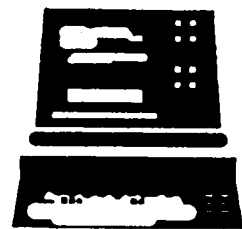


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IN MANAGEMENT INFORMATION,
COMMUNICATIONS, AND COMPUTER SCIENCES
(AIRMICS)

AD-A217 318

TECHNOLOGY ASSESSMENT OF VIDEO TELECONFERENCING

(ASQBG-A-89-010)

February, 1989

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THIS REPORT HAS BEEN REVIEWED AND IS APPROVED



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Video Teleconferencing (VTC)

I. Historical Review

"In 1927, a video teleconference took place between the president of RCA in New York and Herbert Hoover in Washington. Despite predictions that such meetings were soon to be commonplace, that video conference was more than 60 years ahead of its time." [1] As with many new technologies, the idea was good but the cost and stage of development of the technology was not mature enough to make the idea practical.

"At the 1964 World's Fair, videoconferencing was lauded as the precursor to a revolution in communications." [2] Dick Tracy converted his two-way-wrist-radio to a two-way-wrist-video, but few others followed so quickly. In fact, "AT&T's much-heralded Picturephone Meeting Service, a derivative of the mid-1960's model, was canned in 1985 because of lagging sales." [2] Public VTC services have not done well, but private networks are growing as new technology lowers the initial start-up cost and the cost of operation.

Two of the most often referenced private users of VTC are the Boeing Company and Aetna Life & Casualty Company. In 1984 Boeing installed a VTC link between its engineering offices and its test flight operations in Seattle, some 70 miles away. During the development of the 757, Boeing saved a million miles of car travel each year and was able to submit 757 test data to the FAA at least two months early. [3] Aetna started their VTC project in 1979 to link programmers in a suburban location to the headquarters in downtown Hartford. Besides the improved quality of meetings and the fact that meetings tend to stay on schedule, Aetna has documented over \$1 million in travel savings. [3]

On the government side VTC is expanding rapidly. In 1984 the Defense Communications Agency selected AT&T to provide VTC services within DoD. [4] The Navy is even planning for VTC facilities on all 21st century ships. [5] The Air Force is

planning a network to connect program offices and contractors. [6] The Army has several VTC initiatives and has invested millions of dollars to implement current networks.

II. Currently Available

A. Capability

There are three major types of VTC available today, they are: Ad hoc VTC, Slow-scan VTC, and Full-motion VTC. Ad hoc VTC refers to the transmission of a full-motion TV image from one site to many. This form of VTC has been mainly used for product announcements by companies and is usually done over a network of public VTC rooms on a one time basis. This approach is expensive, but effective in reaching a targeted group of people at one time. Slow-scan VTC transmits a picture over a low speed line (telephone lines), in a few seconds a retransmission occurs for only the parts of the picture that have changed. This low cost method is good for a few applications where very little motion is involved. Full-motion VTC most nearly recreates the face to face meeting. Depending on transmission rates, this method can approach the quality of a TV transmission. The major cost factors in this approach are transmission speed and the equipment to code and decode the signals. [11] [12] [13]

AT&T was awarded the contract for the Defense Commercial Telecommunications Network (DCTN) in March of 1984 for the period January 1986 to January 1996. DCTN is a leased communications service that provides voice, data, and video service for DoD and GSA. The major advance that DCTN provides over standard voice and data service is VTC. DCTN is the standard vehicle for VTC within the DoD. The use of any other network requires a waiver from the Defense Communications Agency (DCA). [4] [13]

DCTN provides a secure network with the capability of point-to-point, broadcast, or multipoint operations. By using T-1 lines a high quality Full-motion VTC is available.

[13] VTC technology has changed rapidly in the past four years, since the contract was awarded, and DCTN has not adjusted to allow lower cost alternatives.

While the Army has required use of DCTN for VTC, both the Navy and Air Force have gone in other directions. The Navy got an early start and has developed a good network which saves them money and time. The usage of the system is great enough to cause expansion both to new sites and additional facilities at current sites. The Navy is moving to tie their systems into DCTN for the communications capability, but they seem to plan to continue to build their own VTC sites rather than letting AT&T do it for them under the DCTN contract. [5] The Air Force is trying to establish a low cost VTC network outside of DCTN. The primary purpose would be to link Project Managers and contractors. DCTN is not being used because of high cost (\$300,000 to \$1 million for initial cost per site and \$25,000 in operating cost per month) and the current inability of contractors to link into DCTN. The Air Force plans to obtain a system that will cost about \$100,000 to \$150,000 per site. [6]

The Army has two standard VTC networks that are part of the DCTN communications network. The first network to be installed was the Army Material Command (AMC) Video Enhanced User System (VENUS). Work is being completed on the second network called the HQ DA Network. In 1986 AMC started VENUS by building ten dedicated VTC facilities at a cost of \$4.2 million (prices ranged from \$254,000 to \$506,000). During the first year of operation it was estimated that AMC saved \$843,000 in travel expenses above the cost of operating the system. [9] [10] The system can handle meetings at the SECRET level, however only 5% of all meetings are classified. The HQ DA Network is scheduled to have twenty sites when completed. [18] Even though both the AMC and HQ DA networks are on DCTN, there is only limited interaction allowed between the two networks. The limits come from security requirements and more importantly architectural limitations of DCTN.

The Army is planning a rapid expansion of VTC capabilities. Networks are planned for FORSCOM, TRADOC, the Army National Guard, and an AMC Depot system. Additionally, AMC plans a major expansion of the VENUS system. These changes will result in 57 additional Army sites.

B. Price / Performance / Quality

The greatest influence on price/performance/quality in the VTC area is the digital video compression device, the CODECs (COder/DECoders). The CODECs and their compression algorithms determine the quality of the picture and the cost of transmission which results from the amount of communications capability required to gain the desired quality. If the signal was not compressed, the cost of transmission could run as high as \$100,000 per month. [14] For Full-motion VTC the transmission rates from 56Kbs to 1.5Mbps (also called T-1), the cost of these communications channels also varies from \$24 to \$1000 per hour. [15] [16] It is easy to see that a reduction in transmission rate (and related cost) is desirable if quality can be maintained. Today there is a great deal of difference between a 56Kbps VTC and a 1.5 Mbps VTC. Progress over the last few years has produced dramatic improvements in the CODEC market both in price and quality. "The first CODECs compressed a 90-Mbits-per-second video signal to 3.136Mbps. Four years ago, the average codec cost \$165,000. Current models that compress those same signals to T-1 speed (1.544Mbps) or lower cost about \$80,000." [3] (This was in August 1986, in one of the paragraphs to follow we will see what has happened since this time.) Current technology allows a "good" quality picture to be transmitted at 384Kbps to 768Kbps. One of the problems that prevents greater use of the technology is the absence of standards. The lack of standards prevents the interoperability of networks and retards growth. Progress is being made on defining a standard for the 384Kbps transfer rate. [1] [14] DoD is trying to establish standards which will allow interoperability among VTC systems of all of the military services. [17]

C. Application to the IMA

There are many reasons that are given for using a VTC and not all apply in every case or are not of equal importance. People like people and the interaction between people is important. VTC is able to replicate the face-to-face meeting more realistically than any other information technology we have. VTC allows for the rapid exchange of information and ideas between individuals or groups of people in real time. This interchange includes interactions that cannot take place over the telephone. Group dynamics which are similar to, or the same as, a face-to-face meeting are present in the VTC meeting. Travel time required for meetings is greatly reduced. [7] It has been estimated that managers spend 40% of their time in meetings and 5 to 10% traveling. [8] Any reduction in these figures could produce time that managers could spend on more productive functions. It is difficult to document "hard" cost savings with VTC technology. The major area where cost savings can easily be documented is travel cost. Putting these points in military terms would say that VTC can reduce TDY, stop travel avoidance, speed up and involve more people in the decision making process, and minimize personnel hardships caused by TDY. [9] [10]

III. 1995 (Near Term)

A. Capability

With the maturing of ISDN and the development of VTC standards, VTC capability will greatly expand. ISDN will allow for an increased number of applications to be available to a larger segment of the user population. This increase will mainly be in the low speed end of the market. This year several Japanese companies have started marketing videophones in the United States in the \$400 to \$500 range. "Analyst, however, say it will be seven to 10 years before videophones become as commonplace as videocassette recorders." [24] The number of large dedicated rooms will not grow rapidly, but the number of modular or portable units will increase rapidly. The idea of

having a VTC unit to roll into your office or a unit on your desk will be fairly common. Interoperability of different VTC networks will increase and this will result in links between industry, universities and the government. A critical mass of users will fuel the expansion of VTC along with the continued push to reduce cost.

B. Price / Performance / Quality

Most of the VTC display technology is still driven by broadcast and industrial video practices, but as the use of VTC increases more pressure will be placed on manufacturers to address specific needs of VTC. Some of the trends that are apparent are that there will continue to be improvements in video and audio compression algorithms, along with improved echo cancellation. The cost of CODECs will continue to drop and the quality will continue to increase. Video quality at 112Kbps will be acceptable acceptable for many applications that currently use 384Kbps. Camera quality will increase and this will result in decreased need for special lighting and other expensive room features. Improved network management techniques will allow for multipoint and virtual networks. Graphics and display technology will improve greatly over the next five years, especially as standards emerge. [1] There is likely to be increased usage of Ku Band satellites in VTC. This will produce reduced cost and decreased interference with other signals. [1] [19]

The cost of VTC will go down dramatically. As with most new technologies the first people to use it pay a premium. While room rents for public networks are still high (\$1,000 to \$1,200 per hour) they are cheaper than building your own network, if your usage is low. [8] [20] DCTN cost about \$500,000 per room for construction and \$25,000 per month for operation [9], yet recent announcements by Contel indicate that they will provide unlimited service at \$5,000 to \$10,700 per month depending on the transmission rate desired. [22] [23]

The cost to build a VTC room will continue to decrease as it has over the past six years. Portable units will totally eliminate the need for VTC rooms for many applications. In 1982 a VTC room for high speed transmission cost \$1 million [3], in 1983 the cost was \$500,000, and today an equivalent service can be provide for \$95,000. [21] VTC rooms using low speed transmission were not available in 1983 and today cost between \$30,000 to \$49,500. [15] [16] [21]

Transmission cost will continue to drop. In 1983 756Kbps line cost \$1,500 per hour, today the same line cost \$450. [21] In 1988 a T-1 line cost \$1,000 per hour. [16] In 1983 a VTC could not be run on 56Kbps line, in 1986 it cost \$80 per hour to run a VTC at 56Kbps, today that line will cost \$24 [16] to \$45 [21] per hour to run.

The heart of the VTC is the CODEC and here cost will also continue to take a steep dive. The cost of a CODEC for high speed VTC has decreased from \$151,000 in 1983 to \$68,000 in 1988. [21] In 1983 there were no CODECs for low speed VTC and today they cost less than \$30,000. [21] It is even being predicted that with the advent of fiber optics the cost of high speed CODECs will drop to the \$4,000 to \$24,000 range. [8]

C. Application to the IMA

Reduced equipment cost and lower communications cost will fuel the development of a critical mass of VTC users. As with any new technology, there must be enough people or locations with the capability before I want to use VTC. With an increased number of VTC rooms, portable units, and videophones, the IMA customer will "discover" an ever increasing array of uses for VTC. One of the new applications that could create a significant demand is in the training area. [25] Discussions are currently under way to explore VTC for Reserve and National Guard training (this could result in over 1000 VTC installations). Recruiting will also become an important use of VTC for

the government. Just like the Xerox machine, we will at some point wonder how we ever got along without VTC.

IV. 2010 (Long Term)

A. Capability

VTC will be used in most offices. The full implementation of ISDN and computer networks will allow low speed units to be common in the office and home. Just as the fax, cellular telephone and personal computer have revolutionized our work environment, similar results will occur with VTC. In fact, many of the information technologies will be integrated into single units which can compute, fax, communicate, and transmit video from your desk.

B. Price / Performance / Quality

There is not much doubt that the technology will be available, the question will center on what we can afford. Individual VTC units will gain widespread acceptance when their price drops to the \$200 range. [24] Quality will continue to increase and color will become available at the lower speeds. If black and white pictures are acceptable the quality will be available at much lower speeds.

C. Application to the IMA

The IMA customer will continue to find new application for VTC. Meetings, training, and recruiting will continue to be strong VTC users. Another interesting use that will be feasible by this time will be working at home and using VTC to communicate with your boss or co-workers. One of the drawbacks to home-bound employees has been the lack of adequate ways to communicate. The use of videophones, even at low speeds, could make the dream of working at home (even a few days a week) a reality.

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