Piloting IP Multicast Conferencing over SuperJANET: The PIPVIC Project

Martina Angela Sasse, Louise Clark & Colin Perkins
University College London
Department of Computer Science
Gower Street
London WC1E 6BT

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Abstract

The paper gives an introduction and overview of the activities conducted under the PIPVIC (Piloting IP Videoconferencing) project. The partner sites – who represent a range of UK Higher Education Institutions - are using IP multicast conferencing tools to support a range of collaborative teaching, research and administrative activities over a period of 5 months. The aim of the project is to understand the potential issues involved in running a large-scale IP videoconferencing service, and to document working local set-up and support requirements for sites using such a service.

1. Introduction

The JANET Videoconferencing Strategy [1], as approved by the ACN and JISC, recognises that, given the projected improvements in the packaging of IP-based videoconferencing software, there is a need to undertake piloting activities to understand potential issues involved in running a large scale IP videoconferencing service. The PIPVIC project was set up to address this need, and to:

- Pilot and assess IP multicast videoconferencing with a cross-section of users with differing requirements.
- Identify further requirements for the large-scale deployment and use of a wide-area IP videoconferencing service on SuperJANET.
- Assess the effectiveness of IP videoconferencing tools in a collaborative working environment.
- Begin to test what happens when congestion occurs within a service network environment and to evaluate the effects of congestion on videoconferencing applications within a service network environment.
- Begin to determine the scalability of IP videoconferencing on JANET.

The ultimate aim of the project is to demonstrate how IP multicast conferencing can provide a reliable, flexible and easy-to-use videoconferencing service to support teaching, research and administrative activities amongst the UK academic community.

The pilot sites represent a wide range of Higher Education Institutions in terms of size, type of institution, and level of technical expertise available. UCL - the lead site - has been using multicast since 1993; the University of Exeter and the University of Wales at Aberystwyth have used the technology as part of projects ReLaTe [2] and the MICE-NSC [3] since 1994. The University of Westminster was connected to the SuperJANET Mbone in 1996, and has participated in one field trial. The University of Essex and the School of Slavonic and East European Studies (SSEES) are new to the technology. What all sites have in common is a range of user groups for whom participation in the structured activities of the pilot is a need or an asset.

2 Description of the Pilot

The pilot started on January 2, 1998, and will run for a period of 5 months. At the beginning of the project, connections to all partner sites were tested. Shrink-wrapped versions of the Mbone conferencing tools - provided by the SHRIMP [2] project - were installed and tested. The tools are sdr[3], rat[4], vic[5], nte[6] and wb[7]/wbd [8].

Partner sites use a range of hardware platforms and operating systems: Unix workstations (running SunOS, Solaris, Irix) and PCs (running Linux, FreeBSD, Windows95). All sites, in collaboration with the SuperJANET operations staff, had to ensure relatively congestion-free access to the Mbone.

Weekly project meetings between all sites using the conferencing tools commenced in the second week of January. A technical workshop was run to introduce technical staff at the new sites to Mbone technology; in a second workshop, prospective tutors at the partner sites gained hands-on experience with the tools.

The structured activities cover the main activities that take place in institutions of higher education: teaching (lectures and small group tutorials), research (seminars) and administrative tasks (weekly project meetings).

All sessions are recorded digitally on the basis of which contents analysis can be performed and network statistics extracted.

We are preparing a detailed plan for collection and analysis of statistics on Mbone traffic and network performance. This plan is based on what Mbone experts at UCL and in the international research community regard as best strategy to obtain meaningful feedback at this point in time, and will be agreed with UKERNA. The collection and analysis of data will be documented and constantly reviewed throughout the project. At the end of the project, conclusions as to which data collection and analysis methods provide the most meaningful feedback about network performance will be provided in a separate deliverable.

3 Work Conducted to Date

In preparation for the user trials, UCL hosted two half-day workshops. The technical workshop was aimed at network administrators at the PIPVIC sites and included an introduction to IP multicast, a talk on how to set up multicast routers and the network administration involved in running it, and an introduction to the Mbone tools. The workshop for tutors was designed to prepare the new teachers and covered both a hands-on introduction to the tools and talks on how best to prepare and conduct remote tutorials given by two experienced tutors. Both seminars were multicast to the partner sites and recorded on both MMCR and VCR.

The specialist language course, French for lawyers, has been completed. It was taught from UCL to 3 students in Exeter. The tutor made use of rat, vic, nte and wb in the tutorials. The tutorials were based on the use a video tape which was fed into a workstation and multicast through vic. All sessions were recorded using MMCR, and both students, tutors, and technical staff at both sites filled in a web-based form assessing the quality of the audio and video after each session. The tutorials were observed at the Exeter site. Following the tutorials, a workshop was held at UCL where technical and pedagogical aspects of the tutorials were evaluated.

Presently, a specialist language course in Spanish for lawyers is being taught from UCL to 2 students in Exeter. Again, clips from video tapes are being multicast to the students using vic. This time we are recording the video tapes to a video server at UCL using MMCR, enabling us to replay the video clips using MMCR during the tutorials.

The language course Polish for beginners is presently being taught from SSEES to 2 students in Essex. This is the first user trial where both students and tutor are using PCs running Windows95 for tutorials. Previous trials have used of Unix based platforms.

Future courses include:

- Discussion groups in Human Rights between Essex and SSEES. Prior to the start of the discussion groups, UCL will provide another training session for tutors and students at Essex and SSEES.
- Mandarin for beginners which will be taught from UCL to students at Exeter
- Italian courses between Aberystwyth and Exeter
- And the only non-language tutorial, a course in systems development taught from Westminster to students at UCL.

To date, 3 weekly seminar have been given. UCL started with a seminar introducing the PIPVIC project. Aberystwyth followed with a seminar, which was a practical talk on how to set up and maintain multicast routers. The third seminar, from Westminster, was on how adequate desktop video conferencing is for different types of teaching, followed by a presentation of case studies where multicast conferencing has been used for remote tutorials in previous user trials.

All sessions are recorded using the MERCI Multimedia Conference Recorder (MMCR), which allows digital recording and playback of Mbone conferences. Audio, video and shared workspace activity of the language teaching sessions and technical seminars are recorded; sessions can be replayed by those given access (e.g. tutors who want to review a session), as well as for detailed analysis of sessions.

Sessions recorded on MMCR can be analysed in terms of quality of audio and video received, and the content of the session. We are conducting content analysis of the teaching sessions (activity on different tools, frequency and duration of contributions from each participant) to establish whether the videoconferencing tutorials produce the tutor-learner dialogue required in the educational context. The content analysis is based on previous evaluation work in the ReLaTe project [10].

4 Preliminary Results

The French for lawyers tutorials proved successful with both tutor and students. We have yet to analyse the results from the workshop evaluating the trials in depth, but both students and tutor expressed satisfaction with the quality of the audio and video. The main problems encountered during the tutorials were due to poor audio quality for those students using PCs. The students were meant to take part in the tutorials from PCs running Linux, but had to revert to using 2 Silicon Graphics workstations with one student on one machine and two students sharing the other. This obviously made typing in wb and nte problematic and though all three students could hear one another and the tutor, one of them could not transmit audio.

The problem on the PCs was traced to an interaction between PC audio hardware and the network audio tool, rat. Numerous problems were discovered with certain PC soundcards: analogue cross-talk interference between input and output channels, excessive noise pickup, clock frequency drift between input and output channels, and extreme sensitivity to variation in microphone and headset impedance. Together, these conspire to make successful audio conferencing difficult when using PCs, unless great care has been taken in the selection of the audio hardware.

The audio on PCs has also been the main problem in the Polish tutorials taking place between SSEES and Essex, and more so because the two sites only have PCs available for multicasting. The other problem encountered in running the Polish tutorials is the need for a Polish character set to be available in the shared workspaces. A modified version of nte, capable of displaying Polish characters, was developed and made available for PCs running Windows95. Polish Windows95 language drivers must be installed on all participating machines in order for nte to display the Polish characters correctly.

The Mandarin course for beginners will pose a similar problem – how to display Chinese signs in the shared workspaces. The solution we have chosen is to use graphics tablets which can then be used to draw the signs in wb (or wbd on PCs).

Throughout the structured activities we have been collecting network statistics which we will compare with tutors' and students' subjective opinion of audio and video quality. In addition, analysis of these statistics has revealed, and helped to correct, a number of problems with the multicast routing configuration in the SuperJANET network. This has included increasing the rate limit on the backbone network links from the old value of 512kbps, as was previously recommended for the Mbone in general, to 2Mbps. This new value more accurately reflects network conditions, given the growth in Mbone traffic in recent years, and is also more consistent with recent IETF policy [9].

5 Conclusions

The PIPVIC project has shown that IP multicast based conferencing applications are usable now, although a number of rough-edges remain. Over the last few years, the toolset available has matured, both in terms of usability and technical performance, and although still officially classified as "research software", it performs well in day-to-day use.

Despite this, the use of a set of individual tools provides a greater burden on the users than would a single, integrated, interface. An experimental integrated interface has been prepared, and has received some use, but needs further development before it can be considered fully stable.

Commercial interest in IP multicast conferencing remains strong, and it is hoped that a number of products will be introduced over the medium term, which will provide a better supported route by which this technology may be deployed.

The multicast infrastructure within SuperJANET has been upgraded in line with the recommendations of the PIPVIC project, and now provides a solid base for future use, although continued monitoring is required to ensure that the performance remains acceptable.

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