DESKTOP IP VIDEOCONFERENCING AS AN EFFECTIVE TOOL FOR ONLINE DELIVERY

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Abstract

The capacity to use desktop IP videoconferencing routinely as an augmentative tool in online delivery has been rapidly advanced by increases in the reliability and bandwidth of networks, establishment of IP videoconferencing protocols and the availability of commercial systems that can be configured to meet the needs of distance education. Presented here are criteria for effective implementation of desktop IP videoconferencing as identified in a pilot study aimed at establishing the technology within the framework of educational program design and renewal in Life Science disciplines.

Keywords

Videoconferencing, IP videoconferencing, Desktop videoconferencing, Online delivery, H.323, information interaction design, Implementation experiences

Introduction

A key element in successfully matching emerging technologies to the operational requirements of universities is the capacity to identify the critical points in time for commencing investment in an evolving technology, supported by the ongoing judgment associated with the correct scaling of this investment. In consideration of the level of functionality now available with IP videoconferencing (Internet Protocol videoconferencing) the Faculty of Life Sciences at RMIT has chosen to establish a pilot program in IP videoconferencing, aimed in the first instance at providing a supplementary tool for the regional educational delivery requirements of the institution, and secondly, to provide a basis of expertise from which an informed scaling of the technology can occur.

A number of commercial products are available to meet the needs of educational service delivery via IP videoconferencing. The pilot project was focused on obtaining a solution to educational communication from a single presenter to a class group of up to 40 students. Necessarily, the technology would need to provide the capacity for the presenter to interact with all students in the class, and hence be capable of transmitting a visual field and audio sensitivity that would cover all students in the delivery space.

The IP videoconferencing pilot project assessed a variety videoconferencing solutions, before selecting a product and product configuration that met the immediate requirements of the project and provided a well defined migration path for this technology within the business operations of the Faculty. The pilot project was conceived in response to expanding regional delivery requirements, an issue common to most universities, hence the Information and Communication Technology solution presented in this paper has broad relevance.

Defining a pilot program to assess the capacity of current IP Videoconferencing products to meet distance education requirements

The present standard of IP videoconferencing available from consumer-type webcams does not meet the base requirements for the communication of professional-standard educational presentations. At this point in time, such products are limited to a video frame rate of 10fps and can have unacceptably low audio transmission quality. They are suited however to expanding general communication options for students, within a University Virtual Private Network (VPN).

The pilot project described in this paper was established to meet the requirement of synchronous online communication to support web-based delivery between an RMIT city campus (Melbourne) and a regional campus (Hamilton). Prior to the implementation of the IP videoconferencing link, teaching staff faced the travel overhead of commuting the 250 kms between campuses. The sites are now linked by a 2Mbps network that forms part of a VPN and carries all data communications between the campuses. The IP videoconferencing communication necessarily shares the bandwidth with other TCP/IP traffic, and in the current pilot, the videoconferencing packets were not elevated in priority for transmission on the network.

The capabilities of all commercial IP videoconferencing products are undergoing rapid change. The status of product development and immediate future developments have been well documented (Video Development Initiative, 2002). The aims of the Life Sciences IP videoconferencing pilot program were:

- To determine a suitable commercial product for presenter interaction with a remote class size of 40 students. It was essential that the selected product be capable of application sharing whilst maintaining video and audio.
- To establish IP based videoconferencing at RMIT, provide the Faculty with a dedicated IP videoconferencing suite, and resolve issues relating to the provision of reliable wide area IP videoconferencing
- To establish provision of IP videoconferencing to the RMIT Hamilton campus
- To determine the scalability of IP videoconferencing outside of the RMIT network
- To ensure that a cross-section of users with differing requirements test the concept of IP based videoconferencing
- To refine usage protocols, best practices, and facilities standards for optimum effectiveness of the videoconferencing experience.

Principal criteria for effective IP videoconferencing

After assessment of a number of products and product configurations, it was determined that the following elements provided the best solution to the aims of the pilot:

Desktop IP videoconferencing: A system of this type is based on a PC, primarily designed for individual use and more readily available with data collaboration features than the alternative of stand-alone solutions. The Faculty of Life Sciences operates an extensible standard operating environment (SOE) for all its PC hardware and software and hence Desktop IP videoconferencing as an additional application within the SOE provided significant advantages in minimising staff training time, and could be readily integrated into any location in the Faculty. In particular the use of Desktop IP videoconferencing with application sharing allows the synchronous capabilities of videoconferencing to be integrated with web-based learning materials in a manner that can significantly promote directed online learning that is facilitated by presenter guidance obtained in a videoconference session.

The Desktop solution adopted in the pilot project was the Polycom Viavideo unit, a low-cost Universal Serial Bus (USB) connected camera ($US500) with built-in hardware dedicated to video compression/decompression, capable of 384Kbps videoconferencing and 30fps. This camera is principally designed for one-to-one desktop videoconferencing. We found that despite its design basis, a pair of such cameras, in conjunction with a good quality digital projector was capable of meeting the aims of the pilot, in particular, the camera in the remote teaching space was well able to provide a visual field that accommodated a 40 student class and a microphone sensitivity that allowed all students to be able to communicate with the presenter. Additionally, Desktop IP videoconferencing was adopted in the pilot, as it was considered that this form of IP videoconferencing would undergo more rapid development than established IP videoconferencing units that were workstation independent.

Application sharing: The ability of IP videoconferencing systems to share applications in real time along with video and full duplex audio, provides a major advance in the capacity of educational presenters to contextualise web-based materials for students. A key outcome in the pilot was the sharing of a web-browser application (Internet Explorer), controlled from the presenters desktop, and delivered to the workstation/digital projector at the remote site in parallel with a small-format window of the videoconference transmission of the presenter. This combination, allowed presenters to communicate directly with students whilst navigating the suite of online resources to which they had independent access. Importantly, application sharing allowed presenters to use all desktop software packages in their delivery to the remote site. This provides a ready means of facilitating learning via specialised software that may not be readily available to students at the remote site.

Videoconference spaces: The design of videoconference spaces has been well documented. (Video Development Initiative, 2002). For the one-to-many delivery implemented in this project, a small videoconference suite was built. The use of Desktop videoconferencing permitted flexibility in the location of the presenter in instances where the videoconference was chosen to be delivered from a staff members office. Importantly, at the remote site the projection of the videoconference was presented to the class group on a large format screen such that all details were clearly visible to all participants, similarly audio levels were optimised to ensure that sound communication was of high fidelity and sufficient intensity to be readily heard by all participants. The aim being to provide to the students a videoconference experience that conveyed as much immediacy and involvement as possible.

Adherence to H.323 protocol: A key aim of the pilot was the capacity to scale proven technology into the broader university community. Consequently it was essential that the chosen solution conformed to the relevant standard for videoconferencing. The H.323 protocol was defined by the International Telecommunications Union (ITU) as the base standard for real-time multimedia communications and conferencing over packet-based networks (Video Development Initiative, 2002). Adherence to this protocol permits videoconferencing between multi-vendor systems, and was considered essential to the requirements of the pilot project. The H.323 protocol supports the T.120 standard which encompasses the standards for application sharing, file transfer, white-boarding and slide presentation, that is, the supplementary functionality required for remote educational delivery (Video Development Initiative, 2002).

Actions to support Quality of Service (QoS): Technical failure during a videoconference significantly diminishes the viability of the medium as an educational support tool. To-that-end, we designed the hardware and software configuration to be as robust as possible, using dedicated PCs that allowed presenters to access all files on their office workstation, however, to ensure software reliability, users were restricted to running a standard and proven suite of software applications. A service protocol was put in place to establish the videoconferencing session 30 minutes prior to the scheduled class time, to allow for remedial actions if technical problems were manifest. Under conditions of insufficient bandwidth all IP videoconference systems prioritise audio transmission, such that real-time sound communication is maintained as the videoconference communication degrades. This approach buffers the educational delivery from variations in network loads, as the prime communication channel of the spoken word is retained under conditions of diminished network performance. A contingency option of a telephony conference system on a circuit switched network was available as a stand-by in all IP videoconferencing sessions and all sessions were supported by readily accessible technical support at both endpoints.

Network performance planning: For Internet data traffic the Transmission Control Protocol (TCP/IP) is highly reliable, though prone to delay. However for video and audio application, such delays are unacceptable. IP videoconferencing using the H.323 standard requires a dedicated bandwidth of 384kbps and a latency of less than 150msec in each direction. Visual interruption, termed Jitter, results from variation in the delay of packet transmission, and must also be minimised to avoid distortion and unstable image representation. We found that with the desktop unit used in the pilot that a bandwidth of less than 384 Kbps was unacceptable for our regional educational needs. Communication could be sustained at lower bandwidths, however, the perception of student groups was that a bandwidth of 384 Kbps was the lower limit for acceptable professional standard educational delivery.

Depending on the network topology, the impact of one or more IP videoconference sessions at 384 Kbps may result in unacceptable overall performance of the network. Consequently, the introduction and scaling of IP videoconferencing must be integrated into the overall upgrade path for network design. A 384Kbps videoconference generates approximately 1.4Gbit of data over an hour. As the communication used for educational delivery in the first stages of this pilot were over a VPN usage costs were fixed.

Proof-of-concept testing to establish viability: The viability of IP videoconferencing is dependent on two critical components 1.) Sufficient bandwidth and 2.) Reliability of that bandwidth. A number of diagnostic tools are available to access network performance, however we found in practice that *in-situ* testing provided the most definitive diagnostic on the viability of IP videoconferencing between any two end points. In this manner proof of concept testing was conducted to assess scalability of IP videoconferencing between RMIT teaching locations in Melbourne, Hamilton, Sale, Bundoora, Singapore and Hong Kong. Experiences gained from the implementation of IP videoconferencing between the above sites reinforced the necessity to trial IP videoconferencing for an extended period in the order to define the QoS levels that could be provided in a videoconference session.

Staff capability building: The training overhead associated with the use of well-designed Desktop IP videoconferencing software is typically lower than that of non desktop systems due to the inherent familiarity that teaching staff have with desktop software. However beyond the base functionality, the ability to supplement online materials with IP videoconferencing necessitates a complete restructuring of teaching methodologies, as well as the re-conceptualisation of a ‘lecturer’ as a ‘presenter’. The pilot project has proven to be a starting point for the progressive acquisition of the presenter skill-set for staff.

Educational program design and renewal in the Faculty of Life Sciences prioritises an orientation to teaching that is student-centred / learning oriented rather than teacher-centred / content-oriented, and one where teachers act as facilitators, mediators and models to support understanding and intellectual development (Kember, 1998). The challenge of staff capability building in this case is to assist staff with a model of ‘presentation’ that is consonant with this orientation. To do so we are basing staff development on Shedroff’s (1999) concept of “information interaction design”. Shedroff says:

> One of the most important skills for almost everyone to have in the next decade and beyond will be those that allow us to create valuable, compelling, and empowering information and experiences for others. To do this, we must learn existing ways of organising and presenting data and information and develop new ones. Whether our communication tools are traditional print products, electronic products, broadcast programming, interactive experiences, or live performances makes little difference. Nor does it matter if we are employing physical or electronic devices or our own bodies and voices. The process of creating is roughly the same in any medium. The processes involved in solving problems, responding to audiences, and communicating to others are similar enough to consider them identical for the purposes of this paper. These issues apply across all types of media and experiences, because they directly address the phenomena of information overload, information anxiety, media literacy, media immersion, and technological overload--all which need better solutions.

Using this new conceptual foundation for creating worthwhile educational experiences via the use of videoconferencing places related staff capability building firmly within a Knowledge Society model of teaching in higher education. As Laurillard (2002) has written: “The technology can do only so much. On its own, it cannot offer academics what they need to adapt their teaching to the needs of the digital age… Without a change in approach, new technology will not serve universities in meeting the challenge of mass higher education and lifelong learning for the knowledge society.”

Using this foundation also identifies the associated communication skills as generic skills that students too will need, to equip them to work productively as Life Sciences graduates. Teacher modelling of these skills for students to observe, and introducing learning activities that afford students the opportunity to practice these skills in two-way videoconferencing exchanges, can add to the value of the educational experience.

We anticipate that as videoconferencing plays an increasingly strategic role in selected academic programs, teaching staff will require targeted professional development activities, and advice on redesign of learning experiences, to implement this emerging technology effectively.

Identified limitations of the pilot system

The IP videoconferencing pilot rapidly established the system defined above as an effective augmentation to existing delivery and communication techniques in regional delivery on the University VPN.
The Viavideo system used in the pilot, whilst achieving an outstanding result for a low-cost system, displayed several inherent characteristics that constrain its usability. Importantly, the compression algorithms used for the video compression in this low-cost unit, restrict the colour contrast of displayed images in shared applications. This becomes a major limitation when image contrast is central to the educational communication, as occurs with, for example, diagnostic medical images. Additionally, the system does not allow the inclusion of document camera input or controllable pan/tilt/zoom (PTZ). Hence the system is unable to transmit non-digital documents or provide direct student-presenter communication to the remote site. These features are available with some non-Desktop IP videoconference systems, however such units are an order of magnitude more expensive and less readily integrated into our online delivery programs.

Conclusions

Online educational delivery is on the cusp of further advancement with the advent of workable implementations of IP videoconferencing. Commercial Desktop IP videoconferencing systems can be adapted to provide a ready solution to the distance education needs of small classes, provided that close attention is paid to the design of the supportive infrastructure. Such small scale implementations provide the opportunity for the development of local expertise in advance of the major changes that will come to online delivery as IP videoconferencing is scaled as a mainstream communication tool. The project described above has succeeded in establishing IP videoconferencing to RMIT regional campuses at Hamilton and Sale.

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