VIDEO TELETRAINING TO THE DESKTOP

Through Video Conferencing

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Abstract

Desktop video teleconferencing and net-based training are the hottest technologies being implemented today for personnel training and development. All branches of the military services, Fortune 500 companies and Universities are attempting to find a means of implementing this form of training delivery. Each realizes the potential cost savings for organizations who successfully implement desktop: advanced training, stand down training, just-in-time training, performance support, access to on-line college degrees, etc.

This paper will explore technology for desktop video conferencing as a method of training delivery. Design considerations needed to support successful desktop video conferencing are explored. Topics include interoperability, security, modes of data transmission, network performance characteristics, and applicable standards needed for promotion of open systems. The work was conducted at NAWCTSD, where an Advanced Distributive Learning (ADL) laboratory facilitated the exploration of software, courseware, and hardware products needed to implement distributive learning across Local Area Networks (LANs), Wide Area Networks (WANs), Internet and Intranet networks. The technical advantages of different delivery networks are explored, as well as the quality of the learning experience afforded by each of these options.

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In 1984 Ms. Foxx joined NAWCTSD (then known as Naval Training Systems Center) Reliability/Maintainability and Quality Assurance Division. Since that time she transferred to Project Engineering as the Project Engineer for Surface Devices 21D3 Swimmer Delivery Vehicle Trainers, 11G2 Phalanx Maintenance Trainer, Barge Ferry Concept Design, 19F5 Fire Fighting Trainer, the Army JANUS Trainer and Aviation – Coastguard HH-60 and HU-25 Helo trainers, and E-2C/C-2A Aircrew Trainers. Jacquie is currently Lead Project Engineer for the development of the ADL laboratory.

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BACKGROUND

This paper discusses the technology issues involved in delivery of instructor led or collaborative interactive training to the desktop as accomplished through desktop video conferencing. It outlines the issues confronting the NAWCTSD technical design team struggling to ensure delivery of cost effective Navy distributed learning.

In the business and education communities, we are familiar with large room video conferencing. Through video conferencing, we can participate in meetings, demonstrations and training. Today, a new type of video conferencing is available to Fortune 500 Companies around the globe " Desktop Video Conferencing (DVC)". Unlike large room video conferencing, which requires expensive hardware and software and possibly a satellite infrastructure, DVC can be successfully achieved by adding software and hardware to existing networked desktop computers.

With the advent of affordable DVC comes the ability to implement on-demand and just-in-time interactive multimedia instruction to geographically separated desktops.

ADVANCED DISTRIBUTED LEARNING (ADL) LABORATORY GOALS

The ADL laboratory's primary focus is to test and evaluate distributed learning interactive training strategies and materials over the Internet, intranet, Local Area Network (LAN), and Wide Area Network (WAN). The lab will evaluate distributed training management strategies and software, evaluate existing military education and training materials for delivery over a geographically dispersed networks, support collaborative test efforts, and develop initiatives with vendors.

For the fleet, DVC has potential in the areas of shipboard training while deployed, real time mission planning and coordination, and professional military education. It is currently being used for individuals who receive training while working at home, medical training, distance learning, sales, customer service, judicial systems and any other function requiring face to face communication without actually being physically located in the same place.

DVC DESIGN CONSIDERATIONS

Desktop Video Conferencing should not be judged only as a means to inexpensively educate or train large numbers of students; but by how well it provides a quality learning experience to individual students. That quality learning experience should include an appropriate amount of interaction between students and the learning material, between students and instructors, and between students and their fellow students. Barriers to a quality learning experience can be classified as effects of audio/video transmission delays, limitations to realism of interpersonal interactions, and reduction in information transmitted and received.

During Desktop Video Conferencing mediated learning sessions, attention must be paid to turn-taking, encouraging individual student participation, identifying the speaker, and communication clarity. This is especially important when remote students are communicating by audio only. Additionally, adding a view of the speaker to the speaker's voice over a slide presentation as mediated by video conferencing, does not lead to the same experience as face-to-face learning communication (Schiller & Mitchell, 1992). Smoothness of speaker's motion, resolution of speaker image, audio synchronization, ability to present multiple high-resolution windows (speaker in motion and speaker's slides) are all important to the quality of the student's learning experience.

Many studies (Edigo, 1988; O'Malley et al., 1992; Bruce, 1994) have indicated that low resolution two-way video conferencing cannot serve as a direct replacement for face-to-face communication. Low-resolution video conferencing filters out and distorts many of the, often unconscious, signals which enhance communication in face-to-face situations. These signals include lip reading, body movement, gaze, and eye contact. High video resolutions and appropriate video frame rates are needed if Desktop Video Conferencing is going to

offer a learning experience to match face-to-face situations.
Desktop video training via DVC should provide an illusion that will allow people to look and feel like they are all sharing the same space. To acquire that illusion depends upon the quality of service (QOS) received for audio and video being used.

Audio and video must be captured from their analog form and converted to digital code that is manipulated by the computer (Rettinger, 1995). Uncompressed, this data would require massive amounts of bandwidth to transmit, therefore the data is compressed before it is sent over communication channels. Video quality is a function of frame rate, pixel resolution and monitor size. Video should be clear with rich colors, and it should be free of jerky movement, ghosting, freeze frames or other unusual anomalies. The way to eliminate such problems is simply to have adequate bandwidth. This and three other related issues are explored in the section “network performance characteristics.”

Video compression is normally lossy, meaning some of the information is lost during the compression step. This is acceptable though, because encoding algorithms are designed to discard information that is not perceptible to humans or information that is redundant. The ability of video and audio compression engines (called Codecs) to deliver good quality audio and video, given network bandwidth constraints, is partly responsible for the resulting perception of quality. Another important factor determining the perceived audio/video quality is the network itself. Unreliable or slow connections can destroy video and audio quality, no matter how good the monitor, or the speakers, or the Codec. These transmission issues are addressed in the section “modes of data transmission.”

Another important design issue is whether or not the application selected for desktop video teleconferencing will be acceptable to the users. The DVC implementation must have an open architecture that meets current users' needs and evolves as the standards are defined. The video and audio quality, integration issues such as color map problems with other applications, and user interface issues need to be assessed in the environment where the software will be fielded. More importantly, the images need to adequately display the training material being presented. These issues are covered in the “Interoperability” section of the paper. Related to this area is the fourth section, entitled “Security.” Security pertains to issues such as firewalls that must be crossed if DVC is to be accessed by users in remote locations.

UNDERSTANDING DESKTOP VIDEO TELECONFERENCING TECHNOLOGY

The goal of using desktop videoconferencing technology to accomplish distributed learning activities is to provide an illusion – so that participants (whether instructor or students) look and feel like they are all sharing the same time and space, with each location an extension of the other sites that is seen through a “window” of the monitor or other display device being used (Covell, 1998). Training success cannot be attained until the technology is no longer noticeable and fades into the background with videoconferencing participants focusing only on their instructional interactions and the learning tasks.

To design the most cost-effective DVC system, including the desired technology transparency, one needs to understand the enabling technology and functionality of each design factor. Understanding each would put us in a better position for selecting equipment and appropriate supporting technology. The primary technology issues addressed in this paper include:

- Network performance characteristics
- Modes of data transmission
- Interoperability
- Security

NETWORK PERFORMANCE CHARACTERISTICS

Successful DVC depends on the underlying network to deliver four vital performance characteristics (Covell, 1998). They include:

- Isochronous transmission - This describes the regularly timed delivery of data. Video and audio delivery must be sent and received continuously and in a synchronized fashion. Any irregularities in the transmission of either or both media streams will have a perceptible negative impact on the audio and video QOS.

- Bandwidth - The transport medium should have sufficient space allocation to transmit video, audio, and data at levels of quality that let you see facial expressions and movements, hear comments and work on documents. 128 Kbps is the minimum threshold for achieving training quality audio/video transmissions.

- Low latency – The transport option should facilitate voice and video transmission with minimal delay to enable you to carry on interactive sessions.

- Resource contention - An ideal transport medium will not require the user to contend with other users for bandwidth. A user should be guaranteed a fixed amount of bandwidth at all times to transmit video, audio, and data. Unfortunately, most proposed DVC applications assume cost-efficiencies will result by leveraging existing network resources.

DVC systems utilize compressed digital video for the transmission of motion images over data networks. The video compression process reduces the amount of data transmitted over the lines by transmitting only the changes in the picture. By minimizing the bandwidth that is required to transmit the images, video compression also reduces transmission cost.

MODES OF DATA TRANSMISSION

As instructional messages are encoded, transported, and decoded by Desktop Video Conferencing technology, the essential consideration is the richness of the communication and the sense of group presence that usually accompanies face-to-face learning encounters. The dynamics of the learning experience can be dramatically changed when the learning interactions suffer from low Desktop Video Conferencing quality of service.

Inter-communication delays cause performance degradation on a collaborative task when either audio or video is delayed (O'Malley et al., 1994). This is particularly obvious in the inability of students to ask questions appropriately if the instructor has already continued with the next piece of information.

Desktop videoconferencing systems can transmit and receive data in many ways, including Plain Old Telephone Service (POTS), Integrated Services Digital Network (ISDN), high speed digital subscriber lines (T-1, T-3, or T-4), cable television and satellite transmission, LAN/WAN, Internet, Asymmetric Digital Subscriber Line (ADSL), Asynchronous Transmission Mode (ATM), and multicast backbone (MBone). Each of these is defined in the next section and the pros and cons for training delivery are discussed.

POTS Transmission

POTS (Plain Old Telephone Service) is the basic analog telephone service used for voice communications. This service is widely available but has very low bandwidth. Since POTS is an analog service, a modem is required for transmitting DVC digital signals over POTS. A modem *modulates* digital signals from a computer or other digital device to analog signals for transmission over conventional copper twisted-pair telephone line and *demodulates* the analog signal and converts it to a digital signal for the digital device. Presently POTS data transmission is limited by modem technology to 56 kilobits per second (commonly known as 56kbps or 56K). However, 56K may not be realized for all transmissions. There are very few desktop videoconferencing products that attempt to operate at the rates POTS and 56K modems offer. This technology provides poor QOS, with half-duplex audio and jerky video delivery. Currently, POTS and 56K modems can not produce full screen video at acceptable frame rates. If POTS lines and the Internet are your means of training delivery, it would be better to wait a year of two for improved QOS.

ISDN Transmission

ISDN conferencing is a digital service. There are two access rates defined for ISDN, Basic Rate Interface (BRI) and Primary Rate Interface (PRI). BRI provides two data channels of 64 Kbps (B channels) and one signaling channel of 16 Kbps (D channel**)**. There are many DVC products on the market that utilize ISDN BRI. PRI provides 23 or 30 B channels of 64 Kbps and one D channel of 64 Kbps. Unfortunately, ISDN PRI is expensive and not really cost effective for desktop video. ISDN BRI offers minimally acceptable QOS and is available globally. Single line ISDN with two channels at 128K is adequate for basic DVC QOS. A direct link between two ISDN adapters offers almost four times the bandwidth of a modem to modem connection and improves video quality substantially (Lauriston, 1998). Expect 15 frames per second, or less, (jerky motion) with full screen video. The real contrast here is the cost of end-user access to an ISDN line.

T-1, T-3 or T-4 Line Transmission

DVC sessions often utilize dedicated T-1 lines. These high-speed lines are very effective for videoconferencing, but they are usually leased circuits with an expensive monthly cost. The fixed monthly charge is based on distance, not usage. DVC can operate at different data rates, at various fractions of T-1 capacity, enabling the transmission of multiple simultaneous videoconferences over the same T-1 circuit. A DVC system can share a T-1 circuit with other digital data formats such as Internet transmissions or file transfers.

The term “T-1” originated with the Telephone Company as a very specific type of physical equipment. The T-1 line had cable pairs, digital transmission, and regenerated signals at 6,000 feet intervals. The term “T-1” now refers to the Digital Subscriber (DS)-1 rate more than the cable system.

DS-1 or T-1 has a transmission rate of 1.544 Mbps. Improvements to the capacity of the original T-1 created an entire range of digital signal levels, and corresponding cable systems. (See Table 1.) This technology receives an excellent audio and video QOS, but can be too expensive for a single user. An ideal situation would be to leverage using the organization’s T-1. A T-1 line is extremely fast; allowing speeds from 32K to 128K CPS.

Table 1. Digital Signal Levels

Digital Level	Digital Bit Rate	Carrier System
DS-0	64 Kbps	-
DS-1	1.5444 Mbps	T-1
DS-1C	3.152 Mbps	T-1C
DS-2	6.312	T-2
DS-3	44.736	T-3
DS-4	274.176	T-4

Cable Television and Satellite Transmission

Cable modems allow computers to connect to ISPs via cable-TV boxes or satellite systems. Still new, this technology allows your computer to receive data at speeds rivaling the T-1, but may require a standard voice/POTS modem to let your computer send data. Requires additional equipment but should be considered as the availability of the technology becomes more affordable. This delivery method has good promise of meeting the highest QOS training requirements, at an affordable price to a very wide audience.

LAN Transmission

Local Area Networks (LANs) are common on campuses and in companies to connect desktop computers together. At the physical layer, LANs usually consist of 10 Mbps Ethernet, or four or sixteen Mbps Token Ring segments. The difference between Ethernet and Token Ring is how clients gain access to the medium for transmission. Ethernet is a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) network where clients transmit data and listen to detect collisions. If a collision occurs, the client waits a random amount of time before trying to transmit again. Token Ring is a network where a token is passed around and clients must gain access to the token ring before transmitting. While in-house DVC can work, such applications fail a test of common sense, due to the fact that individuals sharing a common LAN should be able to easily meet face-to-face at the same facility. It may be an option to consider at facilities lacking a training or large meeting room facility.

Internet Transmission

LANs provide connectivity among a local community. The internet connects LANs to other LANs. The protocol developed to interconnect various networks is called the Internet Protocol (IP). Two transport layer protocol with IP, TCP, and UDP. Transmission Control Protocol (TCP) provides a reliable end to end service by using error recovery and reordering. User Datagram Protocol (UDP) is an unreliable service making no attempt at error recovery.

Desktop videoconferencing applications that operate over the Internet primarily use UDP for video and audio transmission. TCP is not practical because of its error recovery mechanism. If lost packets were retransmitted, they would arrive too late to be of any use. TCP is used by some of video conferencing applications for other data that is not time sensitive such as whiteboard data and shared application data. This is also a goal of the lab, transmitting data through the Internet. The bottom line (at this point in time) is to avoid DVC broadcast to multiple users via the internet, due to its inherent unreliability and delivery protocols.

Asymmetric Digital Subscriber Line (ADSL) Transmission

ADSL is a fairly new technology, allowing telecommunications managers to get more bandwidth to users without the labor and expense involved in replacing existing twisted pair copper wiring with fiber. ADSL is faster than modem transmission or ISDN, and is said to be ideal for Internet and local-area network access. You don't have to upgrade your POTS wiring or install fiber to use ADSL. There are products available that encompass modems; hub switches and modules to manage account information to ensure privacy. This is probably a reasonable way to go; data on ADSL's effectiveness is being evaluated. There are only a few users in the community currently applying this technology.

Asynchronous Transfer Mode (ATM) Transmission

Asynchronous Transfer Mode (ATM) is the best form for transmission of digital packet data, because ATM has virtually unlimited bandwidth. This would provide the best means of transmission, but again, affordability is a major issue. This technology offers large, medium and small switches and can link legacy systems even desktop computers.

Multicast Backbone (MBone) Transmission

The Multicast Backbone, or MBone has been called a virtual network because it is layered on parts of the Internet. Using the MBone, it is impossible to transmit audio, video and other data in real-time to multiple destinations throughout the global Internet.

The MBone originated in 1992 from an experiment to transmit live audio and video from meetings of the Internet Engineering Task Force (IETF). The name was inspired by the name of the European backbone network "EBONE."

To understand how the MBone works, it is important to understand the difference between unicast and multicast. Unicast is a point-to-point transmission of data. To achieve a one-to-many transmission with unicast, separate copies of the data must be sent by the source to each destination. Multicast enables a more efficient way to deliver the same data to multiple destinations.

Point to point Transmission

Video Teletraining (VTT) has been utilized to connect two locations using sophisticated computer technology. The core of the VTT is the Codec (coder/decoder). This is the electronic device that transmits and receives the video signal that class members will see on their television monitors. Its function is similar to that of an extremely sophisticated modem. In addition, various forms of instructional technology can be integrated into a VTT transmission, including pre-recorded video, student response microphones, remote site cameras, and computers. VTT has been reported to be a cost-effective method of delivering training to geographically dispersed students when considering the travel costs of assembling all students at one classroom site (Belcher, 1997). DVC point-to-point sessions may prove more valuable for one-on-one tutoring and/or performance support applications.

Point to Multipoint Transmission

Some systems are also capable of simultaneously connecting more than two sites through the use of a multi-point control unit (MCU). Multi-point conferencing can be more cost effective than point-to-point conferencing although scheduling, technical, and logistical dimensions of MCU conferences can be challenging.

ISDN data transmission would provide the performance and quality of service needed in the lab for multi point control unit (MCU) technology. Provided is an example of how ITU standards correspond with methods of data transmission. (See Figure 2). Most MCU vendors operate with a proprietary server and require remote users to be configured with licensed software to send/receive images.

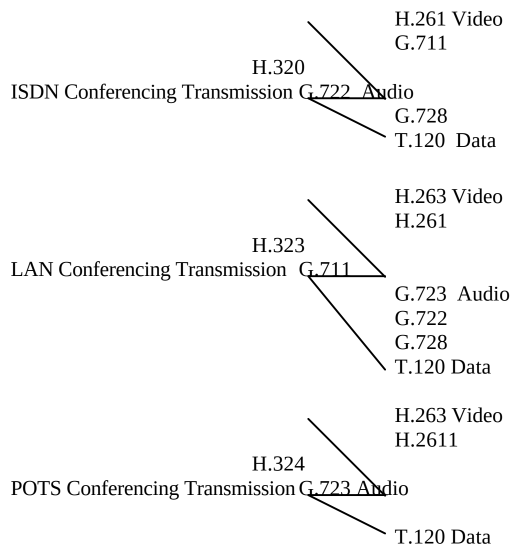

Figure 2. Data Transmission Corresponding With ITU Conferencing Standards

INTEROPERABILITY

While most DVC systems are configured in the same basic model, including a compact camera and single microphone that capture the sights and sounds of your desktop and the desktop you wish to interact with; the quality of transmissions will vary considerably with different network configurations. Desktop systems also routinely provide whiteboard, document sharing, and applications-sharing features, making them productive tools for professional collaboration. Until recently, these tools had been offered as proprietary extensions, but with the new International Telecommunications Union (ITU) T.120 suite of standards, vendors are now building interoperable collaboration tools into their products, significantly extending the functionality of desktop video teleconferencing systems.

Having the ability to interoperate with video teleconference users on other systems is a key design factor. The ability to use publicly switched networks provides the ease with which a system can service large number of participants. However, performance drops markedly when one compares a private dedicated high-speed link with shared LANs, and performance drops more with Intranets, and even more with Internet access systems. If high-quality images and rapid update rates are required for your training course, a shared Intranet or the Internet will likely be inadequate for meeting those training requirements. An ability to share applications and documents as well as audio and video, are considerations that will determine the overall flexibility and functionality of systems you'll be able to implement.

Interoperability among products and platforms are improving on an annual basis. The advantage to interoperability standards is that products from different vendors can communicate. Products are now conforming to the evolving desktop videoconferencing interoperability standards. Interoperability Standards are being developed through a collaborative effort including the International Telecommunication Union (ITU), International Multimedia Teleconferencing Consortium (IMTC) and the Personal Conferencing Working Group (PCWG). These working groups are working towards producing and promoting standards for desktop videoconferencing and videoteletraining.

This collaboration is recommending use of standards that address the requirements for data transmission. One such standard coming from ITU is H.320, titled "Narrow-band Visual Telephone Systems and Terminal Equipment." The H320 standard is a series of audio, video, and data recommendations (See Table 3).

Conferencing systems offered by different vendors have yet to interoperate seamlessly as possible with other telecommunication devices. Most require proprietary software and equipment to communicate. It is anticipated that the net-based training community will adopt current DVC technology with some reluctance and general disappointment, due to the poor video quality commonly available today on shared systems.

SECURITY

As described by Hall (1996), a Firewall is a software program, or a set of related programs, designed to provide security for your organization's network. If an organization has a firewall installed, they must release several of the ports the firewall controls in order to allow clients outside the firewall to use a video conference server. Information Technology Managers don't like to do this because the entire organization could be subjected to a security breach.

Corporations have firewalls to protect their corporate LAN structure. At times this could be a serious limitation. One solution is a gateway to the ISDN network. The ideal option is to go directly through the firewall for desktop DVC capability and Internet connection. An alternative is to negotiate with the IT Manager to have the ability to communicate with one other organization who can be identified with appropriate IP addresses.

Early design of firewalls picked a single network level, transport level or application level as the focus of security efforts. Companies designing successful firewalls now combine these strategies to improve network security. Even newer systems have added protocol-based attack detection and real-time break-in avoidance.

Table 3. International Telecommunication Union (ITU) Standards

H.320	Defining videoconferencing over interoperability over ISDN
H.323	A suite of standards defining interoperability of videoconferencing over packet switched networks with no guaranteed quality of service (QOS),
H.261	Same as H.320 and H.323,
H.263	Alternative compression for low bit rate communications
G.711 G.722 G.728	Used in H.320,
G.324	Audio compression for 5.3 And 6.5

	Kbps
H.324	Definition of video conferencing interoperability over POTS establishing low-bandwidth multiplexing control protocols.
H.263	Compress video for low bit Rate compression,
G.723	Only low bit rate Compression
V.80	Application interface for developing H.324 systems that convert synchronous data streams to modem asynch, enable rate adjustments during a call, and notify client software of lost packets
T.120	A suite of videoconferencing data collaboration standards that is included in the three H.32x standards described above,
T.124	Conference control standards
T.126	Standard for sharing still Images
T.127	Binary file transfer,
MPEG	Moving Picture Expert Group Broadcast and VHS quality
JPEG	Joint Photographic Expert Group Still Image coding for videoconferencing

Proxies that understand the application protocol can intercept traffic before it reaches the application layer. This allows them to filter or modify traffic based on application issues rather than simply by IP address or authenticated users. Today, more intelligent proxies are now available in our firewalls.

For training administrators, the lesson here is one must work with and negotiate toward a mutually acceptable method of integrating DVC with the organization's network security efforts. Those marketing DVC and net-based training often fail to provide that information to their potential customers. Delivery of DVC within an organization, behind a firewall does not present such problems, but may lack the previously mentioned test of common sense.

SUMMARY

This paper has identified some of the issues the NAWCTSD ADL team faced in coordinating appropriate DVC hardware applications to allow optimum delivery and evaluation of distributed interactive courseware content. Our ADL lab was compliant with the Navy's Information Technology for the 21st Century (IT-21) design, while at the same time leveraging the network capabilities existing at our own facility. We found there were limitations for the lab given our existing facilities' network structure, but these were not insurmountable. One major effort involved tackling the security issues related to going through our company firewall to permit transmission of audio and video to and from external remote sites.

There are a lot of DVC products available with specifications adequate enough to meet the needs of training today. In making decisions for DVC to meet training needs, the following should be considered:

Network Performance Characteristics

- Bandwidth (# of users)
- Isochronous Transmission
- Latency
- Resource Contention

Modes of Data Transmission

- POTS with 56K Modem
- ISDN
- T-1 T-3 or T-4 Line
- Cable or Satellite
- LAN/WAN/Internet
- ADSL
- ATM
- Multicast

Interoperability

- Computer Hardware and peripherals
- Application Sharing
- File Transfer

- Features
- Documentation
- Technical Support

Security

- Firewall

Types of Video Conferencing Software

- ProShare Conferencing Video System 200
- PictureTel Corporation's Live2000p
- PictureTel LiveLAN
- Sony Electronic Incorporated TriniCom 500
- VTEL Corporation's DVS 2000
- White Pine CU – SeeMe Videum V0
- Intel Create & Share Camera Pack

Video Teleconferencing Standards

- ITU Standards

CONCLUSION

Training via DVC will require high quality audio and streaming video in most situations. To do that effectively requires adequate bandwidth to handle the large amounts of data being transmitted without loss. The best transmission methods that fall into that category are T-1 Lines, ADSL and ATM. Currently, most DVC installations are using ISDN transmission due to reasonable pricing for ISDN. By installing an ISDN line for our lab, we accomplished the following:

- Direct access to the desktop
- Guaranteed quality of services (QOS)
- DVC can be tested over the least cost alternative first
- DVC was better over point-to-point ISDN than over the Internet
- ISDN is circuit-switched, where dedicated bandwidth and the connection is there as long as the two parties are communicating
- Readily available DVC conferencing solutions
- Don't have to share access with corporate structure

Costs of implementation is always a consideration in design choice. As for choosing ISDN one may end up assuming responsibility for the following costs:

- Installation
- Recurring use
- Internet Service Provider (ISP) for Internet access
- Long distance charges
- ISDN adapter

REFERENCES

Belcher, Stephen W. (1997). Methodology for Analyzing The Costs and Benefits of Video Tele-training, *Document Number CRM 96-117/March 1997, Center For Naval Analyses*, Alexandria, Virginia, March 1997.

Bruce, V. (1994). The role of the face in face-to-face communication: Implications for videophone design. In S. Emmott & D. Travis (Eds.) *Proceedings of the International Symposium on POTS to PANS: User issues in the multimedia revolution from Plain Old Telephony Services to Pictures and Network Services*. British Telecom: Hintlesham Hall, Suffolk.

Covell, A. B. (1998). Designing a Videoconferencing solution: Characteristics of a successful Videoconference solution, *Network Computing's Interactive Network Design Manual*, Network Computing On-Line, (http://www.networkcomputing.com/netdesign / video1.html), January 15, 1998.

Cox, Nancy, (1998). Building A Corporate Testing Lab, *Network Computing's Interactive Network Design Manual,* Network Computing On-Line, (http://www.networkcomputing.com/netdesign / labs1.html), January 15, 1998.

Edigo, C. (1988). Video Conferencing as a technology to support group work: a review of its failure. *Proceedings of CSCW '88*. pp13-24.

Hall, Eric. (1996). Internet Firewall Essentials, *Network Computing's Interactive Network Design Manual*, Network Computing On-Line, (http://www.networkcomputing.com/netdesign /wall1.html), November 15, 1996.

Lauriston, Robert (1998). What's Wrong With This Picture?: a review of test results of videconferencing technology, if it's finally ready for office use. PC World. Pp173.

O'Malley, C., Bruce, V., & Langton, S. (1994). The effects of delay on video-mediated communication. *British Psychological Society Conference, December 14-18, 1994*.

Rolf, Daniel. (1997). *Distance Learning and Tele-training*, (http://sky.fit.qut.edu.au/DataComms /Teach/units.972/itn530/ass/jeya/trans.htm), August 1997

Rettinger, Leigh A. (1995). Desktop Videoconferencing: Technology and use for Remote Seminar Delivery, *North Carolina State University Paper*, July 1995

Schiller, J., & Mitchell, J. (1992). Interacting at a distance: Staff and student perceptions of teaching and learning via videoconferencing. *AARE/ZARE Joint Conference on Educational Research: Discipline and Diversity, Deakin University, Geelong, Victoria*.