly increase public spending on networks. If combined with existing spending, these projects have the potential to provide the justification and possible business case for investments in equipment upgrades by private telecommunications companies.

The Nebraska Universal Service Fund (NUSF) is another potential source of funding for selected elements of network improvements that would promote the goal of universal service. The NUSF's primary goal is to maintain affordable basic telephone service for all Nebraskans. The NUSF, by statute, can only provide support to eligible telecommunications carriers. It does not currently provide direct support to schools, libraries, health care providers, or the State. It may be possible to identify certain participants or components of an overall project that would be eligible for NUSF support, based on existing statutory policy governing the eligible uses of the fund (Section 86-323). Statutory restrictions, competition for funds and regulations, and priorities of the Public Service Commission will affect the viability of this source of funding for network improvements.

In addition, there may be other federal funding sources that could be accessed. Aggregating bandwidth, having a well-defined core routing network architecture, and demonstrating collaboration and integration of regional and statewide networks should strengthen any application for federal funds. Federal funding sources that have been used in the past include USDA Rural Utilities Services and Federal Star Schools programs. The recent Elementary and Secondary Education Act (No Child Left Behind) may be another potential source of funding.

Having well developed plans for a core routing network, a statewide IP-centric Intranet, a statewide synchronous video network, or other shared regional or statewide networks, should increase the chances for tapping these external funding sources.

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Business Case

Statutory Mandate

The statutes that created the NITC mandate that "It shall be the policy of the state to:" …"(b) Stimulate the demand to encourage and enable long-term infrastructure innovation and improvement; and (c) Organize technology planning in new ways to aggregate demand, reduce costs, and create support networks." (Section 86- 524) In another section, the Legislature declared its intention for "the State of Nebraska to support the development of a unified statewide telecommunications infrastructure. The Statewide telecommunications infrastructure will be scalable, reliable, and efficient." (Section 86- 513 (2)).

The recommendations in this report will help to achieve these statutory directives.

Growing Public Investments in Networks

State government spends approximately $7.2 million per year on data and video networks. The University of Nebraska spends approximately $8 million per year on data, research, and video networks. NETC spends $1.8 million per year on the NEBSAT2 and NEBSAT3 satellite systems, which provide synchronous and broadcast video connections to higher educations. K-12 education spends over $6.5 million per year on Internet, telephone, and video services. Spending on data and video networks by local government, libraries, hospitals, and private education institutions will add to these figures.

These amounts are increasing steadily, and will continue to grow with several new state and federal initiatives. These include a Health Alert Network, Homeland Security, Public Safety Wireless System, and Intelligent Highway System. The Department of Motor Vehicles recently awarded a five-year contract for the development of a digital driver's license system. Eventually this will translate into significant bandwidth requirements when creating the images and when retrieving them for law enforcement and other purposes. The Department of Education envisions a need to interconnect existing K-12 Distance Learning Networks. The Military Department is deploying a video and data network that connects many of its facilities across the state. The University of Nebraska must increase the capacity of its networks to meet the educational requirements of its campuses. Improved statewide networking has been a priority in all NU integrated technology plans since 1996.

Current Problems

The existing approach to developing and managing communications networks across existing governmental entities falls short of the legislative mandate to aggregate demand, encourage innovation, achieve efficiency, and develop a unified and scalable telecommunications infrastructure.

Existing networks are fragmented, costly, and sometimes inefficient. There is little opportunity for achieving economies of scale. Establishing new regional or statewide networks is difficult, expensive and time-consuming, because they require n-1 long distance circuits to link all of the participating entities (where n = number of locations). Ad-hoc connections to serve a one-time event are impractical. Completely decentralized operations also lead to very thin levels of technical support, duplication of effort, and incompatible technologies. These problems with networks and network management cause several critical shortcomings:

- Underutilization of networks;
- Less than optimum value from investments;
- Lack of interconnectivity and interoperability, especially among video networks;
- Lack of market power when negotiating for services, and

- Problems staying current with technology.

In the past, state government and educational entities pursued an ad hoc approach to building networks. The need for a network would arise from a single sponsor with a specific application. Examples include the Nebraska law enforcement network connecting local sheriffs and police departments to the State Patrol's databases, the county automation network providing state applications to county offices, regional distance education consortia, the state's extensive satellite system for distance education, and the University's network connecting different campuses and county extension offices. Each application would determine the points to be connected, capacity requirements, and sometimes the technology that would be used.

The distance learning consortia are an example of the formidable barriers to creating a statewide system. The 12 distance learning consortia came into existence in the 1990's through the initiative of local school districts, which formed interlocal cooperation agreements that enabled the newly formed entities to sign long-term video service contracts with telecommunications providers. Because no state video standard existed at the time of their formation, the 12 consortia have chosen at least four different video protocols to serve interactive courses to students. Although a state video standard is now in place, there is no implementation plan to achieve interconnectivity.

Even today, most of the consortia are at a disadvantage when negotiating new contracts for services. For example, on the advice of its provider, one consortium is installing expensive "gateways" to insure interoperability within its membership, rather than choosing a cheaper alternative. Multiple contracting entities also impede achieving any economies of scale, and staggered contract terms will complicate future efforts to implement the state's video standard and achieve a statewide interoperable video system.

Expected Benefits
1. Interoperability. One of the primary goals of the Nebraska Network Work Group was to achieve statewide interoperability of synchronous video networks. This implied a system that would enable all of Nebraska's video facilities and classrooms to "talk" to one another. Currently, the interactive video facilities in Nebraska are divided among 12 separate K-12 consortia (using four different video protocols) that do some partnering with their local community colleges; the Nebraska Video Conference Network that serves over 20 sites across the state, owned by the Division of Communications and operated by Nebraska Educational Telecommunications; satellite Network 3, an interactive video system serving over 20 sites across the state with uplink/downlink capabilities; and the Nebraska Guard Network, a network of several video installations serving the larger armories in Nebraska.

   Additionally, health care institutions have several video networks for patient encounters and professional consulting. Statewide, desktop video-over-IP systems have begun to proliferate as camera/cart systems have become more affordable.

   Implementation of a Nebraska statewide synchronous video network would make it technically feasible to unite these disparate video systems into a single, interoperable system while respecting the local control of the video facilities. The benefits would be greater use of an already sizable state investment, capacity to serve new educational and health alert applications, and the ability to schedule and transmit video across the artificial geographic barriers that now exist.

2. K-20 Collaboration. By seamlessly linking data and video to all 500+ school districts with the 27 higher education institutions in the state, new educational opportunities can emerge with regard to synchronous and asynchronous distance learning, collaborative research and training activities, and digital content development. Nebraska Educational Telecommunications is helping lead a new national initiative to make educational resources available to educational institutions through terrestrial and satellite networks. A Nebraska statewide IP-centric Intranet serving K-20 educational entities also affords portal strategies and administrative computing that would not be able to take place otherwise.

3. New Educational Opportunities.
   a. Multifaceted Learning Supported. Successful teachers generally use a wide variety of approaches and materials to meet the diverse learning needs of their students. One student, for example, might come to an understanding of graphing equations by using pencil and paper to plot data points from a real-world experiment. Another might need to experiment with a computerized graphing tool, manipulating the graph's shape and observing how the accompanying equation changes. Still other students will have "aha" experiences only after watching narrated videos illustrating real-world applications of equations.   With live video broadcasts and advanced technology, supported by higher bandwidth, it would be possible for a moderator to lead a discussion with participating classes, zooming in on different classrooms so students could demonstrate their solutions for others to see.
   b. Virtual labs and classes. We don't always have enough students in any one location to hold a class, we want to simulate the language labs that can be offered on-site and make them accessible to students from many different places. Virtual labs will typically have student workstations and a console that allows the professor to send assignments to groups of students, check in on them and post any group's work for others to see. In this virtual configuration, students can be grouped with peers across the state and on other campuses, using microphones and headsets to converse together.
   c. Use of mentors and consultants. Whether students are participating in virtual classes or one-time events online, the new technology offers an unprecedented opportunity to bring outside experts to the classroom. An engineer might visit virtually and show how his or her team uses surveying tools and geometry skills on a road construction project. Or students might connect with a biology professor who demonstrates the use of an electron microscope to answer their scientific questions. Virtual collaborations of this sort can make a tremendous difference for students with special needs. Help with homework at home is also possible with this network in place.
   d. Life long learning and research. Clearly, the skills needed by students today go far beyond those measurable by conventional tests. The CEO Forum (www.ceoforum.org), consisting of CEOs and directors of 22 high-tech companies, made the following points in their 2001 Report, Key Building Blocks for Student Achievement in the 21st Century: "In the rapidly changing economy, there is a corresponding shift in the skills and abilities that students will need to thrive in the future. These twenty-first century skills include digital literacy, inventive thinking, effective communication, teamwork and the ability to create high-quality products." Next generation Internet technology can help students acquire these skills and become important contributors to a global knowledge community.
   e. Collaboration on line. Ever since the Internet reached K-12 classrooms, teachers have been finding ways to involve their students in projects that have them collaborating with peers in faraway places. Examples include "quests" in which students participate virtually in real-world expeditions, and data collection projects that involve classrooms all over the globe sharing information such as pollution readings or sightings of migrating animals. Bandwidth limitations have often caused such experiences to be asynchronous and text-based; reports are

posted at a Web site for others to access at a later time. Realistic multiple-point video, supported by high bandwidth, will make it far easier for the participants to see, hear and take part in the adventure in a realistic way. Another collaboration example comes from an Internet2 project in which musicians at many locations come together to play music as part of a virtual orchestra. (This was recently done at the University of Nebraska at Omaha.)

f. Access to services across state lines. Opportunities for aggregation and collaboration extend beyond Nebraska's borders. Participation in multi-state purchasing consortia, joining Internet 2, and access to special video classes are examples of collaboration that would extend beyond Nebraska.

4. Competitiveness. Through national educational technology and networking conferences it has been discovered that no fewer than 28 states have developed and deployed statewide networks serving data and video, and in some cases voice service. This has enabled these states' educational systems to make application for Internet 2 (high bandwidth research network), create enterprise video systems serving diverse communities of interest, and to create multi-state digital and collaborative educational opportunities for their learners. As their schools and universities are discussing future Internet Protocol (IP) dialing schemes to unite learners with educational opportunities across the globe, Nebraska is wrestling with the best way to interconnect its own local video systems.

5. Greater Efficiency. Aggregation of the bandwidth demand in strategically located core routing network sites across the state and the resulting negotiations with the provider(s) could result in beneficial economies of scale for the collaborative participants. The extent of any potential benefits (performance, availability, costs, etc.) of this deployment is not available now.

Deploying the core routing network will initiate the creation of the telecommunications foundation for the applications (beyond the physical and data link layers of the OSI model) currently contemplated by the Nebraska Network Work Group. It is intended this statewide core routing network will provide telecommunications bandwidth for a statewide IP-centric Intranet, a statewide synchronous video network, other shared regional or statewide networks, and single application networks. The core routing network will help to achieve ubiquitous service levels, improved network performance, and better access availability. It is anticipated the design will be neither dictatorial nor restrictive in its concept and anticipated results. It is expected the final NETCOM RFP will be flexible and acceptable to all involved parties—participants and proposed service providers. It is intended to meet the requirements of flexibility, scalability, and providing economies of scale.

6. Better Utilization of Investments. As documented elsewhere in this report, public entities in Nebraska already operate many regional and statewide networks that represent significant investment of public funds. Implementing the work group's recommendations will general additional value from these investments. The proposed statewide IP-centric Intranet will permit greater collaboration and new educational opportunities for participating entities. The proposed statewide synchronous video network will expand the opportunity for shared classes and special events for participating entities.

Risk Analysis

The total amount of risk associated with a shared network compared to a number of independently managed, single-application networks will likely increase due to the complexity of the network and the interrelated and interdependent data transmission. Some of the risks to be considered during implementation are highlighted below.

Expected Risks

1. Confidentiality of Patient and Student Information. Care must be taken to keep patient medical records and student data confidential and secure while new network applications are being implemented on the network. Authenticated users will expect a high degree of privacy.
2. Security. The network must ensure a secure environment for educational and health care-related applications. The ability of the network to serve many thousands of diverse users with many different skill levels will be both a strength and a weakness. The management of the IP-centric shared network must take steps to ensure full compliance with the network security policies of the NITC Technical Panel Security Architecture Work Group: http://nitc.nol.org/tp/workgroups/security/index.htm. Accomplishing individual authentication, verification, and validation will be challenging.
3. Redundancy. The network must ensure virtual or physical redundancy for critical applications such as radiological and surgical health care consultations as well as educational course offerings.
4. Quality of Service. Having a shared network means that users and applications will occasionally compete for network resources. Maintaining satisfactory qualities of service will be paramount. Management will have to set thresholds of quality commensurate with respective costs for its users. The network operations center(s) will have to constantly monitor levels of use and recommend network upgrades and repairs as needed.
5. Financial. Having a shared network means that stakeholders will be sharing the costs of the network infrastructure, management and operations. The financial risk of any paying participant not being able to meet their obligation increases in times of economic uncertainty.
6. Costs of Temporary Duplicative Networks. During the implementation phase of the IP-centric, shared network, some parallel or duplicative networks may have to persist in order to live out the contract terms and avoid penalty fees. This will introduce additional financial risk to the stakeholders having to maintain duplicate telecommunications costs.

Conclusion -- Feasibility

The assignment given to the Nebraska Network Work Group was to evaluate the feasibility of a digital network and related support functions serving a wide range of participants. As noted elsewhere in this report, the concept of a single network is a long-term prospect that builds on past efforts to set strategic direction for networks in Nebraska. Those efforts have included adopting video standards and a plan to aggregate telecommunications purchasing and bandwidth. This report recommends additional specific steps to generate greater value from the state's investments in networks.

The work group recognizes the need for significant changes and recommends a phased approach that starts with aggregation of contracts for telecommunication services and creation of initial segments of the core routing network (statewide telecommunications backbone concept). Greater collaboration among entities with closely similar missions may lead to some sharing of resources for the network application layers as well. Although harder and longer to implement than making a major initial investment in a network operations center and statewide backbone, this approach entails less financial risk and relies on existing resources. Avoiding the need for an initial influx of funding has considerable appeal, given the current fiscal environment. Other funding sources discussed elsewhere in this report might be available to help accelerate the rate of implementation. It is essential that sufficient analysis be in place to provide strategic direction and support proposals for funding. In particular, the following steps are needed:

- Adopt a vision statement that calls upon all entities to work together to achieve " an efficient, reliable, and scalable telecommunications infrastructure, widespread communications networks, and sufficient network support functions."
- Promote statewide purchasing and bandwidth aggregation of telecommunications services.
- Implement a telecommunications backbone (core routing network).
- Implement an IP-centric intranet to improve K-20 collaboration and to serve other participants.
- Determine the best option for providing interconnection of synchronous video networks.
- Decide a long-term strategy for network management and support services.

Appendix

A. Glossary of Terms

1. NETCOM. NETCOM is defined as the NEbraska TeleCOMmunications project, frequently referred to as the NETCOM RFP. This request for proposal, circulated in August 2001 with the State subsequently rejecting all bids in October 2001, was designed to accomplish the following objectives:
    *   To reduce voice, data and video communication costs of state government, or to provide economies of scale where appropriate;
    *   To position the state to take advantage of rapidly emerging communications technologies;
    *   To provide an information infrastructure to support governmental, educational and economic development initiatives throughout the state;
    *   To establish opportunities for use by other government, education, political subdivision and non-profit units;
    *   To attempt to leverage the State's purchasing power to create economic development incentives for rural and disadvantaged users;
    *   To address the rate disparity for network and service access throughout the state.

2. Network Concepts
    a. Core Routing Network. The Core Routing Network is defined as the core infrastructure or "backbone" from which all local access circuits emanate. For Nebraska, this is generally described as a an interconnected "loop" design network geographically encompassing the State, which would strategically identify network interface sites closer to the end-user customer(s).
    b. Health Alert Network. The Health Alert Network is generally defined as the aggregate of telecommunications systems used to accomplish high-bandwidth exchange of information to accomplish rapid response notification, training, and data collection among health and public safety facilities and personnel.
    c. Intelligent Transportation System (ITS). The umbrella term for advanced automation in mobile vehicles. The ITS Data Bus enables engine diagnostic equipment, GPS navigation systems, wireless phones, radios, TVs, games and other mobile devices to interoperate over a standard bus.
    d. Nebraska Statewide IP-Centric Intranet . The IP-centric Intranet is envisioned as a singular Intranet dedicated to the purpose of advancing Internet Protocol (IP) applications such as desktop video, data mining, and e-mail. TCP/IP is a communications protocol developed under contract from the U.S. Department of Defense to inter-network dissimilar systems. This de facto UNIX standard is the protocol of the Internet and has become the global standard for communications. TCP/IP is a routable protocol, and the IP part of TCP/IP provides this capability. In a routable protocol, all messages contain not only the address of the destination station, but also the address of a destination network. This allows TCP/IP messages to be sent to multiple networks (subnets) within an organization or around the world, hence its use in the worldwide Internet
    e. Nebraska Statewide Synchronous Video Network. The Statewide Synchronous Video Network is envisioned as an interconnected system of smaller synchronous video networks that allows web-based facility and event scheduling, multipoint conferencing, and promotion of ad hoc educational opportunities.

f. OSI Model. (**O**pen **S**ystem **I**nterconnection) An ISO standard for worldwide communications that defines a framework for implementing protocols in seven layers. Control is passed from one layer to the next, starting at the application layer in one station, proceeding to the bottom layer, over the channel to the next station and back up the hierarchy. Most of the functionality in the OSI model exists in all communications systems, although two or three OSI layers may be incorporated into one.

g. Public Safety Wireless System. Public safety agencies across the State created a specialized design concept called **NE**braska **V**irtual **COM**munications Network (**NEVCOM**). This system is uniquely tailored to Nebraska's needs for interoperability, modern technology, and a high cost-benefit ratio for law enforcement, fire, and rescue personnel to achieve an effective wireless communications system.

h. Shared regional or statewide networks. This term generally refers to the cooperative sharing or aggregation of circuits or data to achieve common goals or objectives either among K-20 educational institutions or public safety agencies.

i. Single application networks. This term generally refers to a network used by a state agency or agencies to perform a specific function (e.g. CHARTS, NFOCUS).

3. TINA. (Telecommunications Infrastructure Needs Assessment) This 1999-2000 consulting engagement with Federal Engineering, Inc., (*FE*) of Fairfax, VA came about as a result of the State of Nebraska's RFP SCA-0146 *Telecommunications Infrastructure Assessment Consulting Services.* The objectives of this project were to perform a telecommunications infrastructure assessment, and to create a comprehensive statewide telecommunications planning document. This document is one of a series of engagement deliverables, presenting the results of the needs assessment activities undertaken by the state's consultant. The report did numerous interviews with communities of interest to generate findings related to infrastructure, economic development, and regulatory impediments. http://www.doc.state.ne.us/tina/tina.html

B. Statutes
1. Section 81-1120.19. Division of communications; powers; limitation. The division shall have authority to purchase or lease communications facilities, services, or channels on terms, which are for the best interests of the State of Nebraska. In making the decision as to what proposal is for the best interests of the state, the decision of the division shall be based upon, but not necessarily limited to, (1) the total cost to the state, computed in accordance with accepted governmental cost-accounting procedures taking into account taxes to be paid or foregone, interest rates, and obsolescence; (2) the quality of the service offered; (3) the comprehensiveness of the proposed facilities or plan; (4) the financial responsibility of the supplier or carrier submitting the proposal; (5) the repair and maintenance capabilities of the supplier or carrier; (6) the experience as a communications carrier or supplier, as applicable; and (7) the alternate methods or facilities available. The powers conferred by this section shall be subject to the condition that, except for existing state-owned facilities, the division shall obtain all exchange, intercity, toll, wide-area and private-line communications service from telecommunications carriers that are certificated or permitted by the Public Service Commission for any area in which such services are rendered. Any purchase or lease, except from such telecommunications carriers, made by the division shall be made through the materiel division of the Department of Administrative Services pursuant to the functions, powers, and duties of such division.

2. Section 86-323. Legislature; declaration of policy. The Legislature declares that it is the policy of the state to preserve and advance universal service based on the following principles: (1) Quality

telecommunications and information services should be available at just, reasonable, and affordable rates; (2) Access to advanced telecommunications and information services should be provided in all regions of the state; (3) Consumers in all regions of the state, including low-income consumers and those in rural and high-cost areas, should have access to telecommunications and information services, including interexchange services and advanced telecommunications and information services, that are reasonably comparable to those services provided in urban areas and that are available at rates that are reasonably comparable to rates charged for similar services in urban areas; (4) All providers of telecommunications services should make an equitable and nondiscriminatory contribution to the preservation and advancement of universal service; (5) There should be specific, predictable, sufficient, and competitively neutral mechanisms to preserve and advance universal service. Funds for the support of high-cost service areas will be available only to the designated eligible telecommunications companies providing service to such areas. Funds for the support of low-income customers, schools, libraries, and providers of health care to rural areas will be available to any entity providing telecommunications services, maintenance, and upgrading of facilities. The distribution of universal service funds should encourage the continued development and maintenance of telecommunications infrastructure; (6) Elementary and secondary schools, libraries, and providers of health care to rural areas should have access to advanced telecommunications services as described in the Telecommunications Act of 1996. To promote the efficient use of facilities in rural areas, universal service rules should not preclude the sharing of facilities supported by universal service funds with other local users, if such ineligible users pay appropriate retail usage rates to the telecommunications company; (7) The implicit support mechanisms in intrastate access rates throughout the state may be replaced while ensuring that local service rates in all areas of the state remain affordable; and (8) The costs of administration of the Nebraska Telecommunications Universal Service Fund should be kept to a minimum.

3. Section 86-512. Legislative intent. Nebraskans, and others throughout the world, have become part of the information age, in which information is a primary element of economic, social, and cultural growth. Our ability to move information quickly and accurately through electronic means is critical to the success of education, business, agriculture, health care, government, libraries, communities, and other areas of interest in a global society. A statewide vision and strategy is needed to ensure coordinated development of the telecommunications infrastructure necessary for Nebraska to keep pace worldwide and collaboration among entities within the state and with other states.

4. Section 86-513. Legislative findings and intent. (1) The Legislature finds that appropriations for information technology continue to increase. Advances in information technology have the potential to improve government efficiency, broaden educational opportunities, and enhance services to Nebraska communities and citizens. To assure the most cost-effective use of state appropriations: (a) Responsibility should be assigned for developing a statewide vision and strategic plan to guide investments in information technology; (b) Organizational and technical support for technology budget decisions should be improved and integrated; (c) A clearinghouse should be formed for technical support and best practices information; and (d) Responsibility should be assigned to an office within state government for improving the planning, budgeting, and management of state government's information resources. (2) It is the intent of the State of Nebraska to support the development of a unified statewide telecommunications infrastructure. The statewide telecommunications infrastructure will be scalable, reliable, and efficient. It is further the intent of the Legislature that the provisions of sections 86-1501 to 86-1514 serve to coordinate the state's investments in information technology in an efficient and expeditious manner. The provisions are not intended to impede the rapid deployment of appropriate technology or establish cumbersome regulations or bureaucracy.

5. Section 86-524. Legislative review. (1) The Appropriations Committee and the Transportation Committee of the Legislature shall jointly review the provisions of sections 86-512 to 86-524 before January 1, 2001, and every two years thereafter. The Executive Board of the Legislative Council shall designate staff with appropriate technical experience to provide the staff support for the review. The committees shall establish criteria to be used for the review in accordance with the following policy objectives within sixty days after April 3, 1998. It shall be the policy of the state to:

(a) Use information technology in education, communities, including health care and economic development, and every level of government service to improve economic opportunities and quality of life for all Nebraskans regardless of location or income; (b) Stimulate the demand to encourage and enable long-term infrastructure innovation and improvement; and (c) Organize technology planning in new ways to aggregate demand, reduce costs, and create support networks; encourage collaboration between communities of interest; and encourage competition among technology and service providers. (2) In the review, the committees shall determine the extent to which: (a) The vision has been realized and short-term and long-term strategies have been articulated and employed; (b) The statewide technology plan and other activities of the commission have improved coordination and assisted policymakers; (c) A clearinghouse of information has been established, maintained, and utilized of Nebraska's information technology infrastructure and of activities taking place in the state involving information technology, and that the information flow between and among individuals and organizations has been facilitated as a result of the clearinghouse; (d) Policies, standards, guidelines, and architectures have been developed and observed; (e) Recommendations made by the commission to the Governor and Legislature have assisted policy and funding decisions; (f) Input and involvement of all interested parties has been encouraged and facilitated; and (g) Long-term infrastructure innovation, improvement, and coordination has been planned for, facilitated, and achieved with minimal barriers and impediments.