# Video Conferencing Trends in High Energy Physics ⋆

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The use of video conferencing technology (packet or circuit) has become the norm in facilitating participation in meetings by collaborators at remote institutions. The modest start-up costs and ease-of-use have made packet video and its associated tools (sdr, vat, vic, wb) very popular for those using Unix workstations. Commercial availability of these same tools for those with PCs will increase their use. At the same time, decreasing costs for circuit (H.320) based systems and greater availability of ISDN BRI service will increase their use as well.
The emergence of T.120 (shared data conferencing) and H.323 (video over IP networks) will have significant impact on the present video conferencing environment. Products supporting the standards offer the potential for better video using the same bandwidth and increased resolution for the display of viewgraphs and documents. This presentation addresses the current state of the technology and makes some predictions about changes in the way that it will be used in the future.

## 1 Introduction

In order to have a perspective about trends in HEP video conferencing, it's necessary to have an appropriate frame of reference. First a brief look at some milestones in the recent past and a snapshot of where HEP video conferencing is today is presented. Then a discussion of where video conferencing will be in a year to eighteen months is given, and some predictions about where things might be in three or four years are made.

⋆ This work was supported by the United States Department of Energy under contract DE-AC02-76CH03000

## 2 Recent History

High Energy Physics researchers began using circuit based video conferencing about seven years ago. A pilot project was initiated involving the SSC, Fermilab, and Lawrence Berkeley Laboratory in 1989. When the CHEP '91 Conference (Tsukuba, Japan) was held, usage had grown to include a number of CDF sites in the United States and two international locations (INFN/Pisa and KEK). There are a few key points to remember about these early efforts; a) all equipment was made by the same vendor for compatibility reasons, b) many of the conferences were multipoint, c) conferences were held at low bitrates (128 kbit/sec), and d) a mixture of dedicated bandwidth circuits and ISDN dial- up was used.

The next major undertaking was to convert the sites in the pilot program from the use of circuit derived bandwidth (from ESnet T-1 backbone circuits) to switched services. In places where ISDN Basic Rate Interface (BRI) service was readily available, that was easily done. At many sites, BRI was not available and the conversion involved getting an ISDN Primary rate Interface (PRI) from FTS- 2000 or a commercial carrier. With the installation of a PRI a site had the complexity of terminating/switching all those B channels; this was handled by the site telephone switch (PBX) when possible or by acquiring a small, dedicated ISDN switch (e.g. - Network Hub from Teleos).

The next milestone for HEP video conferencing was the centralization of video bridge (more properly called a multipoint control unit or MCU) services at Lawrence Livermore National Laboratory (and run by ESnet). While this may seem straightforward, it was a reasonably complex undertaking. The MCU was front-ended by a Teleos Network Hub which had a complex numbering plan and PRI circuits from three different carriers, AT&T FTS-2000, AT&T commercial, and PacBell. In addition to these hardware challenges, a software scheduling tool that was E-mail- and network-centric was developed. Getting the geographically- diverse user community to adopt a standard scheduling model was a problem as well.

In January of 1994, HEP use of video conferencing made another significant technical advance. The proprietary video bridge (MCU) was replaced by a standards-based unit. From this point , any codec complying with the H.320 standards specifications could participate in multipoint meetings. At least, that was the marketing view; the technical details were a little less certain. No standard is meaningful unless it has been independently implemented by two or more vendors, and then the interoperability of the products has been tested for compliance. A great deal of work was done by ESnet, HEPNRC at Fermilab, and manufacturers to resolve compatibility problems between the MCU and various vendor systems.

The last point that will be mentioned in this brief history is the introduction of a WWW based reservation tool. This occurred in February of 1995. Unlike the reservation system of all commercial MCU service providers at the time, the system used by HEP video conferencing sites was network accessible and required a minimum of phone calls. This was essential to a user community that has sites that are literally scattered around the world.

## 3 At Present

In understanding the use of video conferencing by HEP researchers and where it's going, it's important that we look at the service as it exists today. The MCU service consists of a large Teleos Network Hub connected to a twenty port VTel MCU-II. It's presently located at Lawrence Livermore National Laboratory, though it will soon be moving to Lawrence Berkeley National Laboratory. It's operated by ESnet and its use is free of charge as long as at least one of the sites in any conference is a U.S. site doing research funded by DOE. There are approximately 70 registered sites, and a typical months usage is 300 conferences requiring more than 1,300 hours of port time. The traffic is sufficiently heavy so that there is occasional blockage by the reservation system because there aren't enough ports to support a given conference.

ESnet is in the process of expanding its MCU port capacity by adding a 40 port PictureTel Montage. When that unit has been installed, tested, and successfully used in some carefully monitored production conferences, it will become the primary video bridge. The VTel MCU-II will be disconnected, moved to Berkeley, and reinstalled to bring the total capacity to 60 ports. This transition will cause some level of discomfort to the user community, because the PacBell telephone office which serves Berkeley is different than the one which served Livermore. As a result, the MCU port numbering plan will change. This means that all users will have to change their codec dial lists.

Unlike its VTel predecessor, the new PictureTel MCU is a virtual machine. That is, the connections between the Teleos Network Hub and the MCU are not made on a per port basis. Instead, the PictureTel MCU has a number of ISDN PRI connections to the Teleos front end. This scheme greatly reduces wiring complexity but it has impact on the reservation system. Details on how to number the MCU ports so that impact on site dialing lists and user behavior patterns is minimized are yet to be finalized. The new MCU completely supports the ITU-T H.243 recommendation; that is, it will interconnect with other MCU's that support H.243.

Conference reservations are made with a WWW browser (e.g. - Netscape, Mosaic, Internet Explorer). The user accesses the reservation page (http://vcs.es.net/vcss), and schedules the meeting. The system will notify (via E-mail) a designated person at each site on the day of the meeting. The reservation system is capable of handling reservations for multiple MCU's (e.g. - because of specific program requirements, a facility like Brookhaven National Laboratory might install its own video MCU). This capability hasn't been utilized to date.

## 4 Next 18 Months

In the next year to 18 months, video conferencing by HEP researchers will be affected by continued growth and technology developments in video conferencing hardware. We'll discuss a few of the more interesting ones in some detail.

There has been very active work within the International Telecommunications Union on two new video conferencing standards. The first is H.323 (video over local area networks such as TCP/IP with no guaranteed quality of service). The popularity of desktop video systems is expected to grow, but the need to have an ISDN BRI line or lines for each system is a barrier to deployment. The H.323 standard permits the development of LAN/WAN gateway systems which should remove the obstacle. For example, a personal computer on the Fermilab network running Windows/NT, having a 100baseT network card, and equipped with PictureTel's Live200p video card can have a conference with another desktop system at Fermilab via the network. If the same user needs to have a meeting with people at the University of Pennsylvania, the call will be routed via the local network to a LAN/WAN gateway; in the wide area, the data will be passed over ISDN B channels.

A second standard of interest is the ITU H.324 standard (video over analog phone connections). It's expected that this standard will be of great interest for home users, but will have little direct impact on video conferencing as used by HEP researchers. One possible exception is participation of a key person in a video conference while on travel. The standard will probably have considerable indirect impact, however. In order to make video a reality at such a low bandwidth (28.8 kbit/sec), a new codec was developed. Best estimates are that it offers a factor of four or five improvement over the present H.261 codecs. It's expected that the vendors will be able to change the microcode in present video codecs and enjoy a performance boost in existing equipment.

A third ITU standard of importance is designated T.120 (data sharing terminals). The best advice at present is to view this standard as a work in progress. Portions of it have been approved and vendors are delivering equipment that is touted as being T.120 compliant. However, the application sharing section is still in draft. Despite the marketing glitz, without application sharing (white board, spreadsheet, etc.) T.120 is only of modest interest. Some of the hardware that is being delivered holds promise for improved graphics resolution over the FCIF capability of present video codecs (FCIF - 352x288 pixels).

## 5 Long Term Outlook

It's difficult to attempt predictions about what will happen in a very dynamic technology segment beyond the eighteen-month time frame. One thing that has sparked a lot of interest is video over ATM networks. This concept (video over ATM) blurs the formerly clear distinction between packet and circuit video conferencing. This discussion focuses on higher bitrate (384 kbit/sec or higher at 30 frames/second) for near-broadcast quality video. While of great interest to network engineers, a dialogue about packet video and audio over ATM (guaranteed Quality of Service) networks as contrasted with 100baseT (non-guaranteed QoS) networks isn't relevant here.

Vendors are beginning to offer prototype products that make it possible to do video over ATM. Companies such as IBM, First Virtual, and ADC Kentrox have hardware available today. As with any new technology, all the pieces necessary to satisfy a user requirement aren't available or don't quite fit. As an example, it's not presently possible to do interactive multipoint video over ATM networks; at the moment, no vendor makes an MCU with an ATM interface.

ESnet, with HEPNRC as a collaborator, is involved in a pilot project that's in the early stages of implementation. The majority of the hardware and software shown in Fig. 1 is supplied by First Virtual Corporation, and the multimedia PCs are equipped with H.320 video conferencing kits. The system consists of a LAN/WAN gateway server, an ATM switch, a video storage server, and the desktop units; the multimedia PC's are equipped with a 25 mbit/sec ATM card in addition to the H.320 video kit. The following is a more detailed description of the components of Figure 1:

1. LAN/WAN gateway server - the gateway is an ATM-to-ISDN interface that distributes high- quality 384 kbit/sec H.320 streams to the desktop over ATM. Desktop video conferencing stations communicate with the gateway rather than directly to an ISDN line(s)
2. Video storage server - the video server is a shared multimedia device that supports archive and playback services over an ATM network. Clients and servers on the LAN or the WAN can take advantage of these services in real time.; The unit supports AVI, H.320, and MPEG formats

3. ATM switch - the ATM switch is available in a number of configurations; all models have a number of 25 mbit/sec ATM ports, two 155 mbit/sec ATM ports, and one or more local area network (10baseT, 100baseT, token ring) ports
4. ATM adapter - each desktop video conferencing station is equipped with a 25 mbit/sec full duplex ATM adapter card. The adapter enables switching between the PC ISA bus, the ATM network and the H.320 video conferencing cards
5. Video workstation - industry standard PC (ISA bus) running Windows 3.1 or Windows 95 equipped with a PictureTel Live50 kit (H.320 codec card, camera, audio unit, and desktop video application software).

The previously described hardware and software has been deployed and tested as part of a pilot project at Lawrence Livermore National Laboratory over the last 15 months. The new research is the connection of a Madge (formerly Teleos) Network Hub, a PictureTel (Montage) MCU, and a couple of traditional H.320 codecs via ADC/Kentrox boxes to multipoint video over a wide area ATM network. This is shown in Fig. 2. Some of the questions that will be answered by this research project are:

- the viability of using circuit derived bandwidth from ESnet ATM backbone circuits
- how well do multipoint conferences work where one or more codecs are connected via ATM
- is wide area network access to the video storage server a wise use of network resources
- how can these new kinds of video services be managed

## 6 Conclusion

Rapid and continued changes in underlying technologies result in major shifts in computing and data communications every few years. The introduction of ATM networks has produced such a shift. Multimedia applications will produce another such shift, and video conferencing is a significant element of multimedia applications. HEP researchers who are separated geographically need to communicate as though they are in the same room. Researchers want to participate in a meeting, not become operators of complex equipment. While current equipment falls short of that mark, it is clear hat video conferencing is moving toward the desired goal

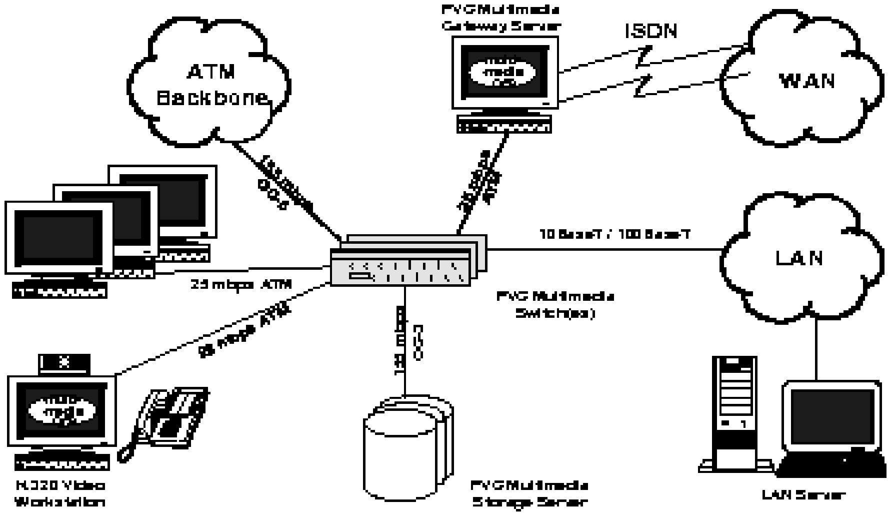


Fig. 1: Overview of First Virtual Multimedia Solution
Over ATM Networks

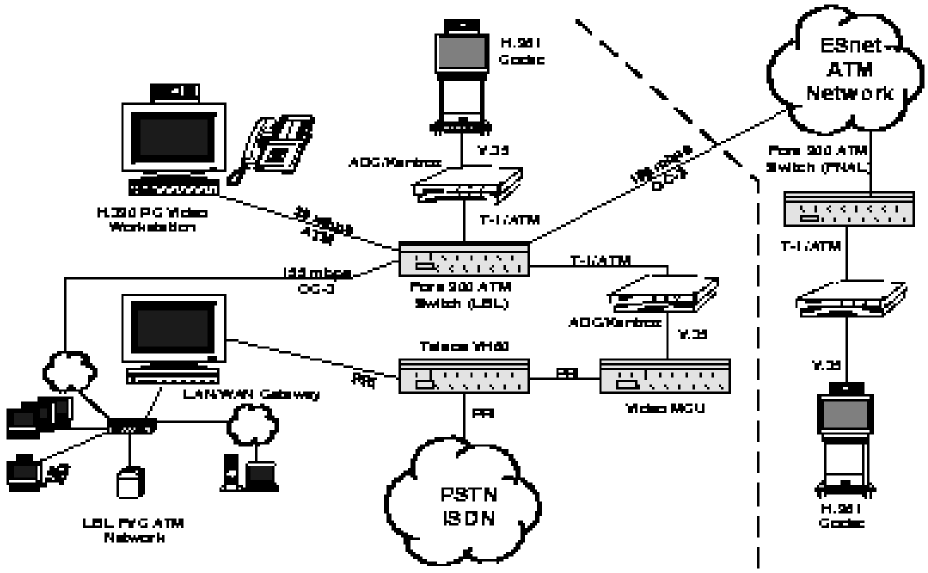


Fig. 2: Overview of WAN Video Over ATM Network
Experiment