Introduction To
Multimedia Conferencing

29 September 1998

Version 1 (DRAFT)

Acknowledgements

This document is based on the UKERNA document called "Introduction to Multimedia Conferencing and the SHRIMP Tools", which will soon be obtainable from http://www.ja.net/service_development/video/service_developments/shrimp/index.html.

In their current form, the documents are nearly identical.

Disclaimer

Contents

1. Introduction

This document is an introduction to multicast videoconferencing. It introduces multicast technology and a selection of the software tools available for taking part in multimedia conferencing and it tells the reader what to do to get started.

The software tools introduced in this document are all available from the UCL Multimedia Web Site http://www-mice.cs.ucl.ac.uk/multimedia/software/ Documentation for each of the tools is also available from the site.

The tool selection which is introduced in this document consists of:

- a tool for announcing multimedia conferences, and which allows the user to join an announced conference by the click of a button (SDR).
- an audio tool (RAT)
- a video tool (VIC)
- a shared text-based workspace tool (NTE)
- a shared drawing-based workspace tool (WB/WBD)
- a tool for announcing multimedia conferences, and which allows the user to join an announced conference by the click of a button (SDR).

This document is intended for readers who have little or no experience with multimedia conferencing on the Mbone. It gives an introduction to the underlying technology and the software. A glossary of terms is included at the end of the document.

2. Background

Videoconferencing has been possible for some time. Telephone companies offer videophone and videoconferencing services, but most of these require the purchase of special equipment and the setting up of special rooms for videoconferencing. They also require a Multipoint Control Unit (MCU) which causes multi-way conferences to be set up as a series of point-to-point connections between the MCU and each participant. This is an expensive and often cumbersome way of holding remote meetings, and does not scale to supporting large user groups who want to have interactive meetings. The Internet provides an alternative that can be scaled more economically.

The Internet is mainly used for supporting asynchronous communication such as e-mail and the WWW (World Wide Web), but parts of it can also be used for transmitting voice and video in real time, making multimedia conferencing on the

Internet possible. Conferencing on the Internet is different because it uses *multicast* transmission instead of the point-to-point communication used by the telephone companies. It is this multicast technology (explained more fully in the next section) that gives the Internet community an economic way of supporting multi-way multimedia conferences between large numbers of participants.

3. Introduction to the Technology

A computer-supported conference involves the transmission of audio, video and data (e.g. from shared workspaces) – hence “multimedia”. In this section we review the process of capturing, sending and receiving these multimedia streams. This is followed by a brief introduction to multicasting over the Internet.

3.1. Transmission processes

Analogue video and audio signals must be digitised before they can be transmitted. The digitised data is then compressed to reduce the quantity of information to be transmitted. There are different ways of digitising and compressing the analogue streams produced by the camera and microphone. These variations are also reflected on the receiving end of the interaction where the process must be reversed to provide analogue video and sound again.

Digitising may be achieved in several different ways. CODEC, as a contraction of COder/DECoder, is the generic term for any device or process performing the conversion of an analogue stream to digital and back, whether hardware or software. A hardware CODEC may handle video or audio or both together. Software CODECs generally refer to a specific coding process, e.g. a G.722 CODEC, a H.261 CODEC, thus a device loosely described as a CODEC may feature several separate CODECs. Many workstations use a frame grabber to supply the video, frame by frame, to a software CODEC program. Audio may be digitised by workstation hardware.

Video compression may involve several stages. Basic compression is applied to each frame. Further compression is achieved by calculating differences between successive frames and sending only those differences. Further savings in bandwidth can be made by predicting such changes and sending only the information which modifies the predictions. This technique uses motion vectors to predict changes due to motion in the picture. In both these cases there is the need to periodically send full reference frames (INTRA frames). These frames provide a new point of reference for the succeeding *difference* frames (INTER frames). The compression process may be performed in hardware or in software.

After compression, the data are segmented into small fragments – *packets* – before transmission over the network.

At the receiver the data are reassembled, uncompressed and converted back to analogue signals. In some cases the uncompressed video is passed directly to the window management software for display (for example in Sun workstations). In other cases it may be converted to a TV standard format such as PAL and displayed on a standard TV monitor.

3.2. The Multicast backbone (Mbone)

Multicast provides one-to-one, one-to-many and many-to-many network transmission services for applications such as videoconferencing which need to communicate with several hosts simultaneously. A one-to-one connection is like a telephone call, where a fixed connection between two telephones is set up for the duration of the call. A one-to-many is a broadcast where one participant is transmitting to an unlimited number of listeners/viewers. In principle, a many-to-many connection allows an unlimited number of participants to communicate with one another at the same time. It has existed for several years on Local Area Networks. On the Internet it is implemented through the Multicast backbone, or Mbone.

When a conference begins, a tree-like structure of connections is established between the participants. This is done dynamically; it is not necessary to set up all the links in advance and when a new participant joins the conference another branch is just added to the tree. The tree can also be “pruned” dynamically, so that inactive branches are detached, making it more economical than point-to-point conferencing.

On the Internet, networks and hosts (e.g. workstations) are located by means of addresses. IP (Internet Protocol) addresses consist of four numbers which, between them, identify the network and host. Transmission between sites is enabled by routers which communicate with one another and hold tables of routes between addresses. There may be several possible routes between two hosts.

The Mbone is a virtual network. It uses the same physical media as the Internet but at present, many Internet routers are not able to deal with multicast addresses. Special multicast routers *mrouters* are therefore needed. An mrouter is simply a workstation, located on a LAN, which can interpret multicast addresses. Multicast routing can also be performed by routers with suitable hardware and software. The mrouter wraps up multicast messages as “normal” Internet traffic – unicast IP packets – and passes them between mrouters. Thus the Mbone consists of connections between these multicast-aware mrouters, along which encapsulated multicast traffic can flow. These connections are known as tunnels. It is important to remember that the traffic in the tunnels uses the real bandwidth of the Internet. For this reason, moderation is always necessary in using the Mbone tools.

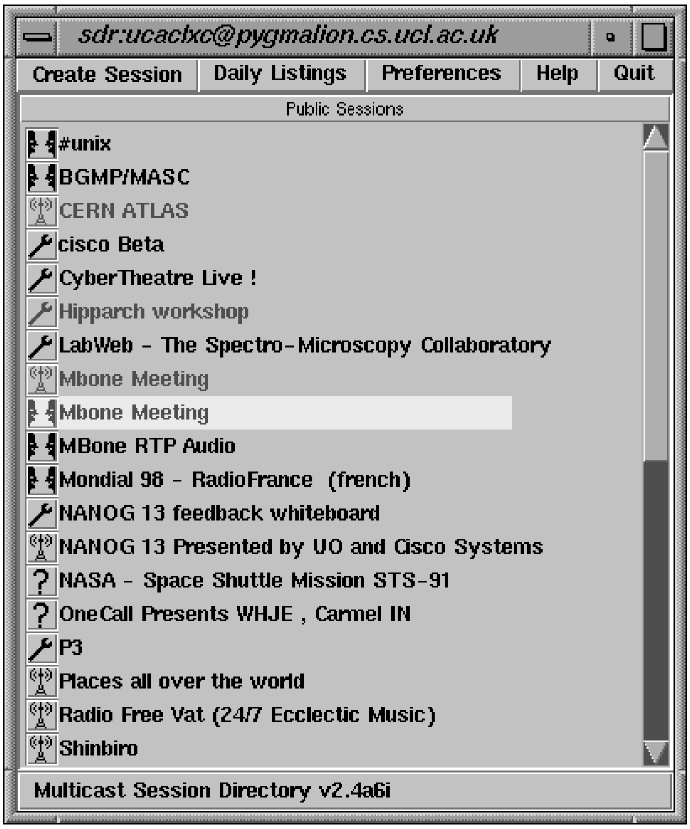
4. The Conferencing Tools

Multimedia conferencing on the Mbone makes use of separate tools – a tool for each element of a typical multimedia conference. However, there is an integrated interface (at the time of writing only available for Windows95/NT4.0) which integrates the audio tool (RAT), the video tool (VIC) and two shared workspaces (WBD and NTE) into an easy to use interface. The tools can be classified into the following groups:

- Conference management
- Video
- Audio
- Shared workspace
- Integrated Interface

4.1. *Conference management tool*

SDR (Multicast Session Directory) is a tool which assists the user in setting up and joining conferences. All conferences set up using SDR are listed in the tool's main window (see Figure 1), rather like a TV listings guide - except that SDR lists conferencing sessions on the Mbone.



#unix
BGMP/MASC
CERN ATLAS
cisco Beta
CyberTheatre Live !
Hipparch workshop
LabWeb - The Spectro-Microscopy Collaboratory
Mbone Meeting
Mbone Meeting
MBone RTP Audio
Mondial 98 - RadioFrance (french)
NANOG 13 feedback whiteboard
NANOG 13 Presented by UO and Cisco Systems
NASA - Space Shuttle Mission STS-91
OneCall Presents WHJE , Carmel IN
P3
Places all over the world
Radio Free Vat (24/7 Ecclectic Music)
Shinbiro

Multicast Session Directory v2.4a6i

Figure 1: SDR - Session Directory Tool

More information about each session can be obtained by clicking on its name in the list. A window will appear with further details about the event and an invitation to join. When you join a conference using SDR the appropriate tools for that session will automatically be started with the correct parameters. Alternatively, the user can decide to start up only a few of the tools.

With SDR anyone can create and advertise their own conferences, and invite other people to join if they wish. It provides a framework for setting up conference sessions and automatically configures the relevant tools. Once a conference has been set up it will be announced to other users of SDR for a certain period of time (usually specified by the organiser of the conference). During this period other SDR users can join the session as they see fit. It is also possible to invite someone for a quick 5-minute consultation or a full meeting - like making a phone call.

Versions 2.5 and higher of SDR support secure conferencing. This means that it is possible to make session announcements which can only be seen by a certain group of people. It is also possible to encrypt sessions, so only people with the correct password can participate in the sessions.

4.2. Video tool

The video tool is called VIC (see Figure 2). The main window shows thumbnail images of participants who are transmitting video. Next to each image is displayed information about the identity of each user, and technical information about their transmission. Images can be displayed in a variety of sizes.

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0.5 f/s 25 kb/s (0%)