Next Generation Environment for Collaborative Research

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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 element 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 (Virtual Rooms Videoconferencing System) provides worldwide videoconferencing service and collaborative environment to the research and education communities. VRVS uses the Internet2 and ESnet high-performance networks infrastructure to deploy its Web-based system, which now includes more than 5790 registered hosts running VRVS software in more than 50 different countries. VRVS hosts an average of 100-multipoint videoconference and collaborative sessions worldwide every month. There are around 35 reflectors that manage the traffic flow, at HENP labs and universities in the US and Europe. 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 the US, Europe and Asia. VRVS continues to expand and implement new digital video technologies, including H.323 ITU standard integration, MPEG-2 videoconferencing integration, shared environments, and Quality of Service.

Keywords: Videoconference, Network, Shared Applications, and worldwide collaboration, H.323

1. VRVS Current Status and Developments

At present, more than 5790 machines (increasing by a factor of 2.5 each year) are registered to the system and that represents more than 3520 different users. Most of these users belong to the HEP and Nuclear Physics communities, where several major experiments and many institutes have officially adopted VRVS as their collaboration system.
During the year 2000, a total of 1300 Multipoint Videoconferences (3800 hours) have been performed using the system, and since the beginning of year 2001, we run in average 200 Multipoint videoconferences (500 hours) per month. The evolution of usage is illustrated in Figure 1.

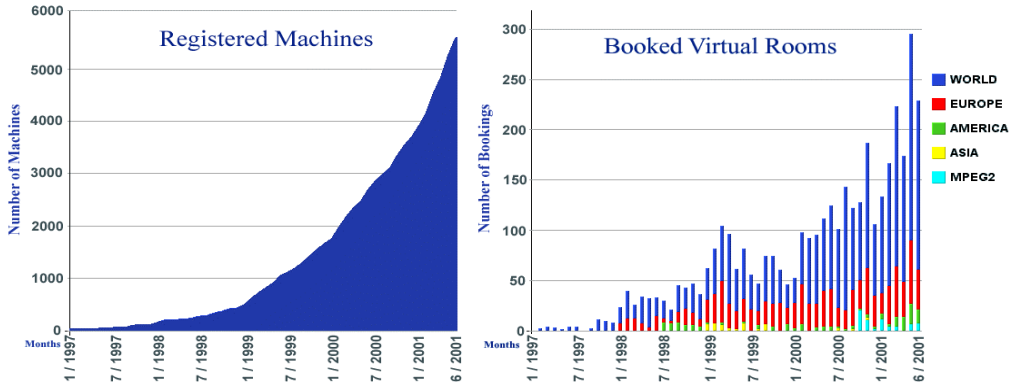

Figure 2: VRVS Statistics: Registered Machines and Scheduled Meetings

The VRVS users are distributed in more than 50 countries all around the world (55% in Europe and 40% in U.S).

During the last 3 years, 10,886 different machines have visited the VRVS web server (initially located at CERN) with 73,882 hits on the main page and a total of 5,620,100 hits. At that time, we

were running Version 2.1, which was very stable and reliable. On March 15 2001, we released a completely new version of VRVS (V2.5). This version is the result of one year of deep and intensive development where we: a) increased the number of client-types supported by the system (H.323 and MPEG2 clients). b) Started a new sharing service (the possibility to share a desktop among the participants) in each Virtual Room. c) And improved the User Interface (scheduling, dynamic host management, automatic software installation, documentation, etc).

In order to support the rapid evolution and deployment, we installed a new powerful Linux server[1] at Caltech to run our new VRVS web server under the "vrvs.org" domain that we acquired. The new generic address is now http://www.vrvs.org.

The interest in VRVS increases every month due to its ease of use, powerful functionality, stability, new features and many successful demonstrations performed during scientific and technical conferences, and other international events. VRVS users are spread around the world and many communities use the system daily as a vital tool for their discussions, workshops, majors meetings and conferences.

a) Reflector deployment

As planned, the deployment and installation of new VRVS reflectors has continued with the recent installation of several reflectors at Internet2, Rediris (Spain) and Weizmann Institute (Israel). Today, we have reached a total of 35 reflectors running in North, Central and South America, Europe, Middle East and Asia. These reflectors are in the U.S. (Caltech, Fermilab, DOE, Berkeley, Argonne, SLAC, BNL, Jeff-Lab, Indiana, GATech, Internet2 (2), ESnet), Canada, Spain (2), France (2), England (2), Wales, Switzerland (2), Italy, Portugal, Poland, Israel, Russia (3), Brazil, Venezuela, Singapore, Taiwan and Japan.

b) H.323 Integration in VRVS

There is now a new version of the reflectors released. This new software makes possible the interaction between the typical VRVS clients (VIC/RAT/VAT applications usually called the Mbone applications) and H.323 clients in the same multipoint videoconference. To achieve this, we developed a new H.323 calling agent. It negotiates the connection parameters between H.323 clients and the reflectors in order to attach the client to the desired Virtual Room.

Today, H.323 clients (outside of VRVS) are limited to display of just one video at the same time. To bypass this limitation, we provided the possibility to select the video that the user wants to watch from the list of the video participants (by default, the video of the speaker is displayed) or he can select a "timer mode" where he sees each site in turn, selected in a "round robin" that switches from one site to the next one according to a preset timer or he can select the "multi-video mode" where he sees all the video from all the participants.

c) Sharing applications service

We integrated the VNC technology (Virtual Network Computer)[2] into VRVS to allow participants to share their computer desktop/applications with the rest of the participants (connected to the same Virtual Room). A specific Java client has been developed from the VNC client. In practice, if a

[1] Dual CPU Pentium III 700 MHz, 512 Mbytes, 100% redundant RAID disks, Rack mounted and connected to the 100Mbps Ethernet, double power supply

[2] See at http://www.uk.research.att.com/vnc

participant in a Virtual Room wants to share his computer desktop, he has to run a VNC server in his machine and declare the machine with the web interface as the "sharing server". Then, the other videoconference participants can watch the computer desktop of the server one with just one click on one icon (that starts the Java applet client). Two levels of sharing are available:

- ***Broadcast level*** displays the computer desktop to the other participants.
- ***Full sharing level*** gives the control of the machine remotely (keyboard and mouse) to the rest of the users.

d) World Wide Booking

An important development in the booking system (and more generally in the user interface) has been done: each user can book and access the Virtual Rooms using his/her current GMT time (so the date and the time are already converted to the user's local time). With this new capability, VRVS is able to manage different time zones and therefore, it is more convenient and intuitive when booking or joining a meeting.

A new user profile manager allows the user of a generic machine not registered in the DNS (Domain Name Service) or with a global domain name (like .org, .net, .com etc) to specify his continent and his local time zone. This is used to determine the geographical location of the machine and connect it to its nearest VRVS reflector.

We have also developed a very important improvement for machines that frequently change their IP address and hostname (users connected through an Internet Service Provider or via DHCP [Dynamic Host Configuration Protocol]). An automatic process re-synchronizes the user profile with the new IP (or hostname) of the machine. This makes the system easier to use for people who travel often and use different IP addresses or hostnames.

e) The installation and initialization of VRVS is easier

The installation of the new VRVS package is now completely automatic for the main platforms (Windows, Solaris and Linux). In parallel, a simplified manual installation is provided for the other supported platforms. We have created a new launcher application (included in the package) more powerful and more secure that can be upgraded dynamically.

Also, in many of our web pages a quick user guide is available with a simple click, and the user interfaces of the typical Mbone applications (Vic/Vat/Rat) have been simplified to be more intuitive and less confusing.

f) MPEG2 Multipoint

A dedicated Virtual Room has been added in VRVS to provide multi point videoconferences with the best available quality and high frame rate, using MPEG2 technology. This Virtual Room has a dedicated user interface to connect and manage Minerva VCP[3] MPEG2 boxes. In order to develop more interactive MPEG2 videoconferencing, we worked with Minerva to improve the code of their VCP codecs, reducing the latency from 600 ms to 120 ms. Several demonstrations have been successfully performed in Japan, US and Europe.
For these conferences, we use a 3/4 D1 resolution (544x480 pixels) and a bandwidth that may be set, from 1.2 Mbps to 6 Mbps.

[3] More information can be found at: http://www.minervanetworks.com/products/vcp.htm

g) AccessGrid Technology integration to VRVS

The AccessGrid project[4] combines video wall technology, multicast and high bandwidth usage. Pushed by strong demand to the VRVS team from a number of Internet2 sites (and the AccessGrid group), we decided to integrate the AccessGrid technology into VRVS. Up to now, in order to become an AccessGrid node, one needed to (1) invest around 50 K$ for video and audio equipment, (2) have your site multicast-enabled and provisioned to handle at least 20 Mbps of network traffic for video and audio streams.

Using VRVS (via its web interface) at *http://www.vrvs.org/accessgrid.html*, we can now be connected to an AccessGrid conference from your desktop (without having to deal with the high cost, multicast and high bandwidth capability). The user has the option to receive only one unicast video stream at a time. He can select the particular video stream he wants to watch, or he can select a "timer mode" where he sees each site in turn, selected in a "round robin" that switches from one site to the next according to a preset timer.

2. Conclusion

The development effort for the coming year will be focused in three main areas which are: (1) consolidate the current VRVS software and deployment, (2) design and test the scalability of the system (software and hardware) in order to address several thousand of new users and many communities, and (3) investigation of new technologies (e.g. wireless networks) and new compression devices (e.g. MPEG4). This effort will come in conjunction with the VRVS deployment and support, and the participation in several international demonstrations and conferences

VRVS has been selected by the Internet2 community as the preferred foundation for the development of new advanced video, audio, and multimedia applications. Deployment of VRVS within the Internet2 backbone already started with the installation of VRVS reflectors in Abilene GigaPoPs.

By the year 2002, we expect to have the system running on most of the Research and Education backbones in the US, Europe and Asia. A great deal of experience will be acquired in running collaborative work services in very large-scale environments, and that will guide our further development. Tests of the latest current and next-generation network protocols (e.g. Multicast and new versions of QoS) will continue to be performed, as the bandwidths, required level of interactivity, and the complexity of the applications launched from within interactive sessions increase. Specific developments will continue to be targeted at particular problems and needs of the research community, that arise in the course of widespread use of the system in the field, as has happened until now. The modular architecture of the system, which is well established, will reduce the manpower required to implement and test new features or add new services, as has been demonstrated in the past. These services will include a new generation of video, audio and collaborative applications. Among the new services, a fair amount of effort will be invested in the integration/development of middleware for authentication and confidentiality and optionally encryption in VRVS. This will be done in association with the development of an integrated "Grid" architecture for seamless worldwide-distributed data access and analysis, in addition to collaborative work.[5]

[4] Information can be found at http://www.accessgrid.org

[5] For example the Particle Physics Data Grid (PPDG) and GriPhyN projects in the US, and the HEP Data Grid project in the European Community.