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AUTHOR Caffarella, Edward; And Others
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ABSTRACT

The feasibility and relative costs of four telecommunication systems for delivering university courses to distant locations in Colorado were compared. The four systems were compressed video, vertical blanking interval video, satellite video, and audiographic systems. Actual costs to install and operate each for a 5-year period were determined, without reference to costs for classroom remodeling, operational staffing, or instructional staffing, working on the assumption that annual maintenance would be 10% of purchase costs. Distance delivery costs were compared with that of having an instructor travel to the site. Instructor travel costs were determined for direct travel expenses and for instructor travel time. The least costly alternative was live instruction with the instructor traveling to the remote site for a semester compressed into a few weeks, a choice that would cost about one-third the cost of any alternative. The least costly electronic delivery modes were compressed video and vertical blanking interval video, which were relatively equal at $84 and $83 an hour. Compressed video would require many more hours and would result in a substantially higher annual cost. Instructional advantages of electronic delivery include the ability to spread a course out over the entire semester, which should enhance learning. (SLD)

An Analysis of the Cost Effectiveness of Various Electronic Alternatives to Delivering Distance Education Compared to Travel Costs for Live Instruction

The following report is an analysis of the feasibility and relative costs for four telecommunication systems for delivering university courses to distant locations. The four systems are compressed video, vertical blanking interval video, satellite video, and audiographic systems. The purpose of the study was to determine the actual costs to install and operate each of the possible systems for a five year period.

The analysis does not include costs for classroom furnishings, classroom remodeling (e.g. lighting, painting), staff to operate the system, nor instructional staffing. All of these costs will be in addition to the costs listed in this report.

Although the specifics of this study relate to the University of Northern Colorado (UNC) and the State of Colorado, the general findings, particularly the relative costs, will be useful to others considering similar systems. In addition, the methodology used to make the comparisons in this study will be useful to others embarking upon similar studies.

The State of Colorado is an ideal candidate for the application of distance education. The state covers approximately 103,599 square miles with a distance of 453 miles from one corner of the state to the opposite corner. The eastern half of the state is rolling plains, the western section is high plateau with the two sections separated by high mountains. Eighty one percent of the population lives within fifty miles of Denver along the boundary between the plains and the high mountains. Within this area the population density is 172 people per square mile. The remainder of the state is very sparsely populated with 6.9 people per square mile.

The University of Northern Colorado has the legislative mandate to provide graduate level programs for school teachers and administrators throughout the state. To meet this legislative mandate the University investigated the feasibility of using various electronic systems to deliver university courses to remote sites. The following report by the staff of the UNC Western Institute for Distance Education (WIDE) contains a description of the results of this investigation. A parallel report entitled "Considerations for the Optimal Design of a 2-Way Interactive Distance Education Classroom" contains a detailed description of the classroom necessary for delivery of distance education.

Course and Student Needs

The first step in investigating the possible alternatives was to determine the existing off campus delivery sites and the possible sites for future expansion of off campus programs.

Course Locations

Off campus programs and courses are currently delivered in Colorado Springs, Denver, Fort Lupton, Grand Junction, Gunnison, La Junta, Pueblo, and Sterling. The number of programs and courses offered in each location are shown in table 1.

Table 1

Number of Programs and Courses at Each Location

Location	Type	Programs	Courses
CO Springs	Cash Funded	3	44
Denver	State Funded	6	41
Denver	Cash Funded	3	51
Fort Lupton	State Funded	1	7
Grand Junction	State Funded	3	10
Gunnison	State Funded	1	3
La Junta	State Funded	1	4
Pueblo	State Funded	4	16
Sterling	State Funded	3	12
TOTAL		25	188

There are plans to offer additional state funded programs in Colorado Springs and Durango starting in the fall of 1992.

Course Times/Days/Terms

Most off campus courses are three semester hour courses and are scheduled during a weekend format such as Friday evening, all day Saturday, and part of Sunday. Courses typically meet for three weekends over a five week period. The offering of these courses generally follows the on campus semesters and summer terms. The courses are offered in this intensive format to make best use of faculty travel time.

By using a telecommunication system the courses could also be offered during the late afternoon and evening as is typically done for on campus graduate courses. These courses could run from 4:30 pm until 6:00 pm two days each week or from 6:15 pm until 9:15 pm once each week. The two day courses are typically scheduled Monday/Wednesday or Tuesday/Thursday. The evening courses typically meet Monday, Tuesday, Wednesday, or Thursday. Courses scheduled in this manner would meet for the normal semester of sixteen weeks.

Needed System Capacity

The proposed telecommunication system needs, at minimum, the capacity to deliver courses in the Friday, Saturday, Sunday format and for the evening format. Additionally the system may be used for administrative purposes when not booked for instruction. These administrative uses will be largely confined to the hours of 8:00 until 4:00. The system will have virtually no use from 9:15 pm until 8:00 am. Assuming a single channel the system would have the maximum capacities shown in Table 2. Realistically the system will not be used during all of the available hours during each week. Therefore for planning purposes the utilization rate has been set at 80% of capacity for instructional times and at 20% for administrative times.

Need for Multiple Channel System

As shown in table 2 a single channel system will accommodate 26 courses each year. Since the university currently offers 188 courses at off campus locations, a single channel system will

Table 2

Telecommunication System Maximum Capacity

	Number of Courses		---- Number of Hours ----		
Time	/sem.	/year	/week	/sem.	/year
Instructional					
Fri/Sat/Sun	5	15	15	225	675
4:30 - 9:15 (Monday - Thursday)	6	18	19	304	912
SUBTOTAL	11	33	34	529	1587
Maximum Cap. (80% of Capacity)	9	26	27	423	1270
Administrative					
8:00 - 4:00 (Monday - Friday)	NA	NA	40	NA	2080
Maximum Cap. (20% of Capacity)	NA	NA	8	NA	416
TOTAL	9	26	35	423	1686

meet the needs of only about one eighth of the statewide course offerings. The system capacity can be expanded in two ways. The system could be configured to allow multiple courses to and from the same locations at the same time. The system could also be configured so that two groups of sites could be running simultaneously. For example, Denver could be connected to Colorado Springs while another course is running at Greeley, Pueblo, and Grand Junction.

A dual channel system would provide additional time slots for course offerings. The dual channel system would have the capacity shown in table 3.

Table 3

Dual Channel System Maximum Capacity

	Number of Courses		---- Number of Hours ---		
Time	/sem.	/year	/week	/sem.	/year
Instructional					
Fri/Sat/Sun	10	30	30	450	1350
4:30 - 9:15 (Monday - Thursday)	12	36	38	608	1824
SUBTOTAL	22	66	68	1058	3174
Maximum Cap. (80% of Capacity)	18	54	54	846	2539
Administrative					
8:00 - 4:00 (Monday - Friday)	NA	NA	40	NA	2080
Maximum Cap. (20% of Capacity)	NA	NA	8	NA	416
TOTAL	18	54	62	846	2955

Redundant System

Any system should be designed so that there is redundancy in the delivery system. Even with the best planning and maintenance there is the possibility that the system, at some point, may fail. If this failure should occur during a course, there should be a means to communicate over an alternate system. This alternate system will be a voice only system using the existing university telephone switch.

Video (Presentation) Subsystem

This section enumerates the various transport systems under consideration for the distance education system. The systems considered include 1) compressed video, 2) vertical blanking interval video, 3) satellite, and 4) audiographic. In addition, for comparison purposes, costs are included for delivering the instruction live with the faculty member driving or flying to the remote site. The following systems wer- not considered appropriate for this project due to cost and technical limitations: 1) broadcast television, 2) instructional television fixed service (ITFS), 3) full motion video over fiber or coaxial cable, and 4) microwave transmission.

Compressed Video

Compressed video is an electronic delivery system with the capability for having live interaction between instructor and students with both audio and video in virtually real time. An advantage of this system is that the transport system, the T-1 telephone line, exists almost universally wherever there is telephone service. Since the television signal must be compressed for transmission over the telephone line the picture is slightly less than full motion quality.

Compressed video is a multimodal delivery system which allows the instructor and the students to see and hear each other during the actual instruction. In addition this system utilizes a variety of presentation techniques which allow the transmission of still graphics, images of three dimensional objects, and transparencies, during the instruction. Peripheral equipment that can be utilized are: video cassette recorder, laserdisc player, printer, and FAX machine. Instructors and students also have access to other electronic resources such as electronic mail, electronic bulletin boards, and educational databases.

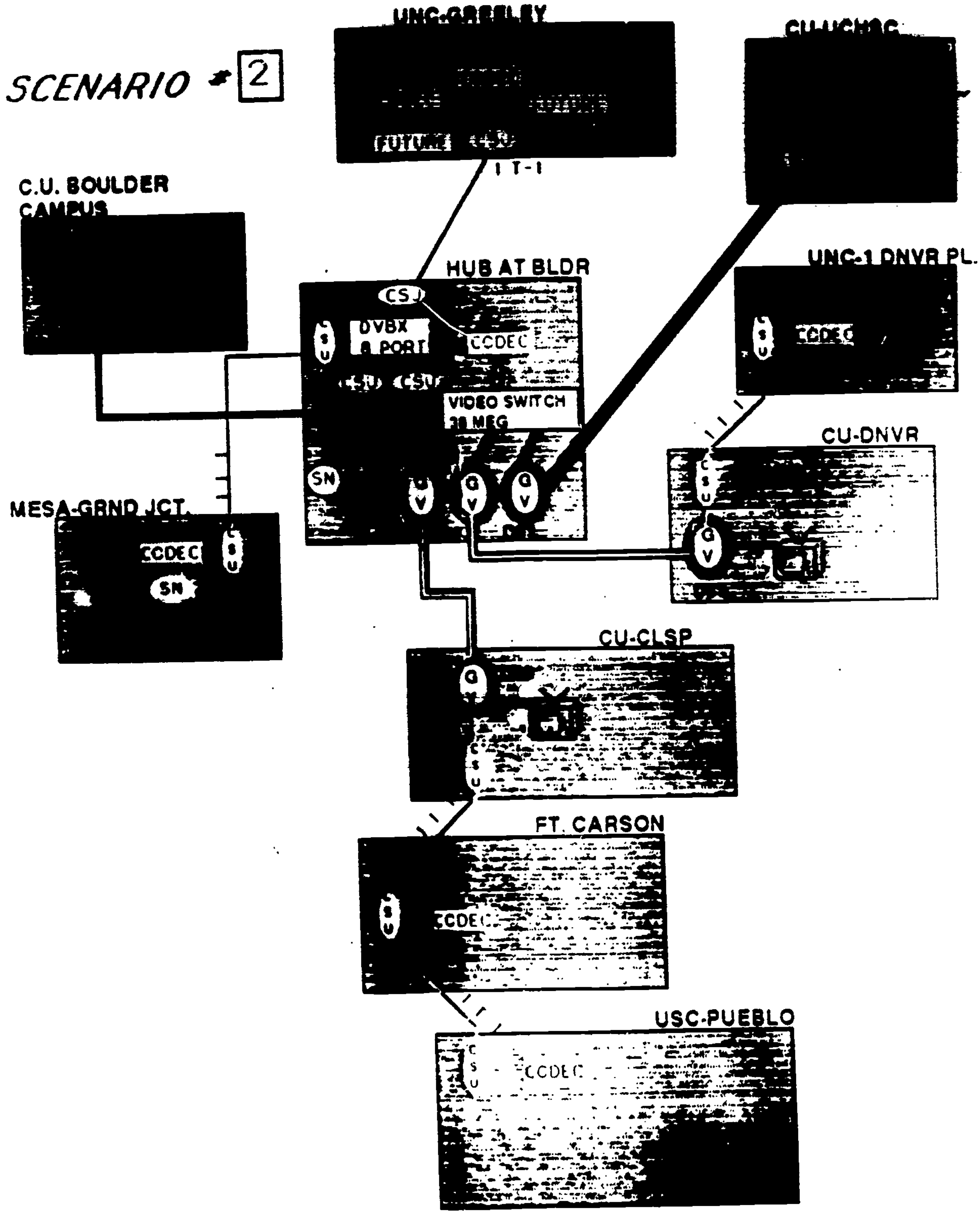
The compressed system will connect the major metropolitan areas of the state including Greeley, Denver, Colorado Springs, Pueblo, and Grand Junction.

The compressed video system will run over T-1 telephone lines. The T-1 lines from Greeley, Denver, Colorado Springs, Pueblo, and Grand Junction will be connected through a multiple access unit located in Boulder. The links from Colorado Springs and Denver to Boulder will be on the existing University of Colorado fiber optic cable. The Pueblo T-1 would be connected through Colorado Springs. This system would allow any combination of sites to be interconnected.

The configuration of the compressed video network is shown in figure 1. The central switching of equipment located in Boulder will be remotely controlled from the University of Northern Colorado. All T-1 telephone lines will terminate in Boulder. The compressed video system will utilize one quarter of a T-1 (384Kbs) for each compressed video signal.

The equipment needs for a compressed video system are as follows. Each classroom site will have a video CODEC

Figure 1.


SCENARIO #2
C.U. BOULDER CAMPUS
HUB AT BLDR
CSU
DVBX
CCDEC
VIDEO SWITCH
T-1
SN
UNC-1 DNVR PL.
CCDEC
CU-DNVR
MESA-GRND JCT.
CCDEC
SN
CU-CLSP
FT. CARSON
CCDEC
USC-PUEBLO
CCDEC

(compressor/decompressor) capable of supporting the Px64 standard at 384Kbs. The channel service unit (CSU) is an electronic device that connects the T-1 lines to the CODECs and multiple access unit (MAU). The MAU is a switching device for connecting multiple CODECs. Each classroom will have two cameras, a presentation stand, 4 monitors, microphones, and other associated equipment. The classroom configuration and equipment needs are described in the WIDE publication entitled "Considerations for the Optimal Design of a 2-Way Interactive Distance Education Classroom". The summarized equipment costs for compressed video are enumerated in Table 4.

Table 4

Compressed Video Equipment Costs

Equipment	CODEC	CSU	MAU	Classroom
Greeley	39000	5300		28445
Boulder		21200	70000	
UC Denver		5300		
Denver	39000	5300		28445
UC Colorado Springs		5300		
Colorado Springs	39000	5300		28445
Pueblo	39000	5300		28445
Grand Junction	39000	5300		28445
TOTAL (all sites)	$465,525			

Leasing Option @7.95% Annual Percentage Rate $9366 /month

The estimated costs for the T-1 telephone lines connecting the various sites are listed in table 5.

Table 5

T-1 Telephone Lines Charges

	/ Month	/ Year	/ 5 years
Greeley to Boulder	1037	12444	62220
Boulder to Grand Junction	3184	38208	191040
CU Denver to UNC-Denver	340	4080	20400
CU Co Springs to Ft. Carson	510	6120	30600
Ft. Carson to Pueblo	935	11220	56100
UCB to UCD & UCCS	250	3000	15000
TOTAL	6256	75072	375360
Installation of T-1 Lines			6776

Assuming a useful life on this system of five years and a maintenance cost of 10% of the capital expenditure the annual cost for the compressed video system will be as follows.

Table 6

Total Network Cost and Average Annual Cost

	Year				
	1	2	3	4	5
Equipment	112392	112392	112392	112392	112392
Maintenance	0	46553	46553	46553	46553
T-1 lines	81848	75072	75072	75072	75072
TOTAL	194240	234017	234017	234017	234017

Grand Total $1,130,308

Average Annual Cost $226,062

This average annual cost of $226,062 amortized over the planned 1686 hours of utilization will result in a cost of $134 per hour. The annual cost amortized over only the 1270 instructional hours will result in a cost of $178 per hour. Both of these costs include the equipment, classroom, and transport costs but do not include classroom remodeling, the costs for instructors nor other support staff.

A dual channel system will require all of the above equipment and T-1 costs. In addition another CODEC ($39,000) and classroom ($28,445) will be needed at a cost of $67,445. This will increase the total equipment cost to $532,970 or a monthly payment of $10,723. The costs for the T-1 telephone lines will remain the same as above.

Table 7

Total Dual Channel Network Cost and Average Annual Cost

	Year				
	1	2	3	4	5
Equipment	128676	128676	128676	128676	128676
Maintenance	0	53297	53297	53297	53297
T-1 lines	81848	75072	75072	75072	75072
TOTAL	210524	257045	257045	257045	257045

Grand Total $1,238,704

Average Annual Cost $247,741

This average annual cost of $247,741 amortized over the planned 2955 hours of utilization on the dual channel network will result in a cost of $84 per hour. The annual cost amortized over only the 2539 instructional hours will result in a cost of $98 per hour. Both of these costs include the equipment, classroom, and transport costs but do not include classroom remodeling, the costs for instructors nor other support staff.

Vertical Blanking Interval Video

Vertical blanking interval (VBI) video is a slow scan video transmission system that is carried along with the regular television broadcast signal. The vertical blanking interval is the black line that appears at the bottom of a regular television picture when the screen rolls. The VBI is used to carry several signals the most common of which is closed captioning for the deaf. The VBI slow scan image, a still picture that changes every eight seconds, is transmitted along with regular programming and is not normally seen by the broadcast viewer. By connecting a decoder to the television set, the images can be viewed in any location that can receive the broadcast signal. The video is carried in the vertical blanking interval of a broadcast television station.

By utilizing the VBI of television station KRMA in Denver virtually every location in Colorado, except Pueblo, can be reached with a VBI signal. The Pueblo area can be reached through the Pueblo public television station. The audio must be carried on a separate audio system.

There are four major transport costs for the vertical blanking interval system, namely encoder box, decoder box, telephone line to television station, and television broadcast time. The receive sites would be located at each site currently (or planned) offering a program.

The origination site classroom will have a camera, a presentation stand, 3 monitors, microphones, and other associated equipment. The classroom configuration and equipment needs are described in the WIDE publication entitled "Considerations for the Optimal Design of a 2-Way Interactive Distance Education Classroom". Each receive site will be equipped with a color monitor at $900 and an audio conference telephone at $2995. The summarized equipment costs are enumerated in Table 8.

Table 8

Vertical Blanking Interval Equipment Costs

Equipment	5 sites	11 sites
Encoder box	15000	15000
Decoder boxes	25000	55000
Origination Classroom	22467	22467
Monitor	4500	9900
Conference Telephone	14975	32945
TOTAL	81942	135312
Leasing Option @7.95% APR	$1649	$2722 /month

The video signal must be sent to the television transmitter in Denver. This can be carried over a voice grade phone line at approximately $11 per hour. The cost for 1270 hours of instruction will be $13,970. The cost for transmission time on the vertical blanking interval is $900 per month or $10,800 per year.

The audio component must be carried over a separate audio network. This will be a bridged multi-way conference call. The estimated cost to connect 5 sites simultaneously is $43 per hour. The annual cost for 1270 hours of instruction at 5 sites is approximately $54,610. The estimated cost to connect 11 sites simultaneously is $108 per hour. The annual cost for 1270 hours of instruction at 11 sites is approximately $137,160. The transport costs for five and eleven site systems are enumerated in tables 9 and 10.

Table 9

Vertical Blanking Interval Transport Costs for 5 Sites

	/ Month	/ Year	/ 5 years
Broadcast Time	900	10800	54000
Video Line	1164	13970	69850
Telephone Lines	4551	54610	273050
TOTAL	6615	79380	396900

Table 10

Vertical Blanking Interval Transport Costs for 9 Sites

	/ Month	/ Year	/ 5 years
Broadcast Time	900	10800	54000
Video Line	1164	13970	69850
Telephone Lines	11430	137160	685800
TOTAL	13494	161928	809640

Assuming a useful life on this system of five years and a maintenance cost of 10% of the capital expenditure the annual cost for a five site system is shown in tables 11.

Table 11

Total Vertical Blanking Interval Cost with 5 Sites

	Year				
	1	2	3	4	5
Equipment	19788	19788	19788	19788	19788
Maintenance	0	8194	8194	8194	8194
Broadcast	10800	10800	10800	10800	10800
Video Line	13970	13970	13970	13970	13970
Telephone	54610	54610	54610	54610	54610
TOTAL	99168	107362	107362	107362	107362

Grand Total $528,616

Average Annual Cost $105,723

The annual cost of $105,723 for 5 sites amortized over the 1270 instructional hours will result in a cost of $83 per hour.

Assuming a useful life on this system of five years and a maintenance cost of 10% of the capital expenditure the annual cost for an eleven site system is shown in tables 12. The annual cost of $205,419 for 11 sites amortized over the 1270 instructional hours will result in a cost of $162 per hour.

Since this system is not generally appropriate for administrative purposes this use has not been calculated. These costs include only the origination, transport, and classroom costs but does not include classroom remodeling, the instructor nor the support staff costs.

Table 12

Total Vertical Blanking Interval Cost with 11 Sites

	Year 1	Year 2	Year 3	Year 4	Year 5
Equipment	32664	32664	32664	32664	32664
Maintenance	0	13531	13531	13531	13531
Broadcast	10800	10800	10800	10800	10800
Video Line	13970	13970	13970	13970	13970
Telephone	137160	137160	137160	137160	137160
TOTAL	194594	208125	208125	208125	208125

Grand Total $1,027,094

Average Annual Cost $205,419

Satellite Video

Satellite delivery is an effective way to deliver instruction to a large number of students at one time. Satellite delivery allows full motion one-way video and one-way audio from one location to several sites. The quality of the full motion picture is extremely high. The audio is usually sent, along with the video, one way from the instructor to the students. Satellite delivery includes the option for sending several types of video signals (e.g. videotape, computer graphics) thereby expanding its instructional use.

For comparison purposes the costs for a satellite based system have been included in this report. The least costly uplink available to UNC is the uplink at the University of Colorado Health Sciences Center. To access this uplink, DS3 service (fiber optic) will be needed from UNC to Boulder. The cost of this DS3 service is $4651 per month ($55,812 per year). The installation of the DS3 service will cost $1618. The cost for uplink rental at $100 per hour is $127,000 for 1270 instructional hours. The transponder time at $150 per hour will cost $190,500 for 1270 hours. UNC will need an origination site classroom at a cost of $28,445. Since many public schools around the state already have satellite down links and are willing to have the UNC utilize them for course delivery there will not be a cost to UNC for down links. The five year lease price on this equipment will be $572 per month or $6,864 per year. The maintenance cost will be $2,845 per year.

In addition to the satellite feed, there will a need for an audio bridge for return audio. This will be a bridged multi-way conference call. The estimated cost to connect 5 sites simultaneously is $43 per hour. The annual cost for 1270 hours of instruction at 5 sites is approximately $54,610. The costs to utilize satellite delivery are enumerated in table 13.

The annual cost of $437,386 for 5 sites amortized over the 1270 instructional hours will result in a cost of $344 per hour. An advantage of the satellite system over other systems is that many of the costs are incurred as the system is used rather than being a fixed amount that will be expended regardless of usage level. Since this system is not generally appropriate for administrative purposes this use has not been calculated. This cost includes only the origination, transport, and classroom

Table 13

Satellite Delivery System

	Year 1	2	3	4	5
DS3 Fiber	55812	55812	55812	55812	55812
DS3 Inst.	1618	0	0	0	0
Uplink	127000	127000	127000	127000	127000
Trans.	190500	190500	190500	190500	190500
Equipment	6864	6864	6864	6864	6864
Maintenance	0	2845	2845	2845	2845
Telephone	54610	58610	58610	58610	58610
TOTAL	436404	437631	437631	437631	437631

Grand Total $2,186,928

Average Annual Cost $437,386

costs but does not include classroom remodeling, the instructor nor the support staff costs.

Audiographic System

Audiographic systems deliver two way slow scan video over regular telephone lines. The video images are replaced on the screen every 30-40 seconds and may be left on the screen for as long as desired by the instructor. Both the instructor and the students may send video images to each other.

The audio is carried over a separate telephone line in a typical conference call fashion. The quality of the audio is excellent because it is carried over voice grade telephone lines. A disadvantage is that the instructor and students can not see live movement of each other. For this reason this option is not appropriate for non-instructional uses such as administrative meetings, conferences, and advising. Instructors may also need to adjust their instructional strategies to accommodate the time consuming process of sending the series of pictures from one location to another.

The audiographic system will provide scanned visual images over regular telephone lines. The scanned images can be previously recorded images or images from a copy stand. The images at the receive site refresh every five to ten seconds. The audio is carried on a separate circuit.

The audiographic system would probably connect the major metropolitan areas of the state including Greeley, Denver, Colorado Springs, Pueblo, and Grand Junction. The system would run over dial up telephone lines. Each site would have an audiographic system unit and an audio conference telephone at $2995. The equipment needs for an audiographic system are as shown in table 14.

The estimated cost to connect 5 sites simultaneously is $43 per hour. The annual cost for 1270 hours of instruction at 5 sites is approximately $54,610.

The audio component must be carried over a separate audio network. This will be a bridged multi-way conference call. The estimated cost to connect 5 sites simultaneously is $43 per hour. The annual cost for 1270 hours of instruction at 5 sites is approximately $54,610.

Table 14

Audiographic Equipment Costs

Site	Audiographic Unit	Conference Telephone
Greeley	20378	2845
Denver	20378	2845
Colorado Springs	20378	2845
Pueblo	20378	2845
Grand Junction	20378	2845
TOTAL (all sites)	$116,115	

Leasing Option @7.95% Annual Percentage Rate $2336 /month

Assuming a useful life on this system of five years and a maintenance cost of 10% of the capital expenditure the annual cost for the audiographic system will be as follows.

Table 15

Total Audiographic System Cost

	Year				
	1	2	3	4	5
Equipment	28032	28032	28032	28032	28032
Maintenance	0	11611	11611	11611	11611
Video Line	54610	54610	54610	54610	54610
Telephone	54610	54610	54610	54610	54610
TOTAL	137252	148863	148863	148863	148863

Grand Total $732,704

Average Annual Cost $146,541

This annual cost of $146,541 amortized over the 1270 instructional hours will result in a cost of $115 per hour. Since this system is not generally appropriate for administrative purposes this use has not been calculated. This cost includes only the origination, transport, and classroom costs but does not include classroom remodeling, the instructor nor the support staff costs.

Live Instruction

An alternative to using an electronic delivery system is to have the instructor drive or fly to the remote site. There are two major cost groups, direct travel expenses and faculty time (travel and on site), associated with this mode of delivery. The first cost is direct travel expenses including lodging, per diem, auto mileage, and air fare. The respective costs for each site are enumerated in table 16.

Table 16

Travel Expenses for Each Location for 3 Credit Course

Location	Lodging	Per Diem	Auto	Air	Total
CO Springs	360	168	147	0	675
Denver	360	216	78	0	654
Fort Lupton	0	168	33	0	201
Grand Junction	360	168	78	900	1506
Gunnison	150	168	78	900	1296
La Junta	360	168	273	0	801
Pueblo	360	168	198	0	726
Sterling	360	168	114	0	642

Faculty time costs for travel and on site preparation are a hidden but real cost to the university. If the faculty were not spending time traveling to and preparing for the remote site instruction they could be doing other university activities. This is a lost opportunity cost. For purposes of determining these costs the average faculty hourly salary with benefits is figured at $37. The time to travel to each site and the cost in travel time is enumerated in table 17. The combined travel

Table 17

Time for Travel and On Site Preparation for Each Location for 3 Credit Course

Location	Time	Cost
CO Springs	21	777
Denver	15	555
Fort Lupton	10.5	389
Grand Junction	24	888
Gunnison	24	888
La Junta	36	1296
Pueblo	24	888
Sterling	18	666

expenses and faculty travel time costs are included in table 18. The actual cost for each site is determined by multiplying the cost per course times the number of courses at each location. The average cost per instructional hour to deliver courses at remote sites is $31. This is the amount that the university will

Table 18

Total Travel Expense and Time Costs for 3 Credit Course

Location	Expenses	Time	Total	Courses	Total Cost
CO Springs	675	777	1452	44	63[illegible]38
Denver	654	555	1209	92	111228
Fort Lupton	201	389	590	7	4130
Grand Junction	1506	888	2394	10	23940
Gunnison	1296	888	2184	3	6552
La Junta	801	1296	2097	4	8388
Pueblo	726	888	1614	16	25824
Sterling	642	666	1308	12	15696
TOTAL				188	259646

Average Travel Expense & Time Cost (3 Credit Course) $1381

Average Cost per Instructional Hour $31

save for each instructional hour for courses that are delivered over an electronic delivery system.

Summary

This study has included an investigation of four electronic distance education delivery systems including compressed video, vertical blanking interval video, satellite video, and audiographic systems. The actual costs for each of these systems and live instruction have been provided showing the relative costs to operate each system. The costs for each alternative are listed in table 19. All annual costs assume that the capital

Table 19

Comparison of System Costs

System	Annual Cost	Hours Available	Per Hour	Per Course
Compressed video (1 channel) (instruction only) 5 sites	226062	1270	178	8010
Compressed video (1 channel) (with administrative uses) 5 sites	226062	1686	134	NA
Compressed video (2 channel) (instruction only) 5 sites	247741	2539	98	4410
Compressed video (2 channel) (with administrative uses) 5 sites	247741	2955	84	NA
Vertical blanking interval 5 sites	105723	1270	83	3735
Vertical blanking interval 11 sites	205419	1270	162	7290
Satellite 5 sites	437386	1270	344	15480
Audiographic 5 sites	146541	1270	115	5175
Live Instruction	NA	NA	31	1395

equipment will be amortized over 5 years and that the maintenance cost will be 10% of the purchase cost. None of the costs listed include any instructor nor support staff costs. An explanation of each cost is enumerated in the body of this document.

The costs for the two channel compressed video and vertical blanking interval video (5 sites) are relatively equal at $84 and $83 per hour respectively. These are two least costly electronic system alternatives on a per available hour basis. The annual costs for these systems are quite different with the compressed video at $247,741 and the vertical blanking interval video at $205,419. The difference in the per hour cost is the 2955 hours available for the compressed video system versus 1270 hours available for the vertical blanking interval video system.

The least costly alternative is live instruction cost with the instructor traveling to the remote site. This is approximately one-third the cost of any other alternative. Clearly there must be some benefit to the electronic delivery system over just eliminating faculty travel and on site time to justify the additional expenditure.

One instructional benefit for any of the systems described above is the opportunity to spread a course out over an entire semester rather than cramming an entire semester into a few weeks. A common concern of both faculty and students is the current compressed format that requires five weeks of work to be taught in only one weekend resulting in information overload and fatigue for both the students and the instructors. When the instructors return to campus they are intellectually and physically "burnt out" for the next few days. Similarly, the students do not have sufficient time to study and think about the concepts presented in class before being presented with another set of concepts.

The telecommunication system has the potential to provide links between the university and the public schools of the state. By connecting the two together the university can offer courses in multiple school locations around the state. The schools can also benefit by sharing courses and instructors. This could be particularly beneficial for small schools in rural areas around the state.

Since the public school uses will generally be from 8:00 am until 3:00 pm when the various systems will have unused capacity the public school uses will not conflict with the university uses. The connections to the public schools will also provide electronic sites for the university to offer off campus courses.

There are some administrative functions that can be completed over the compressed video system. Among these functions are admissions interviews, financial aid counseling sessions, and meetings with staff scattered around the state.

The electronic delivery systems will also enable the university to serve currently unserved populations in remote areas. The number of potential students in many areas is much too small to justify offering a "live" course. With an electronic delivery system the students in these areas could receive university courses.

The decision to implement an electronic distance learning system in a state such as Colorado is a complex decision. The costs, both initial and operating, must be balanced against the potential benefits to the citizens of the state.