A Next Generation Integrated Environment for Collaborative Work Across Internets

D. Collados[1,2], *G. Denis*[1], *P. Galvez*[1], *C. Isnard*[2], *H. Newman*[1]

[1] California Institute of Technology, Pasadena, CA 91125, USA
[2] CERN, 1211 Geneva 23, Switzerland

Abstract

Collaborative environments supporting point to point and multipoint videoconferencing, document and application sharing across both local and wide area networks, video on demand (broadcast and playback) and interactive text facilities will be a crucial for the development of the next generation of HEP experiments by geographically dispersed collaborations. The "Virtual Room Videoconferencing System" (VRVS) has been developed since 1995, in order to provide a low cost, bandwidth-efficient, extensible means for videoconferencing and remote collaboration over networks within the High Energy and Nuclear Physics communities. The VRVS system is based on a Virtual Videoconference Room concept. Since it went into production service in early 1997, deployment of the Web-based system has expanded to include 1940 registered hosts running the VRVS software from more than 40 different countries, and 23 "reflectors" that manage the traffic flow, at HENP labs and universities in the US, Europe and Asia. So far, there are 7 Virtual Rooms for World Wide Conferences (involving more than one continent), and 4 Virtual Rooms each for intra-continental conferences in America, Europe and Asia. We review future and ongoing developments (VRVS extension, MPEG1/2 and H.323 integration, Shared environment, QoS over networks, etc..), to support a set of new and essential requirements for rapid data exchange, and a high level of interactivity in large-scale scientific collaborations

Keywords: networking, desktop computing, international WAN, video conferencing, world-wide collaboration

1 Objective

We will develop, prototype and start deployment of a high performance next generation Integrated Environment for Collaborative Work. The new system, aimed at using the capability of ESnet and Internet2 for rapid data exchange, will be based on the Virtual Room Videoconferencing System (VRVS[1]) developed by Caltech and CERN. The VRVS system has been chosen by the Internet2 Digital Video (I2-DV) Initiative as a preferred foundation for the development of advanced video, audio and multimedia collaborative applications by the Internet2 community. VRVS, based on the LBNL and UCL protocol suite[2] has a fully Web-integrated user interface, developers and administrative APIs, a widely scalable video network topology based on both multicast domains and unicast tunnels, and demonstrated multiplatform support. This has led to its rapidly expanding production use for national and international scientific collaborations in 40 countries[3]. We will deploy and support the current VRVS infrastructure as well as to develop middleware that will

[1] see: http://vrvs.cern.ch for complete information

[2] known as Mbone applications (vic, vat/rat, Wb/Wbd)

[3] several reflectors are currently running in U.S Labs, DoE H.Q, Switzerland, Italy, UK, France, Germany, Finland, Spain, Russia, Israel, Taiwan, Venezuela

provide a seamless interface between the high-end applications and the network layer. Next-generation networks will have to support several hundreds (and eventually thousands) of scientists using the new VRVS-based system. New application-suites and new modes of collaboration will be required, with an overall speed and quality of interaction that are impossible on today's Internet. In the first year, a widespread deployment with the target of several thousand nodes able to support multipoint collaborative work will be pursued. In parallel, several tests and monitoring will be performed at a variety of bandwidths, in association with the system deployments foreseen for both DoE/NGI[4] and Internet2-related (I2-DV) R&D projects[5].

2 Work Plan

Today, the collaborative environment field is moving towards several different technologies (e.g. videoconferencing, streaming video, multicast, data collaboration,...), and different standard protocols (H.320, H.323, H.310, Mbone, ...) for videoconference. In the meantime, there is no unified interface or structure capable of interacting with these applications. We found that VRVS is a very effective framework to address this issue, since it provides a unified scheduling, registration and authorization procedure, and support for new high-end (as well as less demanding) applications. The VRVS system software also has been shown, over the last two years, to be highly adaptable to the integration of a variety of new short-term and longer-term developments, because of its modular architecture. This modularity extends down to the level of the basic application-components (currently the "mbone" tools in the production VRVS system), where new applications built on the basis of other protocols or utilities may be inserted to replace, or interwork with, the existing module-set.

Several tasks have been identified to spread the use to a larger scientific community, and improve the functionality of the current version.

- Deployment of VRVS over several thousand hosts. The system is technically capable of this right now, but it requires a (modestly) larger base of system support.
- Integration of shared applications, shared workspaces, and the construction of an overall shared environment.
- Integration of high quality video (full screen, full frame, full resolution) using MPEG1, MPEG2, or HDTV when available.
- Integration of H.323 into the VRVS structure.
- Provide full documentation and recommendations for standard desktop, workgroup and larger meeting-room configurations.

2.1 Deployment and support of VRVS

As explained at the beginning of this document, the VRVS user-base is expanding rapidly (and the rate of expansion is increasing). New reflectors will be installed at different locations following the local and regional usage patterns, and in order to optimize the network topology. The number of users and multi-point videoconferences is increasing dramatically (1940 hosts at the time of writing this paper). Therefore even if the current system is very reliable and stable, a trouble ticket system as well as a VRVS help desk will have to be created, in order to meet the requirements and requests from a larger user community (of potentially several thousand).

[4] more information at `http://www.ngi.gov`

[5] more information at `http://www.internet2.edu`

2.2 High Quality video and audio (MPEG1, MPEG2,)

The Internet2 project (as well as other global efforts to increase network capacity and capability), has made it likely that both high quality (full color, full screen, full frame, full resolution) videoconferencing and collaboration in shared immersive environments will become practical within the next couple of years. Video and audio broadcasts to large communities based on MPEG1 and MPEG2 compression are also expected to become practical, and we will evaluate these approaches in our test network. Several hardware-based realtime encoder/decoders[6] for MPEG1, MPEG2 are available in the market today. Support for applications with HDTV-like quality, at relatively low cost and acceptable levels of desktop CPU loading, are expected to appear soon, driven by the next generation of networks, middleware and application-initiatives. Because VRVS' system architecture is built in a way that has been shown to be inherently independent of the applications, integration of high to very-high video and audio quality applications is expected to be relatively easy to implement. Once implemented, the new application-sets will be usable in combination with the VRVS "infrastructure" (booking system, reflector-topology control system, performance-monitoring and logging toolsets, etc.) without substantial additional effort.

2.3 Shared applications, environment and workspace

We will focus our effort to move beyond videoconferencing to higher level collaborative tools. Elements to be added to the VRVS meeting include applications for collaborative data sharing, shared data visualization, synchronized Web browsing, files exchange,etc.. Contacts have been established with several groups working on Collaboratory systems designed to create a framework for sharing Java objects over the Internet, and to provide an integrated set of collaborative tools.[7]

2.4 Integration of H.323 into VRVS

Since the I.T.U[8] videoconferencing protocol H.323 is built using the Real Time Protocol (RTP) commonly used by the Internet community (defined by the IETF), it will be possible to use the VRVS suites and in particular the VRVS reflectors to do multi-point videoconferencing using H.323-based applications. Using a common infrastructure, the user would then have the possibility to use H.323 and/or Mbone applications for doing multipoint collaborative work. First "laboratory" tests have been performed successfully with NetMeeting (a Microsoft Application supporting H.323) available on PCs running Windows 95/98/NT. The first step will be to explore the possibilities, limitations and any code development requirements (including gateway interface requirements) for running H.323 over the VRVS "common infrastructure". A second step would be to explore, prototype and then test the interoperability between H.323 and Mbone applications.

2.5 QoS over the network

Due to the technical requirements for high performance (jitter and delay) of collaborative applications (synchronous and asynchronous), the network is a vital element in order to provide the required quality of service. We start to develop and test resource-allocation strategies to ensure

[6] We selected the MPEG2 encoder/decoder box from Minerva Inc. (`http://www.minervanetworks.com`). Several boxes have been installed at Caltech, CERN and ESnet/LBNL and we performed very successful bi-directional MPEG2 videoconferencing tests at a range of 4 Mbps.

[7] Some investigations on a tool called VNC which stands for Virtual Network Computing. It is, in essence, a remote display system which allows you to view a computing 'desktop' environment not only on the machine where it is running, but from anywhere on the Internet and from a wide variety of machine architectures (windows95/98/NT, Unix's, Linux, Macintosh).

[8] I.T.U, International Telecommunication Union

that data for each stream in a collaborative session gets to its destination, consistently and reliably, with the required level of performance. A number of approaches to meet these needs are currently underway. Notable among these is the Qbone Internet2 initiative, which aims at managed levels of ”Premium service” to support inter- and intra-domain communication services matched to the end-to-end performance requirements of critical applications. Different techniques will be used, such as CBQ or IP precedence (also called TOS), as well as others. The scalability of the approach will be tested through large numbers of artificially generated, and later actual multi-point collaborative sessions, among members of large scientific collaborations.

2.6 Documentation and configuration-recommendations for collaborative desktop setups

Today, many of the users who wish to use desktop collaborative tools are confused by the many system components (cameras, microphones, video and audio cards, USB cameras, etc.), the different ranges of functionality and bandwidth requirements, and the proprietary nature or limited compatibility of most mass-market systems. This ”multimedia” market is constantly fed by new devices with new or different (often proprietary) features, and (mostly) limited performance. In order to address this problem, we will provide a small set of recommended (and tested) configurations for users who wish to become new members of an ”open” collaborative academic and research community, using platform-independent application implementations based on established or emerging de facto protocol standards. As we have done in 1997 (for a relatively small community at that time), we started to provide a range of configurations for the desktop and larger workgroups, covering a range of performance (and cost). The recommended setups[9] will be updated periodically, based on the experience with new hardware configurations and tests by our team, as well as by members of our expanding user community.

3 Collaboration with other Institutes, Groups and Organizations

Collaboration with several key players in the networking and collaborative work areas will be pursued and intensified, since the system is intended to be deployed and developed on a larger scale, starting with a broad sector of the DoE-funded academic and research community in the US. In the longer term, our joint developments are targeted at a broader research and education community, including the Internet2 community in the US as well as its major international partners. Several contacts and close collaborations have been established with several institutes, groups and organizations with these aims (UCAID/Internet2, ESnet, ICAIR, TERENA are among them).

References

1 P. Galvez, G. Denis, H.Newman *Networking, Videoconferencing and Collaborative Environments*, CHEP’98, Chicago, Sept. 1998.

2 Videoconferencing for LHC Experiments. *PEP and Reports* URL: `http://www.cern.ch/it-multimedia/LCB_Project/reports.htm`, July 1997.

[9] The new recommendation web page can be found at `http://vrvs.cern.ch/Doc/Hardware/hardware.html`