MULTICAST VIDEOCONFERENCE TOOLS AND TECHNOLOGIES

_____

A University Thesis Presented to the faculty

Of

California State University, Hayward

_____

In Partial Fulfillment

Of the Requirements for the Degree

Of Master of Science in Telecommunications

_____

By

Rick Kovacic

ACKNOWLEDGEMENTS

TABLE OF CONTENTS

MULTICAST VIDEOCONFERENCE TOOLS

AND TECHNOLOGIES

BACKGROUND

Review of Technologies: MBone

Use of MBone networks has been studied throughout the decade of the 1990s. The MBone is a virtual network consisting of dedicated multicast routers on LANs around the world that support the transport of multicast packets over IP networks; a dedicated but virtual connection called a "tunnel" from a workstation to a multicast router is required to encapsulate the multicast packets inside of an 'envelope' to insure their deliver from router to workstation intact. Specialized multicast software to receive and interpret multicast traffic is installed on workstations to send and receive multicast packets.

Categories and examples of specialized MBone software is summarized below:

- Session: e.g. SDR (Session DiRectory) and nSDR - tools to recognize and establish connections with advertising MBone sessions. The main interface of the SDR session software is shown to the right.

- Video: e.g. VIC (Video Conference)– tools
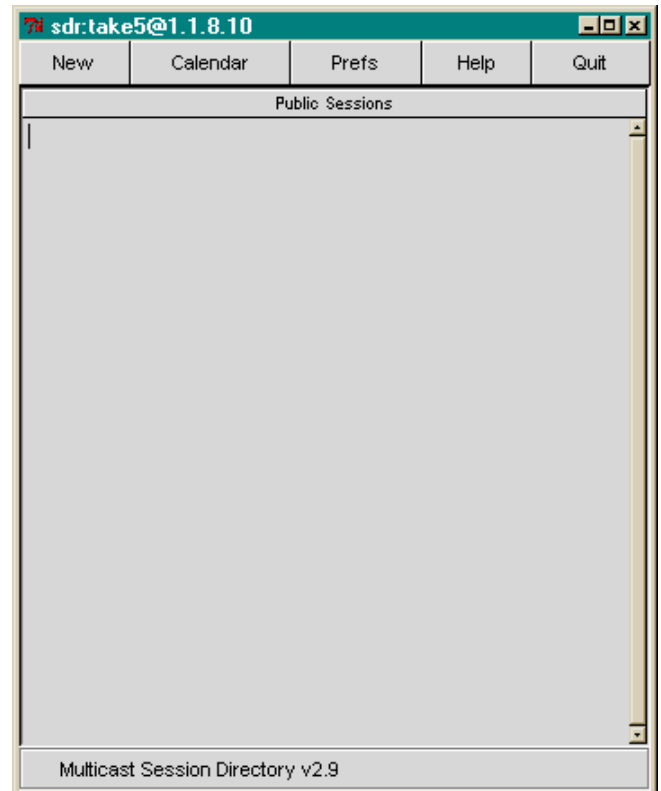
to send and receive video signals from MBone sessions

- Audio software: e.g. RAT (Robust Audio Tool) – a software package that receives and transmits multicast audio packets

- Text Exchange: e.g. NTE (Network Text Editor) – tools that allow text exchange via a dedicated display and create window

- Whiteboards: WBD (WhiteBoarD) – draw and display canvasses or windows that allow collaborative display of 2D objects and images

Many of the existing software tools operate individually and provide only one specific function, i.e., connecting to and listing of existing MBone sessions. Attempts have been made to integrate many of the above categories of functions into single software applications, providing multiple functions in one software applications. Examples include ReLaTe from and SHRIMP from UCL Networked Multimedia Research Group (http://www-mice.cs.ucl.ac.uk/multimedia/software/) at the University of London, and MASH from the Open MASH Users Group (http://www.openmash.org) at the University of California Berkeley.

Deficiencies: MBone

There are some inherent deficiencies concerning usability with MBone networks. One particular deficiency is the effectiveness of such a virtual network in distributing traffic to all interested parties; most corporate and educational LANs in the United States do not maintain multicast routers on their networks, requiring knowledgeable personnel to locate and tunnel to a nearby multicast router handling MBone traffic. Such tunnels do not guarantee the delivery of multicast

traffic, as filtering of specific packets may be occurring on the router tunneled to, and are most effective on UNIX or Linux-based machines. Tunneling on Windows or Macintosh machines has yet to be fully addressed by software vendors, although a variety of 3rd party utilities are available for tunnel creation (as Multikit, Livegate, and mTunnel) and Microsoft has integrated their Point-to-Point Tunneling Protocol (PPTP) in the Windows 2000 operating system. Also, many LANs filter multicast traffic to reduce the load on network elements, eliminating the opportunity of workstations located within areas of said LAN from receiving multicast traffic.

Review of Technologies: Web-based Multicast Videoconferencing

There are several web-based video conference services being provided publicly by manufacturers of multicast server hardware. Two of the most prominent are First Virtual Communication's ClickToMeet (http://www.clicktomeet.net/), CuSeeMeWorld (http://www.cuseemeworld.com/), and Evoke Communications (http://www.evoke.com/index.asp) video conference community sites. These services allow a user with video conference camera, microphone/headset, and high-speed Internet access to contact other VC users through a web browser interface. The user is required to have the software applications and drivers installed on their personal computer to access the VC sites; registration with the service is also required to be granted access to the community. At the time of this writing, FVC and CuSeeMe were announcing a merger which may affect the web-based VC services they currently offered.

The advantage of such "video portals" is the accessibility – no highly-specialized or cost-intensive VC hardware is required, mainly standard web browser tools and Internet access. Any
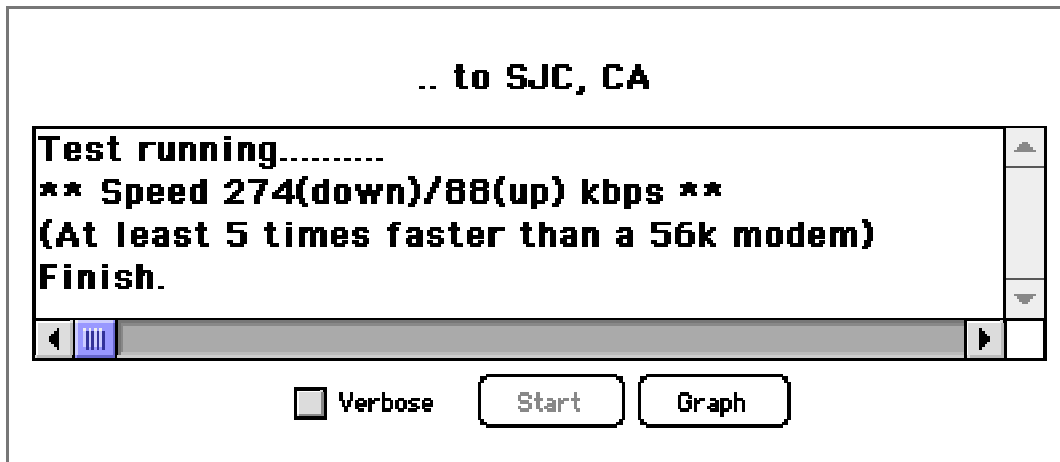
person with a PC or workstation that has this required VC software and Internet access can participate in either community. The FVC solution does require that client's workstations must be configurable for a utilizing the FVC Gatekeeper, and have capacity for setting an H.323. endpoint. Certified and Recommended Endpoints for FVC's ClickToMeet.net include:

- Intel ProShare v 5.2 or higher
- Intel TeamStation v 5.0 or higher
- FVC V-Meeting v 1.0 or higher
- FVC V-Station v 1.2 or higher
- Polycom ViewStation SP v 5.5 or higher
- Polycom ViewStation MP v 5.5 or higher

- Polycom ViewStation FX v 5.5 or higher
- Polycom ViaVideo v.1.51 or higher
- Ptel 970-IP v 4.0.1381 or higher
- Zydacron Z340 v 1.2 or higher
- Zydacron Z360 v 1.2 or higher
- Zydacron CommCenter v 1.2 or higher
- CuSeeMe Pro 5.0 (Coming Soon)

Part of the FVC service entails a check of the speed of the network connection for individual PCs interested in using the service. These Speed tests are part of the DSLReports (http://www.dslreports.com/stest) web service, and consist of a Java applet sending information from the user's browser to a dedicated test server at a regional location. Below is a graphic representation of results received from a test conducted on a Macintosh PPC over an aDSL network connection to a test server in the San Francisco Bay Area:

```
                        .. to SJC, CA

 Test running...........
 ** Speed 274(down)/88(up) kbps **
 (At least 5 times faster than a 56k modem)
 Finish.

    ☐ Verbose      [ Start ]   [ Graph ]
```

Another web-based service offering is CuSeeMe, a web portal that provides access through a

VideoConference Directory of what are termed "video chat" sites; multicast VC services that are

maintained by various network administrators around the world. These sites are listed

alphabetically and include the following information:

- Name of the site
- Host name
- Videochat (IP) Address
- Chat Room Description
- Text Link to connect to the service

A graphic example of one of the listings is shown below:

Name:	AIOLI
Host:	ESM2
Videochat Address:	147.94.38.3
Chat Room Description:	Public chat rooms. Located in France. Not rated.

Connect With CU-SeeMe Now

A user must register with the service, which entails filling out an online form of personal

information and submitting to their database. A username and password are displayed in the

browser window upon submission of the form; a current and valid email address is required to

register. This information is also sent to the email address a user lists in the online form for

verification. Once registered, a user can access the videochat sites listed in the Video Directory

list.

The CuSeeMe service is supported mainly for Windows-based PCs, although a Macintosh-compatible version was announced in the closing stages of this test. Limited information was available about its features and effectiveness at the time of this writing.

Evoke Communication's webconferencing, collaboration tools and webcasting are separate services offered by this company at their website. A user is required to register with their service and provide a password and method of payment for service fees. The main interface for logging onto the service is shown below:
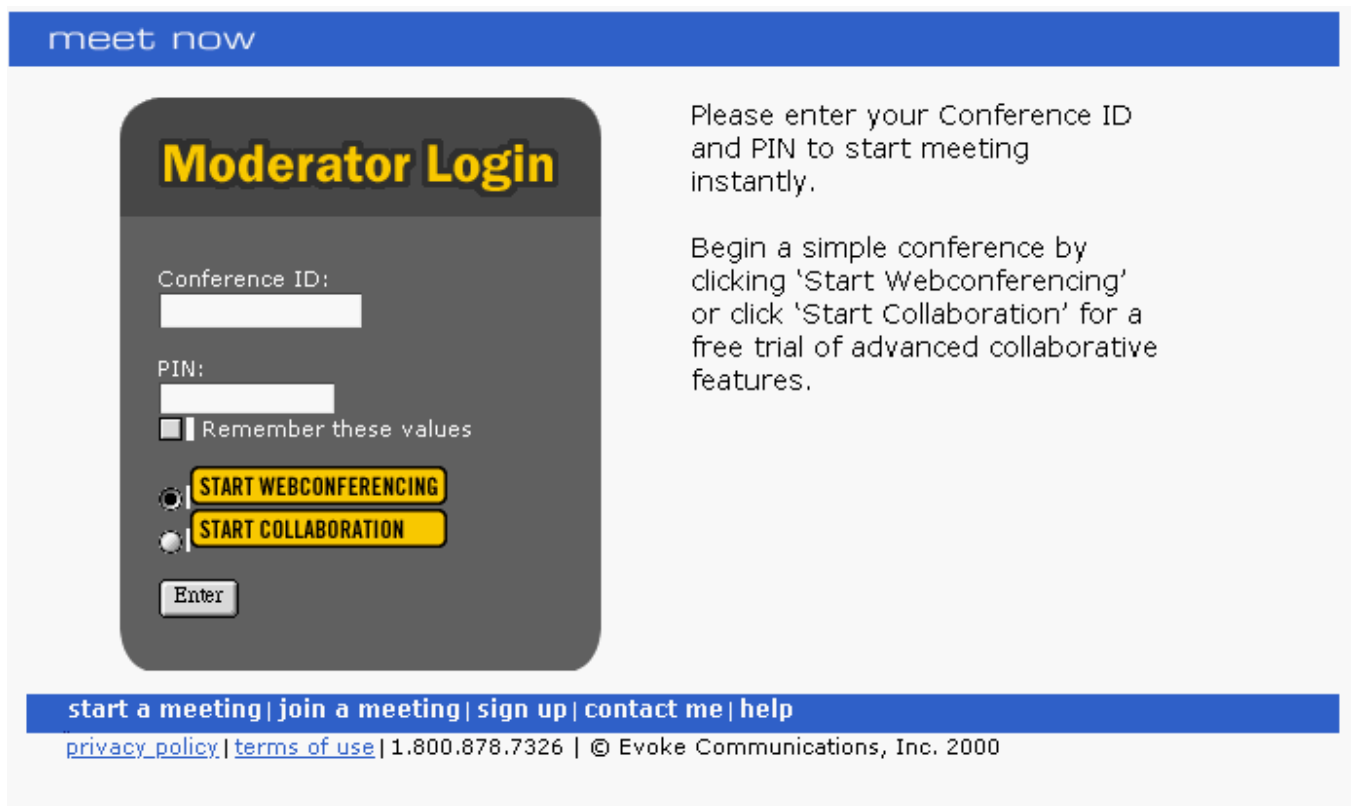
A variety of features and capabilities are included in each of the Evoke services[1]:

Web Conferencing -

- Instant dial-in for all users of a conference

- Sharing of presentation materials during the conference

- Recording of live conference sessions for later access.

Collaborative tools

- Online whiteboarding sessions allow participants to exchange text and graphical information

- Shared desktop applications provide for real-time editing of word processing, spreadsheet and other electronic files by multiple parties simultaneously

- A Web tour with remote participants can be conducted by the 'moderator' or host of a session

- Highlighting tools allow for markup of presentation slides in real-time during sessions

- Live text chat provides text exchange, audience feedback and polling of session participants in real-time.

- Web Casting - this service is subcontracted to Digital Island, a provider of streaming media content. Information on the services are available at the Digital Island web site (http://www.digitalisland.net/).

Deficiencies: Web-based Multicast Videoconferencing

The obvious deficiency to web-based systems is having the access, hardware and software necessary to utilize the services. Without a personal computer and Internet access, using the services is not possible. Camera and video boards used by each user would affect the quality of the video transmission and limit the effectiveness of the session. But within the context of IP

---

[1] Evoke Communications web site: http://www.evoke.com/solutions/index.asp

multicasting, these requirements are considered necessary for any videoconference capabilities and not considered a deficiency by this author.

For home users using dialup Internet connections, the quality of such video portal services are highly restrictive. Although some are advertised as operational with a 28.8kbps modem, such network bandwidth would allow only minimal video and audio capabilities. Full-motion video with audio at network transmission rates of less than 256kbps would limit the effectiveness of the communication between users. Additionally, most of the web-based video portals supported only specific computer platforms and operating systems (as Windows98/NT4.0 or Unix) and thus cater toward specific users, limiting the overall effectiveness, reach and audience/market of the services.

The FVC ClicktoMeet.com has user restrictions to their service. A user must request registration to the multicast service, and be given a username and password to access the service. The access information is not given in real-time as on the CuSeeMe registration site, but is sent via email to an address provided by the user. Thus, there is a delay between the time a person registers with the service and when access to the service can be utilized. Additionally, a user's network must be configured for unrestricted multicast packet flow through firewalls and routers including those of ISPs on the transmission path; an enduser may not have control over network capabilities and configurations and might be restricted to service limitations as a result. And the enduser must have a configurable H.323 endpoint to use the service; a multitude of VC endpoint machines are eligible.

With the Evoke Communications services, meetings must be pre-scheduled if real-time communication is to be achieved. Other parties wanting to join a meeting must know if its existence at the pre-scheduled time, know its ID number and have access to the service as a registered user. This approach is different than other web-based services, which allow a user to locate a person or a current session/meeting and join it at will. The Evoke approach is more private and secure, and caters to business users who want to collaborate on issues in a private manner.

Review of Technologies: dedicated Multicast Hardware

Dedicated multicast camera equipment, server hardware and bundled software applications allow a group or company to host multipoint VC sessions from their own network, and configure the system according to their own needs. There are substantial startup costs associated with establishing a network multicast service, and network requirements associated with the use of the equipment. But purchasing, configuring, and utilizing dedicated multicast hardware on a LAN is one way of guaranteeing multicast sessions will be usable and available.

Group videoconferencing solutions from companies as Polycom are self-contained camera/software bundles that interface with Ethernet hubs to deliver multicast traffic over TCP/IP or dedicated ISDN circuits. These packages are known for their ease of setup and installation, and do not require a cpu and related equipment to operate. The operating feature of these systems are their high-resolution VC tilt&pan cameras that operate by IR remote control

and contain the software installation in the base of the camera. Setup of operating features is done via the remote interfacing with this software, and all features are accessed in the same manner. Packaged solutions are available for desktop, small to large group VC with multiple monitors, whiteboard, copystand and cpu interfaces. Information on group videoconferencing solutions is available at the Polycom web site located at

http://www.polycom.com/products/product_main.html .

Products from FVC, Cisco and other vendors are main rack-mounted, dedicated servers with tested software for generating multicast sessions in the form of multipoint videoconferences with synchronized audio, text exchange (chat) facilities, collaborative workspace (whiteboard), and share application capabilities. These hardware solutions are based on H.320 and H.323 standards and allow full-motion video up to 30fps; most require a 10/100baseT Ethernet LAN for sending and receiving multicast traffic. Most solutions also allow flexibility in network transmission technologies, however, supporting both Ethernet or ISDN services. OEM software applications are packaged with these hardware solutions and provide the purchaser the ability to configure the system of specific or customized use. Most systems require an initial investment of approximately $10,000 to 25,000 US.

An example of such a system is FVC's ClickToMeet integrated platform of rack-mounted multicast server and multipoint software application. This bundled solution is a web-based video portal for IP, ATM, and ISDN network services that allows audio, video and collaborative tool sharing. A Software Development Kit (SDK) is available for the ClickToMeet package;

additionally, an H.323 software code for quick deployment is available for individual PCs wanting to utilize individual desktop conferencing.

This interface allows a user to locate and call other registered users, identify their registration status (Ready to call, Unable to call, Line busy, or Do not disturb), categorize frequently called numbers, and schedule meetings for future use. A graphic representation of the multipoint software interface of this product is show below:

Other proprietary tools from vendors as Cisco are attempting to build on the original characteristics and benefits of the public MBone tools. Cisco's IP/TV provides streaming video for PC users using enterprise networks and supports three modes of video distribution: live, prerecorded video broadcasting and video-on-demand (VOD). This solution is cost- and

equipment-intensive and requires research on the part of the user to obtain and configure the components correctly.

The Cisco IP/VC Videoconferencing Product Family, a group of IP-based network conferencing solutions that allow an organization to upgrade an existing IP network infrastructure for multicast purposes. These products provide architecture for Voice, Video, and Integrated Data (AVVID) services with high-quality audio and video transmission and rack-mounted hardware. An overview of the components this product family are listed below[2]:

- The Cisco IP/VC 3510 is a small MCU (sometimes called a "bridge") that enables multiple sites to participate in a single videoconference call.
- The IP/VC 3520 and 3525 gateways facilitate communication between IP-based H.323 videoconference networks and legacy ISDN-based H.320 videoconference networks.
- The IP/VC 3540 is a chassis-based large-capacity system that performs multiple functions. Initially, the IP/VC 3540 will offer MCU and T.120 data conferencing/collaboration services.
- The Cisco IP/VC 3530 Video Terminal Adapter (VTA) converts older ISDN-based videoconference systems for use over an IP network.
- The Cisco IP/VC 3500 Series products are complemented by the Cisco Multimedia Conference Manager (MCM), a Cisco IOS® software feature set that provides gatekeeper and proxy services. The gatekeeper manages H.323 call control, security, and LAN bandwidth, while the proxy capitalizes on the quality-of-service (QoS) features in Cisco routers to provide priority handling of the conference video and audio streams.

---

[2] Q & A Cisco IP/VC Videoconferencing Solution,
http://www.cisco.com/warp/public/cc/pd/mxsv/ipvc3500/prodlit/ipvcq_qp.htm

The Cisco IP/VC infrastructure is designed to connect with a variety of endpoints from companies such as Microsoft, PictureTel, Polycom, Sony, Tandberg, VCON, VTEL, Zydacron, and others.

Other MBone tools that have been developed by software manufacturers and become proprietary products are discussed in the next section.

Deficiencies: dedicated Multicast Hardware

Substantial purchasing and startup expenses are associated with dedicated multicast systems; justification for multiple users with high-speed network availability is mainly reserved for medium- to large-scale companies and corporations whose products and services require extensive communication and personal contact from their employees, suppliers, and customers.

Use of only one dedicated systems was explored extensively in this study, details explained in the Approach section of this paper. No dedicated server hardware was available for testing; no technical commentary or evaluation is offered here on this solution.

Review of Technologies: Proprietary Multicast Software

Many vendors have released OEM software solutions for business and consumer that utilize local integrated applications with high-speed Internet access and protocols (TCP, UDP and IP) for sending and receiving multicast traffic. Most of these packages are low-cost, readily available, and require little effort in the way of installing and configuring on a local machine. Some of the

software offerings are platform specific and others cross-platform, allowing for multiple

machines and operating systems to communicate using the same VC solution.

One such multicast application package to recently emerge is iVisit from Eyematic Interfaces

Incorporated. This software package is available for both Windows and Macintosh platforms, in

demo form and downloadable from the iVisit web site (http://www.ivisit.com/). This package is

similar to past offerings from companies as CuSeeMe but with extended features; the main

interface features and functions of iVisit are listed below:

- Local AV window
- Directory list
- Test exchange/Chat window
- Guest list window
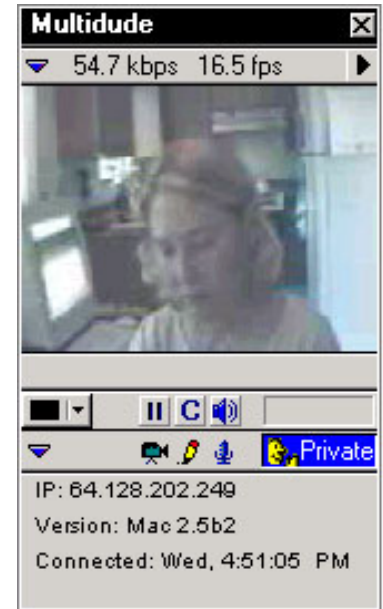- Network statistics window

The Local AV window shows the video feed of the local

machine, allows for adjustments of window size, audio

parameters, and session recording features. A dynamic

measurement of video frame rate is included to monitor

video transmission. Audio adjustments include volume slide

controls for both input and output, plus muting, squelch,

codec choice and other audio parameters. Of note is the

Push-to-Talk feature that allows for muting of audio signals during sessions to eliminate

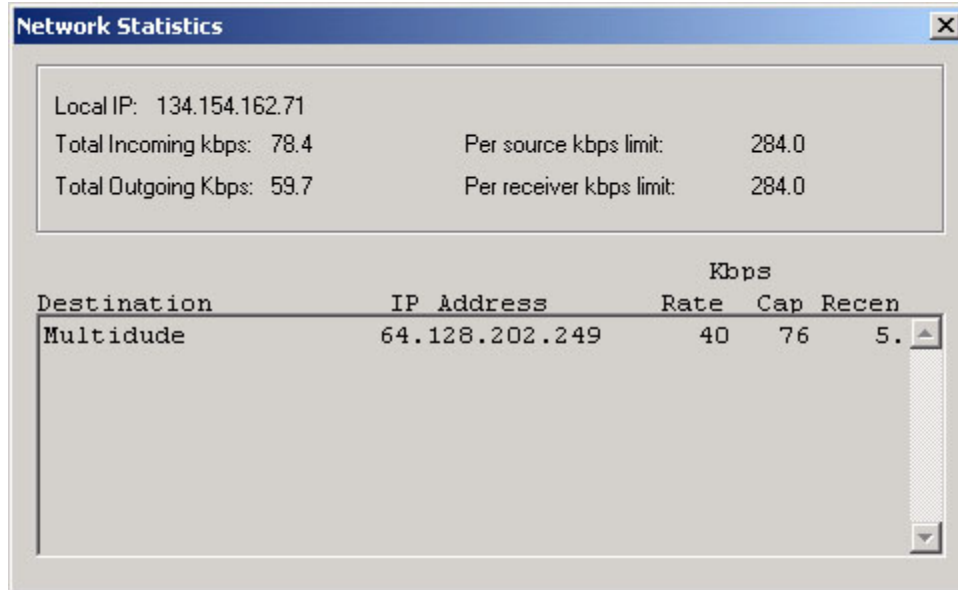unnecessary bandwidth usage and noise.

The Directory list shows various groups of iVisit users currently available for conferencing; all users must be logged onto the system with a user account and username. A user can either connect with persons in one of the public groups, or can save specific user addresses to a Bookmarks area for easy location. Button controls on the bottom of the Directory window allow for logging onto a group, calling a specific user, disconnecting from a group or user, and making inquiries to the Help guide. A search feature is also included in this window to locate specific users or groups.

When connected to a session, a three forms of communication are possible: 1) video images of session users, 2) audio transmissions from users, and 3) text exchange (chat). These are all 'real-time' communication features and allow simulation of a real-world environment. The chat windows features an entry bar on bottom and scrolling text of the exchange that has taken place during the session. Settings can be adjusted in this window, text can be saved at the end of a session, and a built-in Help Guide allows users to diagnose problems. All users connected to a particular session can input text into the chat window and receive replies from any other session user. This feature helps to facilitate communication and enhances the audio feature significantly.

The Guest List window shows all participants in a session, represented by separate 'thumbnail' video images with various control functions. Individual windows can be enlarged for enhanced viewing during sessions (see graphic to right). Icons show the participation level of the user (audio, video, text) and whether the user is logged in on a public or private session status. Addition information include IP address of user, iVisit software platform and version, time logged onto the session. User connection statistics include the connection transmission rate and video frame rate. Security features include the ability to pause or disconnect the user from the session.

The Network Statistics window provides a variety of information concerning the location and connection of the users in a session. The top of the window displays the local machine information as IP address, incoming and outgoing packet rates, and parameters for sending an receiving multicast data. The bottom of the window shows similar statistics for each user in the group. These statistics are helpful in monitoring session and connection usage if on a dialup network connection, and to diagnose problems during sessions.

Network Statistics

Local IP: 134.154.162.71

Total Incoming kbps: 78.4   Per source kbps limit: 284.0

Total Outgoing Kbps: 59.7   Per receiver kbps limit: 284.0

			Kbps	
Destination	IP Address	Rate	Cap	Recen
Multidude	64.128.202.249	40	76	5.

Individual menus in the software allow for adjustments of all communications settings, including video, audio, codec settings, and network connection parameters. These options allow for a user to tailor the software for their specific platform, cpu, operating system, camera, microphone and Internet access characteristics.

Deficiencies: Proprietary Multicast Software

Cross-compatibility of proprietary software is always an issue regardless of its application. In the area of multicast video solutions many software packages are designed to operate on only one specific computer platform and with one or selected operating systems on that platform. Cross-platform compatibility challenges the developers in making a product that appeals to a wider target market and user group, but extends the scope and usability of the product

significantly. Technical and development problems can be substantial if applications are not initially designed to work on multiple platforms.

Another major issue with any publicly-available software package is the question of network connection bandwidth and transmission rates for users participating in multicast sessions. With iVisit, various users can logon and participate in sessions at will, with no guarantee of the quality of video or audio packets, or of any, packets being received.

Issues concerning hardware and QoS of multicast service influence the overall experience of the end user. Frequently, video images are frozen if sufficient network bandwidth is not available or cpu operating cycles are too slow locally, and quality of images are greatly affected by the local users camera and video card hardware. Ability of camera and operating system software drivers to be of sufficient speed and characteristics to fully utilize the software's characteristics are also of concern and out of the user's control. Although these are not characteristics of the multicast software per se, they have a direct influence on the effectiveness of the software when used for multipoint videoconferencing and ultimately affect the amount of usage by end users.

Audio reception with the iVisit software is sketchy at best; variations in network bandwidth, sound cards, and microphone equipment limit the effectiveness of the audio transmission during sessions. There are also compatibility questions concerning the codecs used in the software; little information is available online concerning the technical features and changing of settings to enhance quality is a trial-and-error process.