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TEL8 TELECOMMUNICATIONS NETWORK: A POOLED FUND STUDY FOR TRANSPORTATION VIDEOCONFERENCING

PB99-128522

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Interim Report

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16. Abstract

The document provides a summary of the development of a telecommunications network dedicated to transportation. The network was initially established as a satellite-based videoconference system among state DOTs and transportation research universities in FHWA Region 8. The report details the development of transportation-related programming and training for the network as well as the technological evolution of the system.

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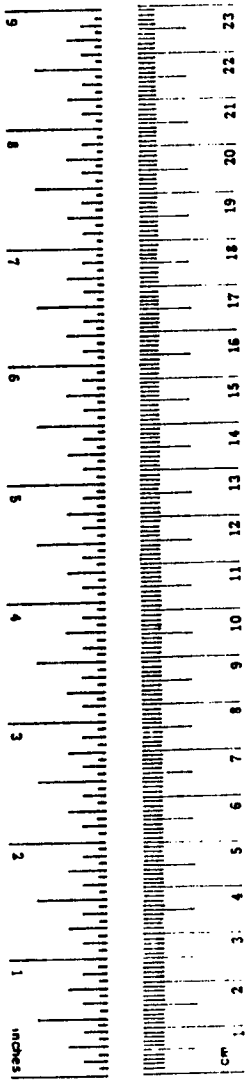
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F

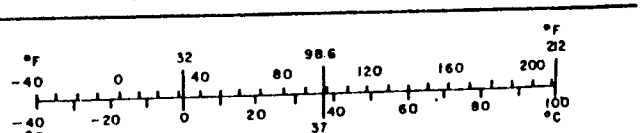


Figure 1. Metric Conversion Factors

Preface

The TEL8 Pooled Fund Study was created to support the development of a telecommunications system dedicated to improving and enhancing transportation in the Federal Highway Administration (FHWA) Region 8. TEL8 established a partnership among the region's six state Departments of Transportation (DOT) and the Mountain-Plains Consortium (MPC) of transportation research universities with the state DOTs pooling financial resources in support of the project. The network was designed and established as a satellite-based interactive videoconference system with TEL8 videoconference programming being developed by the Board of Directors, DOT training personnel and MPC university staff.

The Pooled Fund Study demonstrated and confirmed the value of the system. Several successful programming activities were initiated over TEL8 including DOT information seminars and graduate level classes from the MPC research universities. Moreover, the project identified several areas that required additional attention in order to maximize the system's potential. Those areas include the application of more functional videoconference technology and the elevation of programming to the highest network priority. To meet those challenges, TEL8 made a major investment in new, terrestrial-based network technology and appointed a program director.

The Study concludes with a look at second generation TEL8 issues and directions including the potential expansion of the network.

Table of Contents

Introduction

This report presents and summarizes the TEL8 Pooled Fund Study. The TEL8 Pooled Fund Study was created to support the efforts of the six state departments of transportation (DOT's) in Region 8 to establish a telecommunications network dedicated to improving transportation in the region through the use of enhanced communications, technology transfer, education and research. The telecommunications network was named TEL8 and developed to serve the transportation interests of the region by utilizing a state-of-the-art, interactive videoconference telecommunications system. The North Dakota Department of Transportation contracts the administration of the Pooled Fund Study to the Upper Great Plains Transportation Institute (UGPTI) at North Dakota State University (NDSU).

The report introduces TEL8, details its development and presents the accomplishments of the Pooled Fund Study including the benefits and costs of the project, what was learned, and who were involved in the Study. While not a direct part of the Pooled Fund Study, a partnership with the Mountain-Plains Consortium (MPC), a consortium of transportation research Universities in the region, was initiated to complete the TEL8 network. The report includes this important partnership as integral in the formation and development of TEL8.

TEL8 Development

The development of TEL8 included establishing the organization, determining the governing structure, defining the vision, mission and goals of the organization, deploying the telecommunications technology, initiating and developing TEL8 programming and utilizing the system for special events.

TEL8 Introduction

TEL8 is a Region 8 satellite-based telecommunications system dedicated to improving transportation in the region. It was established with 10 network sites consisting of the six state departments of transportation (DOT's) in North Dakota, South Dakota, Montana, Wyoming, Colorado, and Utah, and the four Mountain-Plains Consortium (MPC) universities consisting of North Dakota State University, University of Wyoming, Colorado State University, and Utah State University. The system is governed by a Board of Directors with representatives from each of the State DOT's and MPC universities and the FHWA regional office (Figure 2).

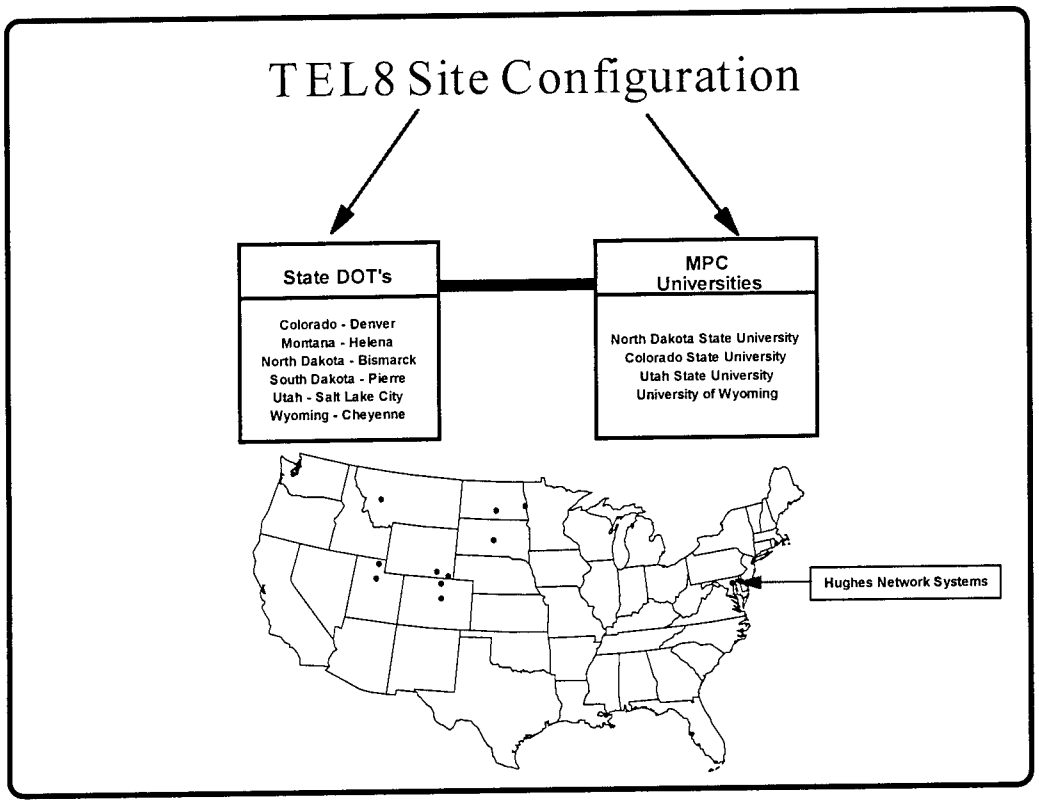


Figure 2. The TEL8 Network and Hughes Network System (Satellite Provider).

TEL8 was developed to serve the transportation interests of the region by employing a state-of-the art telecommunications system. Each of the original ten TEL8 sites in the system is equipped with in-room audio and video equipment, coding/decoding digital compression equipment and a satellite transmission link. With this equipment, each site is capable of sending and receiving interactive audio/video signals. Programming activities delivered via the system include, but are not limited to, graduate level courses in transportation, technology transfer and continuing education courses, seminars of varying lengths, and teleconferencing among state DOT's and MPC universities.

Vision and Mission

The Board of Directors adopted the TEL8 vision and mission statements. The TEL8 vision is:

To be a leader in the United States in distance learning and communications by utilizing cutting edge technology and maximizing the capability of that technology by providing superior customer-driven programming that adds maximum value to the TEL8 clientele.

The TEL8 mission is:

> *To contribute to quality transportation in Region 8 through a distance learning and teleconferencing network that serves the participating DOT's and universities by enhancing communications, education, technology transfer, and research.*

Accomplishing the TEL8 vision and mission is measured by the achievement of seven well-defined goals. The goals for TEL8 are meant to:

- Enhance communications among the participating state DOT's, universities, FHWA, and other national and regional organizations.
- Improve the access to, and the quality and quantity of, inter- and intrastate education to all participating DOT's and universities.
- Focus the development and prioritization of the use of TEL8 on (1) interstate transportation teleconferencing, (2) interstate transportation education, and (3) intrastate transportation education.
- Assure that the system responds to the priority needs of participating departments of transportation on a pilot basis in the short term and an established strategic direction in the long term.
- Maximize the cost effectiveness and efficient use of communication time and resources available to the system.
- Research and demonstrate applications that improve the effectiveness and efficiency of distance communications and learning.
- Facilitate the improvement of transportation emergency communications and management among the participating states.

TEL8 Organization

The TEL8 organization was established through the TEL8 Pooled Fund Study and by funds provided to the Mountain-Plains Consortium through a grant from the University Transportation Centers Program of the U.S. Department of Transportation. The organization operates under the Transportation Telecommunications Network Region VIII Bylaws developed and adopted by the organizing TEL8 entities. The governing body is a Board of Directors with a representative from each of the TEL8 sites. The officers of the board consist of a President, Vice-President and a Secretary-Treasurer. An Executive Director is appointed by the Board and is responsible for carrying out the functions and purposes of the TEL8 as directed and approved by the Board. Additional staff responsible for administering the day-to-day operations of TEL8, include an associate director, an administrative assistant and a telecommunications technician who is

financially supported on a half-time basis by TEL8. Additionally, standing committees are appointed by the Board and have responsibilities in the programming, implementation and technology areas. The president calls meetings as required with an annual face-to-face meeting held at a central location.

The incorporation of an associate director into the administrative staff occurred during the second year of the study. The associate director responsibilities included coordination and management of the daily TEL8 technical and management operations as well as participation in the development of policy alternatives for the Board of Directors. The Board of Directors voted to provide financial support for the associate director and the administrative assistant on a part time basis for the fiscal year starting July 1, 1998. This financial support will be reviewed at the end of the fiscal year and was initiated as part of an effort to develop a cohesive administrative and management system.

DOTs and MPC Partnership

The partnership among the state DOTs and the MPC universities has been recognized by TEL8 as one of the primary strengths of the organization. These two entities have different but very complementary roles in improving transportation activities and the development of the TEL8 network brought them together within a formal structure. The partnership itself has provided avenues of exploration for new opportunities between the two groups as well as providing concrete education, training and research interaction. An example of the continuing benefits of the relationship include students from two universities and two DOTs participating in graduate classes during the spring semester of 1998. Additionally, the DOT training implementation committee has invited the universities to participate in the InfoX program series, a series of day-long seminars devoted to sharing the experiences of practical DOT training and transportation-related applications. It is anticipated that additional DOT training programs will be used by the MPC for seminar-type program content.

The MPC universities have been and are recognized for the educational opportunities they bring to the partnership. Several DOTs have had many of their employees further their education and training through the opportunities MPC brings to the partnership via TEL8. This contribution is invaluable and is a major reason DOTs value this partnership. Moreover, additional MPC training will be developed exclusively for DOT participation further illustrating the significance of this partnership formed by TEL8.

Network Technology

The TEL8 telecommunications network was established as a Hughes Very Small Aperture (VSAT) satellite-based system. Each TEL8 site purchased satellite uplink and downlink transmission equipment allowing two-way interactive videoconferences among all sites (Figure 3). Additionally, each site developed a videoconference room or room capability incorporating

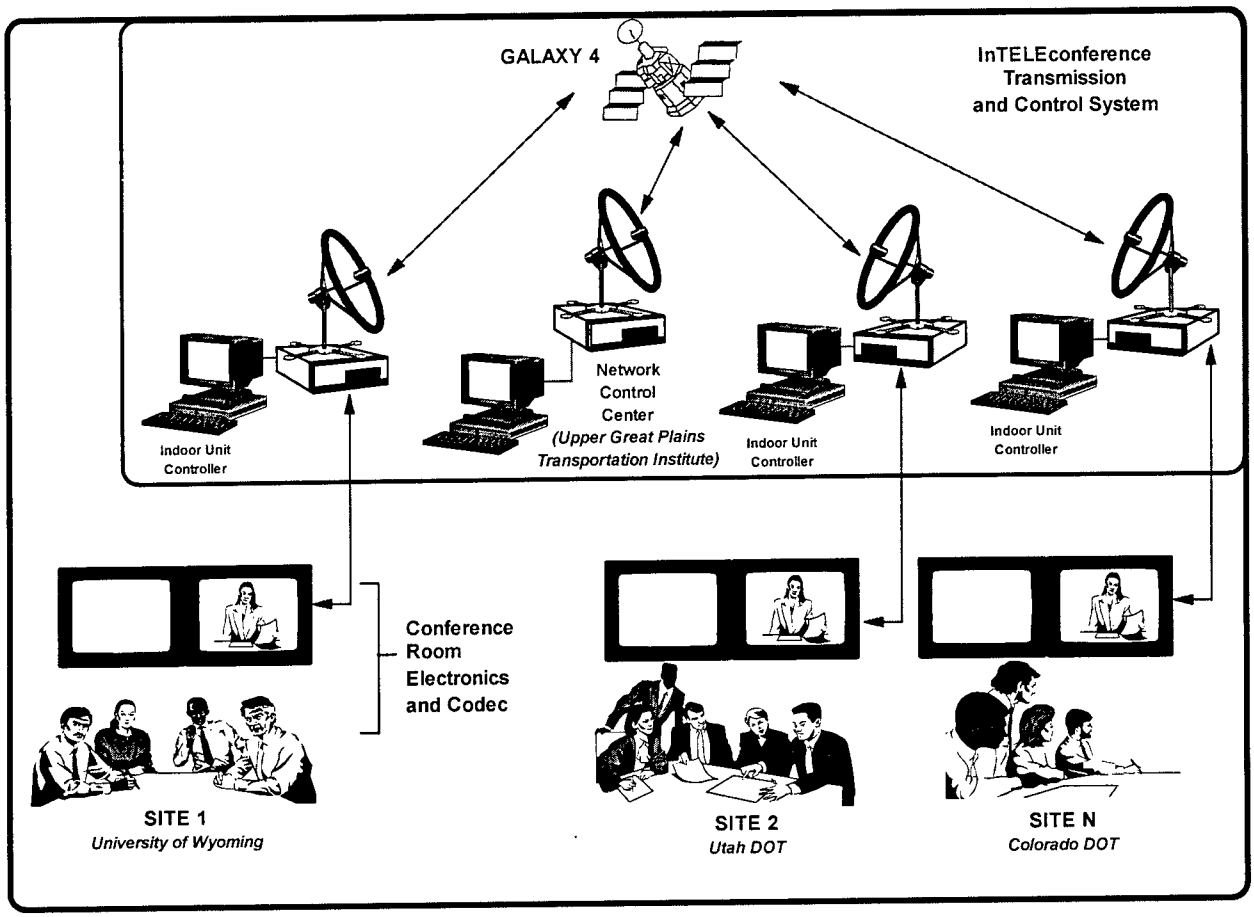


Figure 3. TEL8 Site Equipment Configuration

audio and videoconference technology. A major piece of videoconference equipment, the codec, utilized CLI technology, a leading codec manufacturer at the time.

A Network Control Center (NCC) was established at the NDSU sites. The NCC is responsible for daily operations of the system including the satellite connectivity for all sites, the satellite space segment scheduling of videoconferences and the maintenance and support of all satellite-related technology at all sites across the system. The NCC is staffed by the TEL8 telecommunications technician and other administrative staff as necessary.

The VSAT transmission medium proved to be efficient and adequate but not elegant for TEL8. VSAT was more cost effective at the time the network was established when compared to the land-based technologies. It provided low-cost 24 hours a day, seven days a week videoconference capability and afforded a first opportunity for many TEL8 users to be exposed to videoconferencing. However, as videoconference technology evolved during the study, other transmission mediums developed additional functionality, particularly full-duplex audio, that made them attractive to TEL8.

TEL8 Programming

The development of TEL8 programming has been recognized as a major organizational priority since the initiation of the project. Initial programming efforts included board committees, particularly the DOT implementation committee, DOT training staff, MPC university personnel and others. Examples of programming offered over TEL8 include NHI courses, MPC graduate classes, MPC research seminars, InfoX (DOT seminar series), TEL8 Board of Directors meetings, TEL8 technicians' meetings and technical committee meetings. Several conferences were specifically developed for TEL8 and delivered over the system including a Low Volume Roads Conference and a Rural FBO Conference.

The Board of Directors emphasized and formalized TEL8 programming through the appointment of a TEL8 program director during the third year of the project. The program director is responsible for the initiation, development and acquisition of a more structured and extensive TEL8 training program. Moreover, the program director will be a liaison with those involved at all TEL8 sites who are responsible for training and programming at their respecitive sites. The program director will be supported financially on a half-time basis by system revenue. During the latter part of the project the program director initiated and lead the development of a program and training schedule for the calendar year 1998. The TEL8 training program was approved by the Board of Directors in early 1998 with the financial support for the program being allocated across all sites. The 1998 training program is detailed later in this report.

TEL8 Special Event Programming

Several significant national events have been telecast by TEL8. A significant milestone was accomplished with the programming of the 1996 and 1997 Transportation Research Board (TRB) sessions from Washington, D.C., back to the TEL8 sites. The 1997 TRB programming was telecast to six additional states via a TEL8 satellite-terrestrial gateway. The gateway enabled terrestrial-based videoconference systems to receive TEL8 satellite programming.

Figure 4. States participating in the teleconference delivery of the 1997 TRB Annual Meeting Videoconference Sessions.

Other national events telecast by TEL8 included an ISTEA re-authorization hearing from Helena, Montana; the 1996 AASHTO Annual Meeting from Buffalo, New York; and a transportation-education national conference from Knoxville, Tennessee. Secretary Pèna and Secretary Slater were some of the notable transportation officials who made presentations during TEL8 special events. The telecasting of special national events will continue to be an important use of the TEL8 system.

Associates and Partners

There were several opportunities to coordinate and lease satellite space segment usage during the study. With the approval of the FHWA, satellite space segment time was leased to the VSAT Tri-School Consortium, a telecommunications system consisting of three high schools located at Crosby, Kenmare and Washburn, N.D.; and to the West Virginia Department of Education. The leased satellite time allowed those systems to provide classes and training for their students. All revenue from the lease of the satellite time was utilized by TEL8 for supporting or enhancing TEL8 operations. The association with the West Virginia Department of Education also allowed for the leasing of their mobile satellite unit for use with the telecast of the TRB, ISTEA Hearing, and AASHTO special events.

Program Benefits

The TEL8 Board of Directors assessed the value and savings of the TEL8 system for the first two years of the project. Two categories of assessment were developed - program value and program savings. Program value is the value provided to an organization by the TEL8 programming. For example, an organization may receive valuable information through the TEL8 system it would not necessarily receive otherwise. Program savings would be the costs saved by using the system, and would include travel costs to a conference broadcast over TEL8. Not all sites responded to the survey but significant value and savings were reported. In 1995 the total dollar amount of those sites that responded to the survey equaled $200,261. The 1996 figure for those sites that responded to the survey was $337,000. A 1997 figure is currently not available.

Several TEL8 sites indicated that the benefits of the system included many that were hard to quantify. For instance, many sites reported beneficial meetings or activities that occurred because of TEL8 that would not have happened otherwise. Others noted that the system has great potential and the "real value is in future system." However, there was at least one survey comment that there had not been anything of great value over the system that people from their state would have traveled to.

The TEL8 Board of Directors recognized that the system needs to be improved to maximize the potential benefits of a telecommunication system in Region 8 and that, on balance, the benefits of the system were demonstrated during the first three years of the project. A major re-investment in the reconfiguration of the system begun during the last year of the study further indicated the Board's assessment that program benefits, both actualized and potential, merit such an investment.

Program Costs

During the 3-year period of the Pooled Fund Study, the DOTs incurred costs for salary and wages for a TEL8 technician, equipment and operational expenses. A program director was hired during the third year of the project and is supported by revenue funds generated by the leasing of space segment time.

Major equipment purchases were made during the first year of the study which included the satellite in-room equipment and outdoor units; in-room conferencing equipment, codec and the shared purchase of the Network Control Center (NCC) equipment.

Each DOT allocates monies for TEL8 operational expenses. Major expenses include the leasing of satellite space segment and a satellite equipment maintenance contract. All sites in the TEL8 organization share the cost of the space segment and the maintenance contract. Other costs involve the day-to-day operations of managing the system including travel expenses for of face-to-face board meetings, personnel expenses for TRB transmissions from Washington, DC, and training meetings for the TEL8 technician and executive director.

TEL8 administrative staff keep a record of each site's allocation and expenses and are reported and billed on a quarterly basis. A summary of the project's account may be found in the appendix.

TEL8 Evaluation and Future Direction

TEL8 Evaluation and Strategic Plan

The 1997 TEL8 annual meeting afforded an opportunity to assess the current TEL8 system as part of a strategic planning process and identify and recommend any needed changes to improve the system. A survey of TEL8 personnel revealed the following strengths and weaknesses of the system:

Strengths

- Education: Students at various sites able to pursue graduate degrees
- Communication link with regional DOTs readily available
- Concept is basically sound; particularly for universities
- Universities use the system for expanding the offering and selection of classes; universities gain students
- Programming recognized as key issue; programming director appointed
- Centralized Network Control Center
- Overall, the technology is stable
- Educators at the MPC Universities have accepted the system
- People are willing (want) to make TEL8 a success
- Administrative leadership (director, executive director)

Weaknesses

- System should be more user-friendly
- System has had some technical problems
- TEL8 would benefit with increased involvement by the Board; a more active Board would help see that the goals, objectives, and vision of the organization are fully realized
- No system standard for site configuration
- Organization has two major groups (DOTs & Univ.); TEL8 hasn't taken complete advantage of the opportunities or challenges presented with the two groups
- Some turnover of DOT board members
- Service and support from HNS
- Top management at the DOTs seem indifferent to the potentials of the system
- There has not been a proactive effort at providing programming, but this seems to be changing
- Technical resources have not been adequately provided at all the sites to support the system
- Board has been ineffectual

The strengths and weaknesses were reviewed, discussed and synthesized into a series of prioritized goals forming a strategic plan for improving and enhancing TEL8. The following is the prioritized list of strategic objectives:

1. Increase/improve programming
2. Improve quantity use of system
3. Improve quality use of system
4. Improve technical functionality of system
5. Improve direction/management of system
6. Improve technical support at sites
7. Increase internal/external marketing
8. Improve budget and revenue support
9. Increase state/university top level support
10. Continue/increase sale of surplus capacity
11. Improve connectivity of TEL8 and state systems
12. Increase federal/state/local/university membership

TEL8 activities were focused during the last part of the study to meeting and realizing the strategic plan. The following discussion highlights several major TEL8 activities currently in place to meet these objectives.

Second Generation Programming and Training

Increasing and improving programming and training was recognized as the highest priority among the strategic goals and objectives. During the third year of the project the Board of Directors hired a program director to meet those objectives. The program director will be financially supported half-time by the system.

The program director initiated the development of a 1998 training and program schedule. This schedule was developed during the third year of the study and approved by the board in early 1998. Costs for providing the training program are estimated at $37,800 and were allocated among all TEL8 sites with the DOTs assuming a larger proportion of the costs. Additional funding to cover these costs will be sought from the T2 centers in the region.

The 1998 TEL8 training schedule includes:

- Two Asphalt Pavement Courses
- Rural Transit Coordination Seminar
- Rural Transportation Management Course
- Several NHI Courses
- Leadership Development Institute for Transportation Series
- Several Workshops including DOT personnel
- Franklin Covey Courses
- Three Intelligent Transportation Systems Short Course

The adoption of a formal, system-wide programming schedule financially supported by TEL8 as a whole is an important organizational milestone and contributes significantly to the evolution of the system. The schedule also includes the InfoX seminar series, graduate level transportation classes, implementation committee meetings, and many other activities. Additional programming and training beyond the formal schedule will include DOT information exchanges and ad hoc meetings.

Second Generation Technology and System Reconfiguration

The strategic planning process and two years of experience with the original technological configuration including the satellite transmission medium and the CLI codec, coupled with the rapid evolution of videoconference technology, revealed the need for major improvements to the technical aspect of the system. Improvements identified as necessary were to improve codec videoconference functionality, increase transmission medium functionality and connectivity and enhance the videoconference environment for TEL8 users. After lengthy discussions taking place during several videoconference meetings, the Board of Directors voted to meet these challenges with a significant investment in improving TEL8 videoconference technology. In addition, the Board stressed that while improved technology will greatly improve the system, additional resources needed to be allocated to programming, the highest priority strategic objective.

The TEL8 second generation technology and system reconfiguration included the selection of a new, state-of-the-art codec and switching from the satellite transmission medium to a terrestrial-based medium. The new codec technology brings significant new functionality aimed at improving the overall user-friendliness of the system. Moreover, the switch to a terrestrial-

based transmission medium, while providing a more cost-effective videoconference transmission vehicle, will bring new system functionality identified as meeting several of the strategic plan objectives. Examples of these capabilities include full-duplex audio and a query system allowing seamless identification of questions during a videoconference. Both of these functions have been recognized for some time as required enhancements to the system. AT&T will provide a private, primary rate network for TEL8 as the transmission medium with a separate and legal tariff exclusive to TEL8.

The comparative cost analysis of the potential transmission mediums also indicated that TEL8 would benefit from purchasing and operating its own videoconference bridge. A bridge is required for videoconferences involving more than two sites, a configuration predominantly utilized by TEL8. The bridge will be located at NDSU, the old satellite Network Control Center, and be administered by the telecommunications technician. The Board will be requesting the FHWA and the MPC for approval to lease excess bridge capacity in a similar fashion as the excess space segment was leased. TEL8 started the reconfiguration process during the third year of the study with the complete equipment installation and transmission medium switchover scheduled for April 1998.

Conclusion

The TEL8 Pooled Fund Study demonstrated the effectiveness and the potential of a tele-communications network dedicated to transportation. The TEL8 system delivered transportation-related resources, programming and training to a region-wide audience in FHWA Region 8 and beyond. The pooling of resources by the states in the region to establish TEL8 brought new opportunities for cooperation, education, outreach, extension of training opportunities, and the maximizing of training and research funds. The sharing of human resources across the network exposed more transportation professionals to existing expertise in the region. TEL8 provided a new medium for addressing the problems and issues shared by the transportation systems in the region while illustrating a new paradigm for developing solutions to those problems.

The partnership between DOTs and universities highlights the TEL8 paradigm and proved to be a valuable outcome to the study. The formalization of this relationship inside the TEL8 organization focused each group on the requirements, opportunities and issues of the other. Both groups have benefitted from the partnership and are addressing several challenges in an effort to take full advantage of this relationship. These issues are actively being examined and include university credits for courses, DOT employee time for education and university courses tailored to meet DOT needs.

The TEL8 study also demonstrated the feasibility and value for other transportation agencies to access the TEL8 network. The TRB and AASHTO special events brought those organizations to a new audience of transportation professionals and displayed the efficiency of an organized, videoconference network. The ISTEA hearings with Secretary Pèna showed the effectiveness of the network by allowing the Secretary the opportunity to interact with the CEOs from six state DOTs. This TEL8 ability to effectively provide connectivity to other transportation entities will be further utilized in the future. Furthermore, individual state DOTs have learned through the

TEL8 experience the advantages of developing intrastate videoconference facilities within their own organizations and have initiated programs to do so.

The study identified several issues vital to TEL8 and the development of a successful transportation telecommunications network. The quality and quantity of the programming in the system remains the primary challenge to TEL8. The creation of a programming director position during the third year of the study is an effort to meet that challenge and the role of the program director will be paramount in the success of TEL8. Additionally, the videoconference technology deployed by any system must not inhibit the utilization and development of an organization. Early TEL8 experience demonstrated that the original technological configuration of the system was not elegant and prevented the maximization of the network. Finally, the project identified the potential of the network. This potential not only includes the programming challenges already discussed but the communication facilities provided by the system. TEL8 needs to expend additional effort to utilize the network communications capability more fully.

TEL8 expansion is under discussion and other transportation organizations in the region have expressed interest in joining TEL8. Beyond the region, other organizations have expressed similar interest in TEL8. While any expansion is only in the preliminary discussion stage, expansion is viewed as a positive outcome of the project and is seen as an opportunity for TEL8.

Recommendations

The TEL8 project makes a series of recommendations for other transportation telecommunication networks. The first is the development of a partnership or working relationship with other transportation entities similarly situated. The DOT/MPC partnership within TEL8 has proven invaluable in the opportunities afforded to the system. Secondly, a strong emphasis on developing and acquiring programming for the system's clientele should be established. The appointment and financial support of a program director and other administrative staff should be considered. It is as important to invest in the people in the system as in the videoconference equipment utilized by the network. Thirdly, communicate with the users of the system to make it relevant to the solutions or opportunities they seek. This may be realized through traditional means but should include training in using the system so these users will be active in letting their organizations learn of the network's potential. Finally, take advantage of latest telecommunications technology and place special emphasis on the user-friendliness of the system. Furthermore, to reduce system complexity and any requisite technical support have the system configured as a whole including in-room videoconference equipment.

These recommendations underline the importance of developing an organizational structure that meets the needs of those using the network. Technology is necessary in establishing a network but technology should not overshadow the human resources necessary for the system. TEL8's experience recommends developing the human potential of any network.

APPENDIX A: TEL8 POOLED FUND STUDY EXPENDITURES

NORTH DAKOTA STATE UNIVERSITY
Statement of Expenditures

Fund-Dept:	4352 - 5980
Grant-Contract ID:	17-893-0794
Agency Name:	NORTH DAKOTA DEPARTMENT OF TRANSPORTATION
Project Title:	TRANSPORTATION TELECOMMUNICATION NETWORK
Principal Investigator:	GENE GRIFFIN

Elements of Cost	Current Period Expense 01-01-97 to 12-31-97	Cumulative Expense 07-01-94 to 12-31-97	Total Budget
Salaries & Wages-GRA	0.00	0.00	0.00
Salaries & Wages-Support Staff	6,345.66	18,542.51	0.00
Fringe Benefits	1,088.16	4,696.06	0.00
Subtotal	7,433.82	23,238.57	0.00
Travel/students	273.05	11,516.43	0.00
Communications	450.68	1,296.32	0.00
Data Processing	0.00	162.83	0.00
Rents & Leases	0.00	900.00	0.00
Office/Advertising	414.82	1,592.46	0.00
Repairs	7,488.98	74,061.56	
Supplies	578.70	5,881.71	0.00
Fees	112,976.50	243,179.00	0.00
Instructional	0.00	0.00	0.00
Expendable Equip/Durable Supplies	2,655.00	3,045.00	0.00
General	2,096.96	4,472.25	0.00
Subtotal	126,934.69	346,107.56	0.00
Equipment Accounts	0.00	587.00	0.00
Major Equipment	6,747.00	567,331.60	1,200,000.00
Subtotal	6,747.00	567,918.60	1,200,000.00
Total Direct Costs	141,115.51	937,264.73	1,200,000.00
Indirect Cost Rate	0.00	0.00	0.00
Total Cost	141,115.51	937,264.73	1,200,000.00
Advance Received		0.00	
Payments Previously Received		882,937.26 *	
Balance Remaining		54,327.47	

I CERTIFY THAT ALL EXPENDITURES REPORTED OR PAYMENTS REQUESTED ARE FOR APPROPRIATE PURPOSES AND IN ACCORDANCE WITH THE PROVISIONS OF THE APPLICATION AND AWARD DOCUMENTS.

Approved by: Carmen Pederson, Grants Officer Date: 1-22-98