A New Partnership Between Universities and State DOT's in the Rocky Mountain Area: The TEL8 System

by

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Preface

With rapid advancement in technology, it is becoming difficult for transportation professionals to keep pace over their career lifetimes. Continuing education programs are a way to help combat this problem. These programs are being pursued by departments of transportation and universities across the country. In the Rocky Mountain Area the Mountain-Plains Consortium was established to help combine the educational resources of higher education institutions in Federal Highway Administration's Region 8. Through this cooperative effort the TEL8 system was developed. TEL8 is a satellite-based telecommunications system.

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Executive Summary

In 1995, the Mountain-Plains Consortium (MPC) in the Rocky Mountain Area initiated TEL8. TEL8 is a satellite-based telecommunications system which serves ten sites in Federal Highway Administration's Region 8. Each site consists of in-room audio and video equipment which receives and transmits live sound and picture, coding/decoding compression equipment, and a satellite transmission system. Each site is capable of sending and receiving signals from other sites in several modes of conferencing ranging from broadcast to multi-point two-way conferencing. The goals of TEL8, its development, and lessons learned are presented along with cost data for this cutting edge technology. The wide variety of applications are also discussed. These are: formal graduate course work, informally scheduled learning opportunities and open communication forums. The system provides a network for interaction among the six departments of transportation and four regional universities. A user assessment of this form of distance learning is compared to more traditional forms using results of several client-based surveys.[1]

[1] Wilson, Eugene M. and Khaled Ksaibati Department of Civil Engineering University of Wyoming Box 3295 University Station Laramie, Wyoming 82071

INTRODUCTION

The rapid changes of technology and knowledge affect transportation professionals in practice by shortening their productive career lifetimes. With these changes, it is becoming necessary for transportation professionals to participate in refresher courses, retraining, postbaccalaureate education and continuing education programs. The transportation industry has long recognized that advancing the knowledge and skills of the work force is the key to continued success. In today's world, global cooperation and advancement of all workers and professionals is taking on a greater meaning. A more knowledgeable population provides for a better world and also creates a wealthier worldwide marketplace. The need to advance knowledge and skills worldwide is difficult due to many global factors. The spatial separation of trainer expertise and learner is one of the major barriers to advancing worker knowledge and skills. Technology, however, continues to shrink this factor.

This report provides an illustration of a system in the rocky mountain region which is beginning to link transportation professionals in six rural western states covering almost 20 percent of the U.S. continental land area, ten percent of its' roads and three percent of the nation's population (Wilson 1996). This system, called TEL8, is a telecommunication network dedicated to transportation in the Federal Highway Administration (FHWA) Region 8 area. Figure 1 contains an illustration of the TEL8 service area. TEL8 is becoming recognized as a model for actively networking groups through formal training, informal training and communication of user driven linkages. A significant part of this report is directed to describing the TEL8 system characteristics, lessons learned and the enhanced future of TEL8. The TEL8 network provides valuable insight into possible opportunities for other similar or compatible

networks for distance learning. Through new and enhanced communications the world is shrinking--fast.

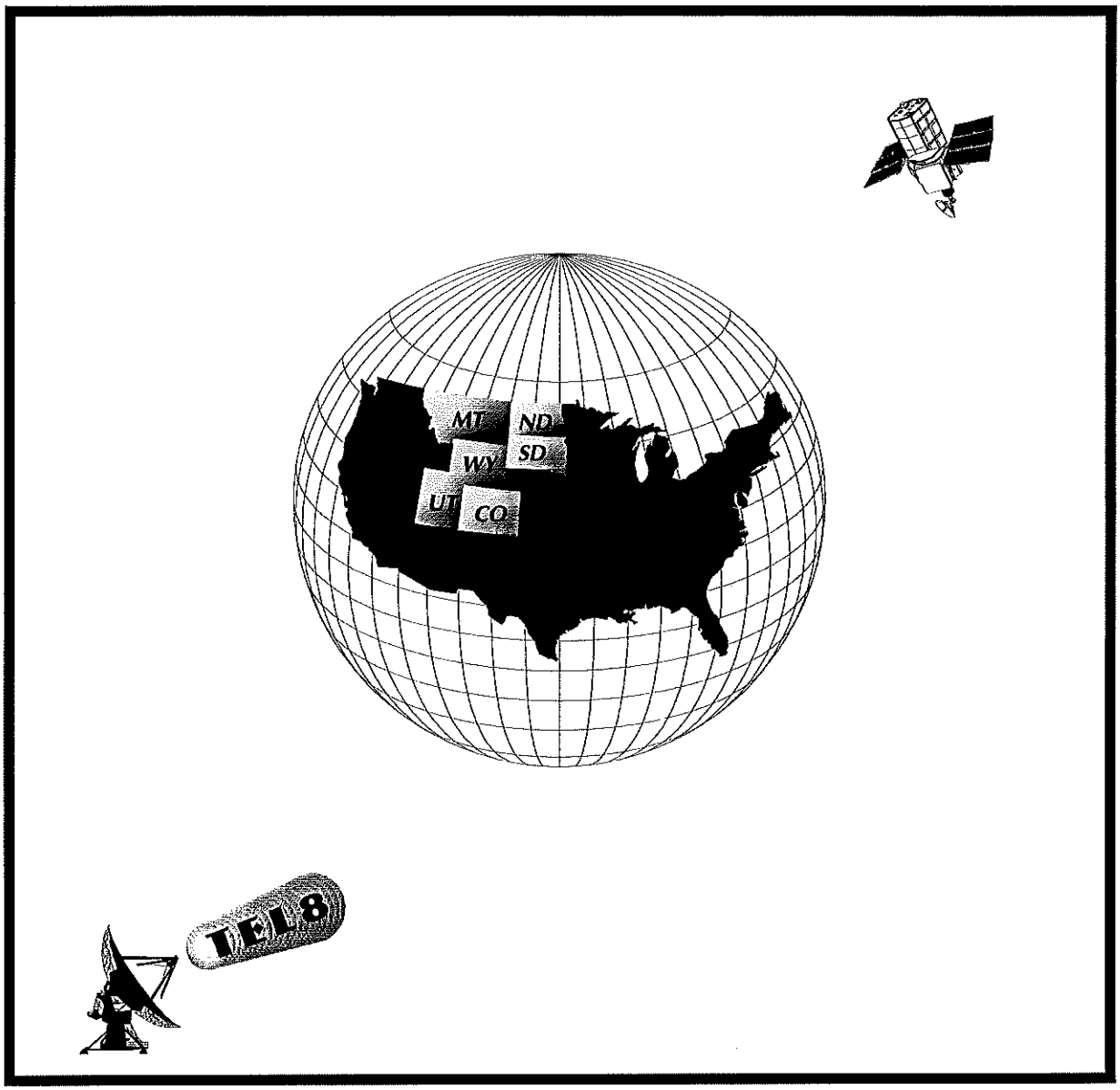

FIGURE 1. The TEL8 Region

The concept of TEL8 began with a vision to reduce the spatial separation and to more fully take advantage of the regional expertise that exists in transportation. The Mountain-Plains Consortium, MPC, provided the opportunity to help develop this concept. MPC is one of the U.S. Department of Transportation (DOT) funded University Transportation Centers. TEL8 became a reality in 1995 with a cooperative agreement between MPC and the Region 8 state Dot's. The base network of TEL8 has potential to expand within each TEL8 state, to other regions in the U.S. and to network other users or countries worldwide. Several distance learning alternatives are briefly presented in the following section to emphasize the advantages of a two-way interactive system such as TEL8.

DISTANCE LEARNING ALTERNATIVES

There are three forms of communication activities for distance learning: Audio, visual, or both audio and visual. These learning channels are further modified as to interactive or non-interactive. There are a number of advantages and disadvantages to all forms of distance learning and the types of interaction. There are also interaction combinations for each transmission form. One of the more accepted forms of distance learning is to network via video tape. This passive form is widely accepted since both audio and visual communication are presented. The presence of an interaction with a classroom teacher enhances the video tape learning experience.

A program using either audio or video tape alone provides minimum one way learning. Interaction through a computer dialogue is also possible. At the other end of the distance learning experience is the one - on - one interchange of a traveling teacher aiding in the exchange

to one student or learner. Of course, the teacher is the world renown expert and the student is the highly motivated learner. The point is that the world of learning has many alternatives and technology is changing rapidly.

The TEL8 system began with the knowledge that technology changes will probably date the useful life of the system. Hopefully, enhancements will enable the system to maintain and strengthen its distance learning activities. Like a computer, though, the next changes will date today's system.

Table 1 contains a summary viewpoint of media and methods in distance education (Farr and Shaeffer 1993). In reviewing this Table, consider these endless opportunities of instructional methods: Videotapes, lectures, one-on-one instruction, games, simulations, audio tapes, self-assessment, self-testing, case studies, slides, films, photographs, role plays, computer-based training, non-computerized self-study, interactive video, multimedia, video teleconferencing and audio teleconferencing. Enhancement of the distance learning experience in a two way interactive system is made by combining learning methods and limiting the exposure time. Use of all of these instructional methods is possible with the TEL8 system. The audio and visual platform of TEL8 enables innovations in learning. An example is to video tape a two way interactive session and then to use this session at a later date interacting with one of the presenters. Combinations are endless and imaginative individuals will capture distance learning opportunities given the chance.

TABLE 1: Selecting Media and Methods in Distance Education

	Information	Procedures	Principles & Concepts	Attitudes & Values
Audio	- readings - audio/videotapes - lecture - student presentation - guest speaker	- demonstrations - lecture - readings	- class discussion - peer teaching - case studies - panel discussions - group projects	- reaction panel - debates - panel discussions - class discussions - case studies - role playing
Audio Graphic	- readings - audio/videotape - lecture - student presentation - guest speaker	- demonstrations - lecture - readings	- class discussion - peer teaching - case studies - panel discussions - group projects	- reaction panel - debates - panel discussions - class discussions - case studies - role playing
2-way audio/ 1-way video	- readings - audio/videotapes - lecture - student presentation - guest speaker	- demonstrations - lecture - readings	- class discussion - peer teaching - case studies - panel discussions - group projects	- reaction panel - debates - panel discussions - class discussions - case studies - role playing
2-way audio/ 2-way video	- readings - audio/videotape - lecture - student presentations - guest speaker	- demonstrations - lecture - readings	- class discussion - peer teaching - case studies - panel discussions - group projects	- reaction panel - debates - panel discussions - class discussions - case studies - role playing
Computer Conference	- readings - guest contributors	- readings - tutorials	- class discussions - panel discussions - group projects	- reaction reports - class discussions - debates - role playing

SOURCE: Farr, Charlotte and Shaeffer, James M. "Matching Media, Methods, and Objectives in Distance Education". Educational Technology, July 1993.

TEL8 SYSTEM

The TEL8 system is a satellite-based telecommunications system that is installed at ten sites in the Rocky Mountain and Upper Great Plains Regions. It is called the TEL8 system because it originally only had 8 sites. The system is sponsored by the Mountain-Plains Consortium, an organization formed to promote cooperative and continuing transportation education programs.

This system is administered and operated by the Upper Great Plains Transportation Institute at North Dakota State University. The TEL8 sites are the main offices for the state departments of transportation in Wyoming, Colorado, North Dakota, South Dakota, Montana, Utah and the following universities: University of Wyoming, Colorado State University, North Dakota State University and Utah State University.

TEL8 Distance Learning

Today, the TEL8 system is being used in three primary areas of communication application. These are: formal graduate course work, informally scheduled learning opportunities and open communication forums. The following sections describe these three areas in detail.

TEL8 and Graduate Education

The formal graduate level course work is fast becoming the best of the best due to the intended audience and also due to the interactions the audience provides. These activities have not been without their own learning curves, i.e. problems solved under fire. However, the instructor generally has the advantages of knowledge, of being a good teacher and of the fact that good teachers work hard at effectively applying learning technologies. Graduate level course work is presented by each of the four MPC universities, University of Wyoming (UW), Colorado State University (CSU), North Dakota State University (NDSU), and Utah State University (USU). As shown in Table 2, the Transportation programs at these four universities offer 34 advanced transportation related courses. Although it is not practical to offer all courses on the TEL8 system, students will have the choices among a variety of courses in any given semester.

TABLE 2. Transportation Related Courses Offered by MPC Universities

University	Traffic	Planning	Pavement	Others
CSU	0	0	1	5
NDSU	1	3	2	1
UW	4	2	3	1
USU	3	3	1	4
Total	8	8	7	11

The format used when offering a TEL8 course is a live classroom setting for interested students in each of the dot's in Region 8 and the other MPC universities. Registration and fee arrangements are linked to the local university in each state and there are no fees transferred to the presenting university. A formal agreement is being developed for each MPC university to provide at least one course by each participating university every year.

In the fall semester of 1995, two graduate courses were offered on the TEL8 system. The Pavement Management Systems course was offered at UW and 29 students from 2 dot's and 2 Universities took the course for graduate credits. Several other students also audited this course. The second course was Transportation Administration which was offered by NDSU. Eleven students enrolled in this course. Real-time video and audio transmission was provided to students enrolled in both courses. When a student at a remote-site wanted to ask a question, he/she pushed a microphone button. After finishing the question, the student had to switch off the microphone to reduce the noise level during transmission.

Mixing traditional students and practicing engineers in a class room setting proved to be beneficial. The students employed in dot's contribute to classes by providing real world learned experiences. Their knowledge contributes to the success of the classes although initially on-campus students were often intimidated by the knowledge levels of the adult learners. Forming learning teams of DOT and MPC students and incorporating presentation exercises improve the learning experiences.

Collection of homework was done by the use of regular mail, facsimile, and electronic mail. All lectures were taped for later use by the instructor and to provide back-up if the TEL8 system malfunctioned at a site. To reduce the number of homework assignments, a comprehensive project was assigned in the Pavement Management Systems course. The students worked in groups at each site and presented their findings from the project at the end of the semester. This term project proved to be beneficial in promoting team work and interaction among the students. Exams in this course were given simultaneously and monitored by the instructor. Due to the practical nature of the materials covered in the Pavement Management Systems course, DOT's students secured slightly higher scores in the exams than the traditional university students. Each TEL8 site has a coordinator who helped in operating the TEL8 equipment, collecting and mailing homework and monitoring the students during examination.

TEL8 and Informal Training

Informal training activities are more difficult to advance, but probably hold one of the keys to the ultimate value of a two-way interactive system. These activities include seminars and topical short courses. Although these activities are informal, these activities require participation

by the program managers to achieve success. A first time user needs full guidance to the system as well as to the needed modifications to presentation techniques. It is easy to view this statement of additional need as a barrier to distance learning. The challenge is to create win - win scenarios which will lead to the system programming being expanded to its fullest potential.

In either a formal or informal training setting the two way interactions have the ability to provide effective distance learning. More distance learning programming is occurring by more individuals as the knowledge of the system expands. The learners or receivers also win by expanding their knowledge base and these TEL8 enrichment opportunities are obtained without the costs and time associated with traveling. In order for effective training to occur, the interactive components need to be carefully developed. The exposure time needs to recognize that a limit is reached with distance learning techniques rather quickly. An effective eight hour program involving one or two instructors and the same audience is not desirable. Frequent breaks and interactions of learning activities which are delivered by the remote sites are highly desired. A maximum program of two to four hours duration with breaks and interactive exercises is recommended.

TEL8 and Communication

The last area of use for the TEL8 system is communication. Involving the profession into interactive distance communication opportunities is also a challenge. Most think of a television experience, others think of a fear. The values of the system will not happen without driving the systems use by the program managers. The need to feed the win - win scenario is very high. The win - win opportunities are higher. On several occasions the TEL8 system has demonstrated its

value as an impromptu communications link. The use of the system in this capacity may encounter scheduling problems. It is envisioned that regularly scheduled meetings will become an active component of TEL8 programming. The benefits of frequent topical or functional based short meetings are beginning to be recognized by both dot's and MPC Universities in the region.

TEL8 Effectiveness

Evaluating distance learning technologies is a difficult thing to do. However, routine evaluations are necessary if distance learning is to be effective and enjoyable. Many TEL8 user evaluations have been conducted and the results indicate that distance learning via the TEL8 system has been very successful. As with any other technology, there are many advantages and disadvantages to this mode of learning. One major advantage is the fact that distance learning greatly decreases training expenses. The costs associated with travel are either reduced or eliminated, and the trainees are away from the office less, resulting in greater productivity.

At the present time there are also disadvantages to consider. One disadvantage of this technology is the time delay between video and voice. Initially, this results in a distraction to the learning process. Another concern is equipment familiarity. Using a new technology requires presenters to spend the time necessary to become familiar with the equipment. Minor problems may also occur. Many remote site users commented on need for more remote site class participation. As trainers and learners become more familiar with training via satellite, they become more comfortable with the technology and interaction increases. Once interaction between trainees begins, it is easy to keep flowing. With time and effort many of these disadvantages are overcome. Distance learning is a major success in the TEL8 region.

TEL8 Equipment

Each site in the TEL8 system consists of audio and video equipment that can transmit and receive video signals. The equipment within the classroom varies from site to site. At the University of Wyoming site there are two monitors for the instructor to view and one camera facing the instructor. The same setup is used for the in room class or audience. The room includes a VCR which can playback instructional material or record a conference. There is a video slide projector for broadcasting slide presentations and a video imager which works like a overhead projector. The monitors also have picture in a picture capabilities. Most of the room equipment can be controlled by the AMX radio frequency remote control system.

TEL8 Initial and Operating Costs

In this section, the experiences with the system are presented in terms of cost to purchase, to operate and to control the system. Request to bid for the TEL8 system transmission was made to both telecommunication surface and satellite communication networks. The basis of TEL8 is a compressed audio and video signal. The cost data provided in Table 3, 4 and 5 reflect a three year fixed price bid for equally distributed costs over ten sites. In-room equipment costs are different for classroom vs. conference room design.

TABLE 3. TEL8 Capital Costs

	Classroom	Conference Room
Digitizing & Compression Equipment		
CODEC - Rembrandt II/VP, Application Package 3 with RS449/T1 Interface	$30,375.00	$30,375.00
Shipping	350.00	350.00
TOTAL	***$30,725.00***	***$30,725.00***
In-Room Equipment		
Classroom ($35,939 - $37,445)		
Conference Room ($25,495 - $27,001)		
AVERAGE TOTAL	***$36,692.00***	***26,248.00***
Transmission Equipment		
VSAT Satellite	$32,500.00	32,500.00
Network Control Center (includes software and PC)	$5,682.00	$5,682.00
TOTAL	***$38,182.00***	***$31,182.00***
COSTS PER SITE	**$105,599.00**	**$95,155.00**

TABLE 4. TEL8 Operating Costs

	Conference Room
Transmission Costs	
24-Hour Dedicated Time (per year)	$138,240.00
Transmission Maintenance (per year)	$21,000.00
Other Costs	
Support Staff (NCC - 1/2 time estimate per year)	$12,000.00
In-Room Equipment and Codec Maintenance Operation	*
ESTIMATED TOTAL ANNUAL OPERATING COSTS	***$171,240.00***
COSTS PER SITE	***$17,124.00***

* No cost experience to date

TABLE 5. Initial TEL8 Training Costs

Introductory Training to System Operations	$1,200.00
Remote Operations	1,800.00
Network Control Center Operations	3,600.00
TOTAL TRAINING COSTS	***$6,600.00***
COSTS PER SITE	***$660.00***

Not shown in these tables are future in-room equipment enhancements which are already occurring at most university sites. These features are directed at making the system more user friendly. Included in these enhancements is the ability to switch to different secondary sites using a keyboard controlled touch pad entry. With the ten sites, a refinement to cue that there is an inquiry from a non-visible site is also being investigated. The limitation to two-way interactive use with most TEL8 programs are minimum. Generally four to six sites are involved in most programs and two-way interaction occurs freely without difficulties. As more sites participate, remote site interaction decreases and a polling approach is often used to provide interaction.

The transmission cost in Table 4 provides exclusive use for a two-way audio-video exchange between all ten sites. Purchasing additional space segments would allow multiple two-way activities to occur at the same time. The primary disadvantages to adding additional sites to the TEL8 network is the fact that interaction decreases as the number of sites increases in any program. The dedicated seven days a week, 24 hours a day service, offers many opportunities. In the following section combining alternatives of TEL systems are discussed.

TEL-WIN

It is possible to establish a TEL system for any group of users located anywhere in the footprint of the satellite. If a compatible design to TEL8 is used, linking all or part of any regional network into other regional networks is easy to accomplish. Another system in a region may also acquire partial time use from TEL8 or acquire its own satellite time. If the same satellite and compatibility was obtained, the present TEL8 network control is easily expanded to

operate more regions. Mixing and matching different sites between different regions would then be easy.

SUMMARY AND CONCLUSIONS

The expanded potential for TEL-WIN is vast. The two-way interactive system should complement the fax and e-mail as the short range future for distance learning. These technologies hold the future for global distance learning. Change is inevitable in delivery technology, technology being delivered and also the global environment.

The worldwide potential for two-way interactive distance learning systems is tremendous. Sharing transmission expenses, using compatible systems and acquiring additional transmission segments systems should open the future world of distance learning. Improved communication is imperative in an era of exponential developments in knowledge and technology. The TEL8 system has been successful in: 1.) overcoming the lack of a single point source of demand, 2.) increasing the effectiveness of both limited fiscal and human resources, 3.) improving communication to more than the few at the top and, 4.) proving that a two-way interactive system if developed and implemented properly is a very powerful system.

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