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Multipoint Desktop Videoconferencing: technology and implementation for New Zealand business and education

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ABSTRACT

This paper discusses multipoint desktop videoconferencing and describes installation of this technology in New Zealand. Videoconferencing can now be implemented on the desktop. The definition of desktop videoconferencing is that it is a PC-based application for exchanging audio and video data over a network. This technology was implemented in this research work to develop an alternative to travel for: meeting delivery, interaction among remote branches of New Zealand organizations, distance learning, and research focus groups. To achieve this objective, available technologies were surveyed, the necessary media put in place, and the implementation of the technology tested and evaluated.

Keywords
Multipoint, desktop, videoconferencing, MCU.

1. INTRODUCTION

Advances in computer technology such as faster processors and better data compression schemes have made it possible to integrate audio and video data into an organisation's computing environment. Fuetterer (1999), describes the growth of videoconferencing over the last decade as being slow and concentrated in large, room-sized videoconferencing systems. Historically, these systems offered better performance than desktop videoconference systems; however, they were cost prohibitive for many potential users.

Recent developments in the desktop videoconferencing arena address the problems of the past and promise significant gains for desktop videoconferencing systems in organisations in the near future.

Desktop videoconferencing has faced problems of inconsistent industry standards, high cost, poor performance, and limited availability of the necessary bandwidth, according to Waurzyniak, 1995 (as cited in Fuetterer, 1999). These inconsistent industry standards have made it almost impossible for different videoconferencing systems to communicate with each other.

As for network requirements, most desktop videoconferencing systems, today, will run on existing PC hardware, over a typical corporate IP network (Cole-Gomolski, in Computerworld Magazine, 1999). Previously, desktop videoconferencing required Integrated Services Digital Network (ISDN), a high-speed standard that allowed access to voice and data services over a public network, which many companies lacked at the desktop. A user on an IP network connects their PCs

to another users PC through a desktop conferencing application.

Hines (1995), as cited in Fuetterer (1999), describes the primary uses for desktop videoconferencing in organisations as:

- on-on-one meetings
- group meetings for project management
- general communications
- presentations

Travel substitution, real-time application sharing, remote troubleshooting, product demonstrations, product development, telecommuting, distance learning, and research focus groups are other uses for desktop videoconferencing.

Desktop videoconferencing provides a high degree of interaction. The full benefits of the video in the interaction could make significant differences to organisations and improve employee's quality of working life.

Prior to this research project, in 1999, there was a perception that most New Zealand companies did not have the necessary bandwidth, in existing data circuits, for Intel Proshare Video System to operate effectively.

2. MULTIPOINT DESKTOP VIDEOCONFERENCING TECHNOLOGY

2.1 Modes of Conferencing

2.1.1 Two Way Video/Audioconference (Point-to-Point)

Purpose: To allow full two-way voice and videoconferencing capabilities between two primary locations.

Examples: Conduct brief meetings that would otherwise not be feasible if travel were required, or conduct candidate interviewing.

Technologies: Videoconferencing is used to send information over a high capacity channel, such as a permanent T1, Fractional T1 line, telecom DDS line or dial-up connection over ISDN. Video equipped PCs are increasing in popularity and rapidly decreasing in price.

Alternatives: Travel.

Added value of Conferencing Services: Immediacy and cost reduction.

2.1.2 Videoconference - Multipoint

Purpose: Full videoconferencing between multiple locations. Each location can see and hear the other. This is the most effective of conferencing services.

Examples: Distance learning, brief meetings otherwise not feasible, research focus groups, corporate quarterly investor updates, and staff meetings.

Technologies: Video cameras, microphones, speakers, and other peripheral equipment (such as PC screen display devices and scanners to show 3D objects) combined with special hardware and software show the party speaking on the full screen.

Alternatives: Travel to central meeting.

Added Value of Conferencing Services: Conferencing services allow many different locations to be grouped together quickly and cost effectively. The conferencing server performs scheduling and allocates network resources. Application sharing is also supported.

2.2 Client Endpoints

The client endpoints chosen for this implementation were the Intel Proshare Video System 500 product.

2.2.1 Intel Proshare Video System 500

This system lets you make audio, video and data connections using ISDN or LAN.

The system extends the functionality of Microsoft NetMeeting data applications. These data applications let you share documents, graphics, spreadsheets, or any kind of file, and mark them up collaboratively.

Full audio and video capabilities are built into the system. The camera produces the video that the endpoint client sees. Audio equipment can be a headset with microphone or a desktop microphone.

The Proshare system complies with industry standards for ISDN (H.320), LANs (H.323), and data sharing (T.120). You can conduct conferences and transfer files over either ISDN or your corporate network (Intel Corp., 1999).

2.2.2 Features of Intel Proshare Video System 500:

Windows NT: ProShare System software runs under Windows95, 98 or Windows NT. People running

one operating system can call other Intel ProShare Conferencing systems running the other operating system.

Internet Locator Servers: You can locate others who are running the Intel ProShare System and NetMeeting by browsing Microsoft Internet Locator Servers (ILS). When you connect to an ILS, you can select people to call the same way you do from other address lists. When you register with an ILS, other people browsing that server can locate and connect to you.

Gateways: LAN systems and ISDN systems can connect to each other through gateways.

Proxy Support: You can make LAN calls outside a corporate proxy server or firewall.

ISDN Indicators: Two icons in the tool tray display the status of your ISDN telephone call. The status icon shows the condition of the ISDN line. The connection icon shows the quality of the ISDN connection.

Photo Exchange: This allows the endpoint clients to exchange single snapshots or snapshot albums during the conference.

NetMeeting2.1: Microsoft NetMeeting2.1 is integrated with the Intel ProShare system. This enables the client to share applications, files, the Whiteboard , and Chat easily.

LAN Connections: For a LAN conference, all computers must be connected to a LAN using Microsoft Windows95, 98 or Windows NT native TCP/IP network protocol.

LAN connections between two people (point-to-point) support full audio/video and data conferencing.

All LAN connections through a gateway or proxy server support audio/video conferencing, and some support data conferencing also. The support for data conferencing depends on the capabilities of your gateway or proxy server. If your gateway or proxy server supports the T.120 standard, it supports data conferencing.

LAN multipoint conferencing requires a Multipoint Control unit. Without a MCU, the ProShare system supports only point-to-point LAN conferencing. MCUs which support full audio, video, and data conferencing are commercially available and were evaluated.

2.2.3 Supported standards by Intel Proshare Video System 500

ITU H.320 videoconferencing on ISDN
ITU H.323 videoconferencing on LAN
T.120 data conferencing
Audio - Supported standards:
G.711
G.723
G.728
Video - Supported standards:
H.261 FCIF, QCIF
H.263 FCIF, QCIF

2.3 MCU and Gatekeeper

The multipoint control unit chosen for this implementation was White Pine's MeetingPoint Conference Server.

2.3.1 MeetingPoint Conference Server

MeetingPoint conference servers allow administrators to control the use of multimedia communications on their network, offering bandwidth control and optimisation, security, and conferencing services to H.323 standards-based clients. The conference server can be accessed from most computer platforms through a Web-browser. It manages the amount of bandwidth required for group interaction, takes full advantage of IP Multicast technology, and facilitates billing and tracking with third-party systems (White Pine Software Inc., 1998).

2.3.2 H.323 Conferencing

As more computers become videoconferencing-enabled, interoperabliity becomes increasingly important. With users communicating via hardware and software from a wide variety of manufacturers, industry standards are required to ensure interoperability. MeetingPoint is a standards-based solution that provides multipoint conferencing services to H.323 standards based clients.

H.323 serves as the cover for a suite of recommendations defined by the International Telecommunication Union (ITU). H.323 defines videoconferencing over packet-switched networks such as LANs and the Internet. It covers both point-to-point and multipoint audio and video conferencing. ITU has also defined T.120 standards to address the document sharing or data conferencing portion of a multimedia conference.

Point-to-point videoconferencing users that use H.323 standards can participate in multipoint conferences by connecting to a MeetingPoint Conference Server. The clients who fall into this category are Intel Business Video Conferencing with ProShare, Intel TeamStation, Microsoft NetMeeting and PictureTel LiveLAN and CU-SeeMe. These controls include security and

authentication, client access control, conference administration, and monitoring services for multimedia group interaction.

In MeetingPoint, H.323 becomes an attribute. When it is enabled in a conference configuration, H.323 clients are able to connect to and participate in that conference. There are limitations on how H.323 clients can participate in a multipoint conference. This is due to the fact that most H.323 clients are designed for point-to-point videoconferences and not the multipoint conferences. MeetingPoint makes allowances for this by performing some behind the scenes functions.

H.323 Gatekeeper Functionality: The standards that fall under the H.323 cover define several components for real-time multimedia communications over packet-based networks. These include:

- Terminals: H.323 terminals provide real-time voice, video and data communications. Videoconferencing clients such as Intel ProShare, Intel TeamStation, Microsoft NetMeeting and PictureTel LiveLAN are H.323 terminals.
- Gatekeepers: H.323 gateways provide translation between circuit-switched networks and packet-based networks this allows H.323 endpoints to communicate with non-H.323 endpoints.
- Multipoint Control Units (MCUs): H.323 MCUs provide the support that is required for conferences between three or more endpoints. The MCU controls conference resources, and negotiates between the endpoints. MeetingPoint is a multipoint control unit with an H.323 gatekeeeper. MeetingPoint is able to register as an endpoint with its own, local gatekeeper or with a third-party gatekeeper.
- Address Translation: Gatekeepers perform alias-address to transport-address translation. Endpoints register one or more of these aliases with the gatekeeper. Other endpoints then ask the gatekeeper for the desired alias. All MeetingPoint H.323 conferences have registered aliases with the gatekeeper.
- Admissions Control: H.323 endpoints send RAS (Registration, Admission, Status) messages to the gatekeeper. The gatekeeper then authorises network access to these endpoints. When a videoconferencing client sends a request to be connected to a conference, the gatekeeper asks MeetingPoint's existing authorisation mechanisms to determine whether the terminal should be connected to the conference.
- Bandwidth Control: Terminals send requests for network bandwidth to the gatekeeper. For terminals connected to a MeetingPoint conference, the gatekeeper grants or denies the request based on the sum of MeetingPoint's send and receive rates for a conference or for the conference server, whichever is the lesser.
- Zone Management: The gatekeeper is required to provide address translation, admissions control, and bandwidth control to all the endpoints that have registered with it. The rules for deciding which endpoints can register with the gatekeeper are left to the individual network administrator. MeetingPoint's local gatekeeper allows the network administrators to specify IP addresses or subnets from which the gatekeeper will not accept registration requests.

You can specify whether MeetingPoint will use the services of its local gatekeeper or that of a third-party gatekeeper. This is done in the Network area of MeetingPoint's Conference Administrator Web pages when you add a new domain member or edit the settings of an existing one. Gatekeeper functionality can be specified separately for each conference server in a MeetingPoint domain.

2.4 Benefits of New Desktop Videoconferencing Systems

- Complete solution for desktop PCs including board, camera, audio peripherals and software
- Windows 95, 98, and Windows NT-compatible
- Support for point-to-point and multi-point audio, video and data conferencing, enabling PC users worldwide to easily share information and ideas
- Full support for the H.320 and H.323 videoconferencing standards allowing users to conduct audio and video conferences with any other H.320-compliant or H.323-compliant system
- ISDN modem support for high-speed access to corporate networks, online services and the Internet
- Desktop video at 56 - 384 Kbps data rates.

3. ORGANISATIONAL IMPLEMENTATION

3.1 Design of infrastructure

Intel Proshare Video System 500 units were required, for this organization, at Headquarters (Whangarei), Whangarei branch, Glenfield branch and Tauranga branch. A Telecom 128k DDS link connected Whangarei headquarters to Glenfield, a Telecom 64k DDS

link connected Whangarei headquarters to Tauranga, and a fibre optic link connected the two Whangarei sites. The MCU would be located in the boardroom at Headquarters, Whangarei.

3.2 Hardware

All units to be deployed for video conferencing, endpoints and MCU, needed to be a minimum of the following requirements: Processor - Pentium II 350 MHz, RAM - 128 Mb, Graphics Card - 16 Mb VRAM.

3.3 Software

All endpoints required Windows NT4 Workstation and Internet Explorer browser. The MCU required Windows NT4 Server, IIS4, and Internet Explorer browser.

3.4 Network topology

The network topology for the implementation of multipoint desktop videoconferencing used an existing IP network infrastructure. The machines running the Intel Proshare Video System 500's, and the MCU machine, connected into the network exactly the same as any other machines on the network.

3.5 Implementation

Implementation is the process of ensuring that the system is operational, then involving trained users in its operation, and supervising the installation of the equipment. Training users and personnel to interact with the system is an important part of the implementation. The users must be committed to the to the idea that the new system is a worthwhile enterprise and be willing to play the new roles required.

3.5.1 The two phases of deployment

Knowing the network was optimised for H.323 conferencing, deploying it within an organisation follows two phases. Testing performance on the network as each phase is completed helps to identify and isolate potential problems.

Phase 1: Pilot test on a dedicated LAN
Phase 2: Extend to LAN/WAN

Implementation of point-to-point desktop videoconferencing for an organisation involves showing users how to connect to another videoconferencing system. Implementation of multipoint desktop videoconferencing involves preparing a small user manual, for users to refer to the steps to authenticate themselves into a conference.

3.6 Implementing QoS (quality of service) Measures

Once the current network capacity had been determined, and the available bandwidth for video conferencing, preparation on the network for H.323 deployment was considered. It was determined that existing routers would be appropriate, for the audio/video codecs, for the required bandwidth and connection speeds. Audio/video communication requires low latency (accumulated delay) between sender and receiver in order to maintain quality. This is because audio and video data lose relevancy to the receiver if not delivered in a timely manner. Each component on a network introduces some amount of latency. Excessive delay occurs when one or more of these components are not working at the desired capacity. Routers, switches, and other network devices from different vendors introduce different amounts of latency. It was determined that the routers in use were managed routers and sufficient to maintain quality.

3.7 Improvements

Management personnel can make preparations to extend the deployment of desktop videoconferencing-capable endpoints in an organisation, at any time, because the solution is scalable in two ways:

- MCUs can be added (called cascading) anywhere on

the network or network extensions

- Endpoints can be added anywhere on the network or network extensions

4. COST/BENEFIT ANALYSIS

Capital costs:

DDS - Increase of additional bandwidth $140x2	280
4x client endpoint hardware (incl. OS & Proshare system	20,000
1x server hardware (incl. OS)	5,000
Specialised Conference Server software	16,000NZ
	41,280

Offsets:

Frees up 5 machines for installs elsewhere	10,000
Maintenance - prepaid phone per annum	240
	31,520
Interest on $16,000	3,000
	34,520

Director/Management meeting costs prior to conferencing - monthly per meeting:

1 day per week (travel/labour/food - only hours taken to travel to & back here)

2 users - Whangarei to Auckland -	640k @ $1	640
	10hrs @$35 + $40	390
1 user - Auckland		-
1 user - Tauranga to Auckland -	600k @ $1	600
	7hrs @ $30 + $20	230
Meeting room cost - $10 per meeting		10
		1870

Data swapping ability versus hardcopy/fax	30
Convenience - safety on road (people not out on road)	100
	2,000

Payback (payability):

- 17 meetings approximately is the period of payback
- Payback could be as little as 17 weeks or, on worst case scenario, 17 months

Return on investment:

The investment made by this organization is projected to show an annual average return on investment of 27.14% over a three-year period.

Intrinsic benefits:

- Voice/data communication using NetMeeting and Proshare systems for toll savings
- Capability for 'point-to-point' at any time to discuss issues brings about toll savings

- Advantage of using existing circuits. Other staff can also use additional bandwidth for accounting/payroll/email
- Heightened communication value over basic telephone call
- Upgradability by using brand name products with support
- Employees not on the road when busy/tired/in a hurry

5. CONCLUSION

In this research project the approach of implementing Intel Proshare Video System 500 and White Pine's Meeting Point Conference Server was found to be practical.

Multipoint videoconferencing requires a 128k network connection to get acceptable audio and video to three, or more, endpoints. As this organisation had an existing 128k DDS link, between Whangarei and Auckland, this implementation proved the project's analysis correct, in determining that this technology could be implemented on existing data circuits currently being utilised in New Zealand. This technology can be used for distance learning projects and research focus groups to help with current education objectives.

Observations of the technology being used, within this organisation, showed that it had immense appeal to the users. It was noticed, however, that these prospective users watched and listened at first, then or realisation of the ease of use of the systems, they became very willing to interact with the technology. It appeared that they could see the improvement to the quality of their working life. As the systems were deployed in this organization users began to use the technology extensively. The implementation of this technology has made users more productive, giving the organisation increased value through immediacy and cost reduction.

This project has shown that given adequate software, CPU power, and transmission support, desktop videoconferencing can now offer New Zealand users smooth, high-quality images.

Multipoint desktop videoconferencing is a viable telecommunications technology for New Zealand organisations. Evaluation showed cost savings and a more efficient use of existing infrastructure.

6. REFERENCES

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