DISTANCE LEARNING IN A CHANGING WORLD:

THE TEL8 SYSTEM

by

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DISCLAIMER

ABSTRACT

In 1995 the Mountain Plains Consortium (MPC) in the United States initiated TEL8. TEL8 is a satellite-based telecommunications system that serves 10 sites in Federal Highway Administration's Region 8. This paper presents the attributes of TEL8 to demonstrate the roles for distance learning in a changing world.

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 that range from broadcast to multi-point two-way conferencing. The goals of TEL8, its development and lessons learned are presented with cost data for this cutting edge technology. The wide variety of applications also are discussed. 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.

The role of distance learning must be expanded with other technologies such as the World Wide Web to effectively develop the World Interchange Network (WIN). Expanding and sharing transportation technology world wide is dependent on technologies such as TEL8 in a series of regional networks. It is this global vision of TEL8 that is presented.

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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 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 paper provides an illustration of a system in the United States, which is beginning to link transportation professionals in six rural western states covering nearly 20 percent of the U.S. land area, 10 percent of its roads and 3 percent of the nation's population. 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 the paper 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 DOTs. 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 also are 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 also is 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. In reviewing this table, consider these endless opportunities of instructional methods: videotapes, lectures, one-on-one instruction, games, simulations, audiotapes, 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[1]

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

TEL8 DISTANCE LEARNING

Today, the TEL8 system is being used in three primary areas of communication application: formal graduate course work, informally scheduled learning opportunities, and open communication forums. 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 including the University of Wyoming, Colorado State University, North Dakota State University, and Utah State University. The format used is a live classroom setting and the course is available to each of the DOTs in Region 8 and the other MPC universities. Registration and fee arrangements are linked to the local university and no fees transfer to the presenting university. A formal agreement is being developed for each MPC university to provide at least one course each year.

Students employed in DOTs contribute to classes by providing real world learned experiences. Their knowledge contributes to the success of the class although initially on-campus students are often intimidated by the knowledge levels of the adult learners. Forming learning teams of DOT and MPC students and incorporating presentation exercises improves the learning experiences.

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. These TEL8 enrichment opportunities are obtained without the costs and time associated with traveling. For effective training to occur, the interactive components need to be carefully developed. The exposure time must 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.

The last area of use for the TEL8 system is communication. Involving the profession into interactive distance communication opportunities also is 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 quite 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 DOTs and MPC Universities in the region.

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 extremely 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 also are disadvantages to consider. One disadvantage of this technology is the time delay between video and voice, which 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 also may 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 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 Tables 2, 3, and 4 reflect a three-year fixed price bid for equally distributed costs over 10 sites. In-room equipment costs are different for classroom vs. conference room design.

Table 2

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 3

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 4

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. A refinement to cue that there is an inquiry from a non-visible site also is being investigated for TEL8 with the 10 sites. 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 often is used to provide interaction.

The transmission cost in Table 3 provides exclusive use for a two-way audio-video exchange between all 10 sites. Purchasing additional space segments would allow multiple two-way activities to occur at the same time. There also are no limitations to adding additional sites to the TEL8 network. The primary disadvantages 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 world wide opportunities. In the following section, combining alternatives of TEL systems are discussed.

GLOBAL TEL-WIN

It is possible to establish a TEL system for any group of users located worldwide. If a compatible design to TEL8 is used, linking all or part of any regional network into other regional networks is easy to accomplish. In its easiest form, a network system in Scandinavia could arrange to use the same satellite space as TEL8 and have minimum time conflict due to the eight hour time difference. Another system in a region also may 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. Today, TEL8 time has been acquired by another educational user for in-state use in North Dakota.

The global potential for TEL-WIN is vast. In a global environment the two-way interactive system should complement the fax and email 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.

SUMMARY AND CONCLUSIONS

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 the following: 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 an extremely powerful system.

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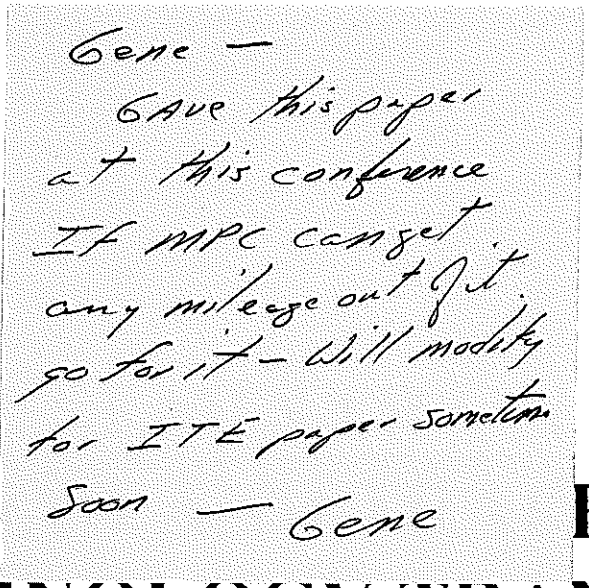

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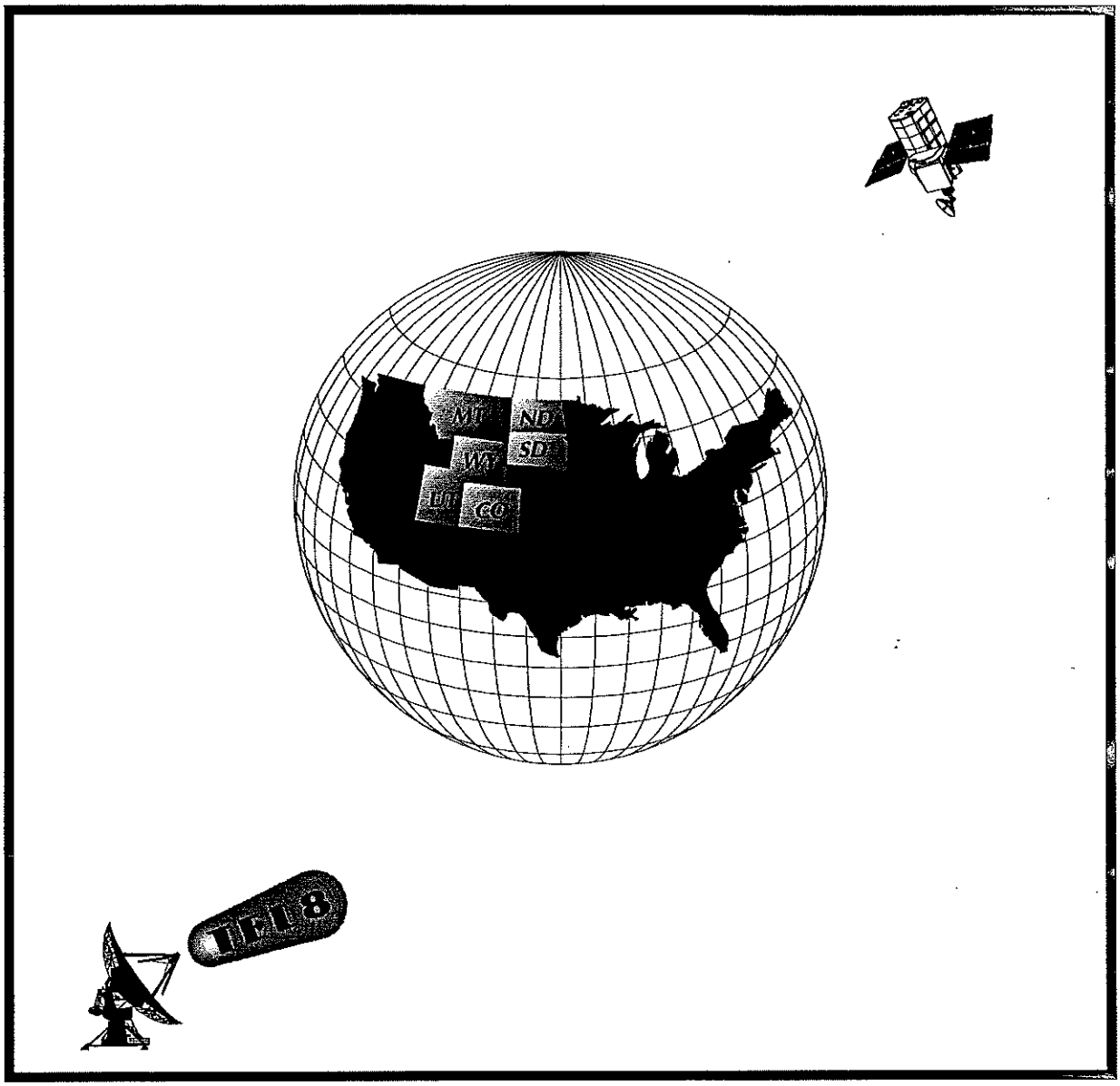

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At the present time there are also disadvantages to consider. One disadvantage of this technology is the time delay between video and voice. Initially, this results in a distraction to the learning process. Another concern is equipment familiarity. 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 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 2, 3 and 4 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 2

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 3

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 4

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 for TEL8. 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 3 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. There are also no limitations to adding additional sites to the TEL8 network. The primary disadvantages 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 world wide opportunities. In the following section combining alternatives of TEL systems are discussed.

GLOBAL TEL-WIN

It is possible to establish a TEL system for any group of users located anywhere. If a compatible design to TEL8 is used, linking all or part of any regional network into other regional networks is easy to accomplish. In its easiest form, a network system in Scandinavia could arrange to use the same satellite space as TEL8 and have minimum time conflict due to the eight hour time difference. 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. Today TEL8 time has been acquired by another educational user for in-state use in North Dakota.

The global potential for TEL-WIN is vast. In a global environment 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.

SUMMARY AND CONCLUSIONS

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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