Good Practice Guidelines for Participatory Multi-Site Videoconferencing

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1 Summary

This report analyzes recent literature and contributes expertise from researchers and practitioners in the field to develop good practice guidelines for multi-site videoconferencing - linking people in multiple sites with videoconferencing. Our goal was to develop effective, empowering and contextually-sensitive good practice guidelines that encourage participation in multi-site videoconferencing.

Videoconferencing was established in the 1920s but was only available on the commercial market in the late 20th century. The use of videoconferencing is on the rise by organizations and individuals because of increasing access to IP networks and the decreasing cost of videoconferencing equipment.

People and organizations choose videoconferencing for many reasons. It saves time and money, allows meetings between people who otherwise might not get together, offers a green solution to meetings, is an important tool for knowledge-building, provides vital services to people in rural and remote communities, and aids community-building and development. Videoconferencing is currently being used for education and learning, health and medicine, meetings and conferences, personal communication and community-building.

To ensure dual and multi-site videoconferencing is used to its full potential, good practices need to be employed by individuals, groups, organizations and communities. In this document we outline good practice guidelines for participatory multi-site videoconferences. These guidelines expand on four factors important for effective videoconferencing: group dynamics, which includes the experiences of the different users and their social interactions; the production and reception of the content, which deals with planning videoconference events and gathering participant feedback; the interaction between users and the technology, which examines access, ease of equipment use and the set-up of the videoconference room; and the technical infrastructure, which includes the videoconferencing equipment, bridge, bandwidths and networks. These four variables integrate both the social and technical aspects of multi-site videoconferencing.

The report appendix includes checklists of the guidelines for quick reference. Every person and organization is at a different stage with multi-site videoconferencing - from not having the equipment yet or using it for the first time to having used it every day for years. For novice users, the important thing is to just start using it – multi-site videoconferencing does not have to be complicated. The authors encourage readers to try out these guidelines when they are ready and modify them to suit their own circumstances and needs. Ideally this report will encourage the development of a large community using good practices for participatory multi-site videoconferencing.

2 Introduction

We analyzed recent and current literature and solicited contributions from researchers and practitioners in the field to develop these guidelines. This report outlines how videoconferencing can be used and improved to encourage participation among people at multiple locations. Multi-site videoconferencing refers to linking people in multiple sites (three or more) using videoconference systems. Our analysis considered the following questions:

- To what extent can people in multiple locations participate and engage with each other using multi-site videoconferencing?
- What variables enable and constrain successful participation and engagement?
- How can technology design and use be improved in order to facilitate participation and engagement?
- How can the communication process be improved?
- What constitutes “successful” participation and engagement?

Participation in multi-site videoconferencing - active contributions by participants - can be facilitated in many ways. Participation includes verbal communication and non-verbal gestures that communicate identification, understanding, and openness to new ideas or information. Participation in videoconferencing also includes the potential engagement of participants who interact with others before during and after the videoconferencing to engage in learning, empowerment, the formation of identity or self definition, as well as individual or group action leading to individual, group, organization or community change.

Why is participation important? Researchers note that participation, or the ability to interact, is key to knowledge retention. Seeing, hearing and having the opportunity to interact can increase knowledge retention as much as 90%, and videoconference experiences where members are not able to participate are not worthwhile (Greenburg, 2004; Peterson, 2000). Therefore technology that enables interaction paired with a participatory atmosphere is vital for multi-site videoconferencing.

“Best” practice depends on the specific context of the multi-site videoconference and the technology used, as well as the individual circumstances surrounding the task at hand, the content of the videoconference, and the group and organizational dynamic. Best practices are determined by the type of videoconference and the group dynamic; therefore we propose “good practices” for multiple situations. We use the term "guidelines" to indicate a set of qualitative, voluntary and flexible recommendations.

Videoconferencing has several immediate and tangible benefits: it allows saving time and money participants would have otherwise spent on travelling, it encourages meetings between people who otherwise could not get together to meet, and it offers a "green" solution to meetings because it reduces the need to travel. Videoconferencing can also be an important tool for knowledge building, provide necessary services for people in rural or remote communities, and aid in community-building and development. Videoconferencing is currently being used for education, telehealth, businesses, and meetings, by communities and for personal communication. To ensure dual and multi-site videoconferencing is used to its full potential, good practices need to be employed by individuals, groups, businesses, organizations and communities.

To identify good multi-site videoconferencing practices we analyze both the technical and social aspects of using the technology. Our goal is to develop effective, empowering and contextually-sensitive good practice guidelines that encourage participation. These guidelines expand upon factors identified in recent research as important to effective videoconferencing and multi-site videoconferencing communications. We identified four core variables:

The first variable is *group dynamics and social relations*. This variable includes the task and level of group collaboration and participation needed; the experiences of different users and the effect on the group; social interactions with and between groups of users; group dynamics issues including trust, motivation, and participation; and representational models. Individuals who do not feel part of the group or do not trust others within the group may be less inclined to participate.

The second variable, the *content* of videoconferencing needs to be examined. For successful videoconferencing both the production and reception must be considered; therefore elements of production and reception need to be examined in order to optimize videoconference use. In multi-site videoconferencing especially the production of the meeting must be planned well in advance for optimum participation.

The third variable is the *interaction between the users and the technology*. This encompasses issues of access, ease of use and the actual physical space – how the conference room is set up. The ease of use will determine how comfortable participants are with the technology and their willingness to participate. The physical space of the room and location of the equipment, lighting and microphones can either encourage or inhibit participation.

The final variable examined is the *technical infrastructure*, which includes the multi-site videoconferencing system itself – videoconference equipment, bridge, bandwidth, network, and security issues. The type of videoconference and the attributes of the technical infrastructure will determine the quality of the videoconference, the number of people who can communicate using the technology and the capacity of the system to incorporate new features and elements.

The technical infrastructure is crucial to multi-site videoconferencing. Clear audio and visual signals can increase participation by increasing the quality of the auditory and visual cues. However, the equipment itself does not ensure successful communications. All variables affect the potential level of participation within multi-site videoconferences.

We also review the different levels of success measured by different interested parties – for example, by technical support, participants and stakeholders (Barfurth et al., 2002) – and how multi-site successes are measured, while suggesting good practices for the benefit of all involved in videoconferencing.

The literature review considered published research as well as information from authoritative sources on the Web that detail best practices for videoconferencing, focusing on multi-site videoconferencing. The analysis also considered research on group behaviour and relationships, collaboration and teamwork in order to identify barriers and solutions to effective and interactive videoconferencing.

3 History and current uses of videoconferencing

Introduction

The rapid adaptation of videoconferencing in the late 20th and early 21st centuries was the result of the public, private and civil society sectors realizing its current and possible future benefits. This chapter outlines a brief history of videoconferencing technology, identifies different benefits videoconferencing provides, and provides case study examples of different types of multi-site videoconferencing.

Videoconferencing history

In the 1920s, crude videoconferencing links were established by Bell technicians between New York City and Washington DC (Wilcox, 2000; Barlow et al., 2002). Experiments and improvements to videoconference systems were underway in the 1930s but the first videoconferencing systems were not introduced to the public until the 1964 World's Fair in New York City (Trawner & Yafchak, 2007).

In the early 1980s, with the development of integrated services digital network (ISDN) lines - transmission networks with a minimum bit rate for video - videoconferencing landed on the commercial market. Videoconferencing technologies expanded commercially but remained extremely expensive until the 1990s and the development of Internet Protocol lines (IP) (Wiredred, 2007).

Videoconferencing in the 21st century is increasing because of the relatively widespread availability of high speed internet and digital network access coupled with the decreased price of videoconferencing systems and personal computers. Consequently videoconferencing is now more accessible for organizations and consumers.

Benefits of videoconferencing

Videoconferencing provides many benefits to individuals, organizations and communities. Some benefits can be easily calculated while others are more difficult to measure.

Easily measured benefits

Easily measured benefits can be quickly and accurately calculated. These benefits include savings in time and money, and the reduced impact of carbon dioxide (CO_2) on the environment.

Time and money savings
The main reason why organizations and individuals chose videoconference systems over in-person meetings is the potential savings in time and money (Wainfan & Davis, 2004). Videoconference systems allow people to attend meetings without spending time traveling; for example, one employee, traveling by plane to and from Fredericton to Ottawa once a month for a year could lose more than 120 hours in productive time. The cost of the employee's hours lost plus the additional travel costs can be considerable (Tandberg, 2007a). Time and money savings benefit both employers and individuals who can use videoconferencing to work from their home base and attend educational sessions, meetings and conferences that they would not be able to attend in person (Papakostopoulos et al., 1999).

Impact on environment
Videoconferencing system manufacturers and retailers, and organizations using videoconferencing, have recently begun promoting videoconference as an environmentally friendly technology. They note that through videoconferencing people can reduce their "carbon footprint" on the world. Carbon footprint refers to the amount of CO2 released into the atmosphere from burning fossil fuels. CO2 is a powerful and lasting green house gas that can have a significantly negative effect on the environment (VideoCom, 2007a).

The Canadian government has launched campaigns to raise awareness and encourage individuals to reduce their use of electricity and transportation (Natural Resources Canada, 2007). Companies are also interested in reducing greenhouse gasses; for example, Tandberg, one of the most popular videoconferencing systems in Canada, has posted a carbon calculator on its website to calculate how much time, money and carbon dioxide can be saved through the use of videoconferencing systems (Tandberg, 2007a). According to the carbon calculator, one employee traveling by plane from Fredericton to Ottawa once a month for a year produces 2,246.4 kg of CO2 emissions.

Benefits more challenging to measure
Some benefits of videoconferencing are very important for individuals, organizations and communities but are more challenging to measure, such as the ability for different groups of people to get together quickly, the increased access to services and resources, and the multiple benefits to residents of remote, rural and Aboriginal communities.

Social Benefits
Videoconferencing allows people living in different places, often different countries and time zones, to collaborate together in real time. By allowing the interaction of different types of people with different backgrounds, multiple perspectives and fields of expertise, videoconferencing can aid in building a broader knowledge base.

Videoconferences can be easier to arrange than in-person meetings, especially when participants are geographically dispersed. Organizers inevitably run into problems with coordinating participants' schedules and travel time, limiting in-person meetings and conferences. Videoconferencing is adaptive – additional people can be added quickly and easily, allowing for people to meet more often (Ohinma & Scott, 2006).

Access

Access to videoconferencing technology can increase the knowledge of participants and lead to more efficient administration and decision-making. Videoconferencing equipment in schools and hospitals can also improve access to education and health care (Ohinma & Scott, 2006).

Videoconferencing technology is particularly important in remote, rural and Aboriginal communities that do not always have access to essential training and services. Videoconferencing provides access to educational sessions such as music education that may not be offered in the community, and medical care, like consultations with specialists, that people would normally travel for. Access to videoconferencing can also have a broader impact on remote Aboriginal communities, giving the communities the opportunity to network and conduct business, community, social and educational activities and giving the federal government the ability to reach remote communities in order to deliver services, conduct program audits and evaluations, conduct RCMP emergency preparedness programs, and even consult with Aboriginal communities (VideoCom, 2007b).

Community Development

Many community initiatives can be supported through the use of videoconferencing. In a study of First Nation community-based broadband use, authors O'Donnell et al. (2007a) concluded that videoconferencing supported by community based organizations K-Net in Sioux Lookout and Atlantic Canada's First Nation Help Desk in Membertou First Nation, Cape Breton, Nova Scotia, is used for a variety of community based activities. Some of these include community get-togethers, meetings, personal, professional and community development, and sessions on education, health, culture and language, and economic and community development.

Videoconference case studies

Personal communication is the latest application for videoconferencing systems. Once used almost exclusively for business, desktop videoconferencing is now available to anyone with the required equipment, bandwidth and software. Desktop videoconferencing systems are primarily used for point-to-point or two-site calls and can be linked with a videoconferencing bridge into multi-site or group videoconferencing (See Appendix: A1).

Currently multi-site videoconferencing is used for education, health and medicine, meetings and collaboration, and community applications. Several examples of each are presented below.

Education

There are many applications for videoconferencing in the education field. Videoconferencing can be used for distance education and professional development, to allow experts around the world to communicate with learners, and to allow learners to interact with each other.

MusicGrid was a pioneer project in e-learning, conducted between 2002-2004 with project partners including the National Research Council and six Canadian school boards. In the project music education was conducted via broadband networks. Students in remote locations who otherwise did not have access to music programs and an instructor learned to play the violin by communicating through videoconference. Concerts were held over multi-site videoconferencing, where groups of students could see and hear the other schools participating in the same videoconferencing music program. The authors note that the technical resources alone were not enough to determine successful collaboration; there was also need for personal trust and mutual organization (Masum et al., 2005).

The Virtual Classroom, a CRC / NRC project, is an ongoing collaborative learning environment for students across Canada to engage with national and global issues, which involves both the use of multi-site videoconferencing and user-generated videos created on the BVCam, a prototype technology developed by the National Research Council. In Virtual Classroom projects students from various geographic locations in Canada interact with each other through multi-site videoconferencing that supports debates and discussions. Initial studies conducted indicate that while technology is necessary for creating this learning environment, there are many social and organizational factors that support engagement and full collaboration (O'Donnell et al., 2007b).

Health and medicine
Telehealth is a growing application for videoconferencing worldwide and is particularly valuable in remote or rural communities where access to health care and medical experts is limited. Videoconferencing is used by medical and health professions for medical education, clinical diagnosis, administrative purposes, and professional development.

The National Research Council currently is working with River Valley Health (RVH) Telehealth, the largest regional health board in New Brunswick, to investigate and develop best practices for multi-point videoconferencing that optimize participation and engagement. In a 2006 survey of RVH Telehealth videoconferencing users the majority of respondents noted that, as a result of videoconferencing, they saved time and gained improved access to education and training. Overall the videoconferencing services scored a high rate of satisfaction by users, and all respondents noted the effectiveness and efficiency of videoconferencing (River Valley Health, 2006).

Meetings and collaboration
The simplest and most popular use of videoconferencing is for meetings because of the savings in time and money of videoconferencing compared to in-person meetings (Trawner & Yafchak, 2007). The development of the global economy has also led to a change in the way business is conducted. Traditional means of collaboration are no longer sufficient or efficient; there is an increased need for collaboration across distance, time and organizations (Mankin et al., 2004). Multi-site videoconferencing is an important tool for virtual group collaboration, enabling one or many off-site group members to participate.

Multi-site can broaden conference participation by reducing the cost for individual participants but it also creates potential barriers – in international multi-site videoconferences, language and location can pose problems. In a two day, 20 hour, four-way telehealth conference between sites in the UK, USA, Greece and Malaysia, interpreters were located at each site and the conference schedule had to reflect the local times for each site (Papakostopoulos et al., 1999). In another telehealth conference between London, Beijing and Hong Kong, the equipment acted as a barrier to participation. Authors Hjelm et al. noted that all the sites did not have the same ideal level of equipment, and therefore the quality of the image and sound was inconsistent among sites (Hjelm at al, 1998).

Community uses
Videoconferencing can also be used for various community development activities. Videoconferencing is a form of communication allowing for greater face-to-face (but not in-person) social interaction. It also creates spaces which allow for the greater visibility of specific cultural groups and therefore encourages empowerment

and identity formation. There is very little published literature on videoconferencing for community uses.

Videoconferencing not only allows different Aboriginal peoples in remote areas the opportunity to communicate with each other but also aids in the ongoing development of the individual communities. Authors O'Donnell et al. (2007b) found that broadband networks and videoconferencing equipment offer First Nation communities in Canada the means to support community development goals. Currently K-Net, the Atlantic Helpdesk and the other Regional Management Organizations in the First Nations SchoolNet program are fostering a community-based model of technological development in order to provide opportunities for their communities to use the networks for a broad range of activities.

Multi-site videoconferencing is used by various groups of people for a variety of purposes, from business meetings to fostering community development. However, "participatory" multi-site videoconferencing does not automatically occur. Four variables can either enable or constrain participatory videoconferencing: group dynamics, the organization of the content of the videoconference, the interaction between users and the technology, and the technical infrastructure.

4 Social infrastructure foundation: Building relationships and good group dynamics within multi-site videoconferences

Introduction

Multi-site videoconference technology, and the interaction of participants with the technology, can help enable participation. While technology and the use of equipment are important to participatory videoconferencing, teamwork also plays a vital role. A good team will overcome technological problems; however, good technical support paired with poor team dynamics makes virtual teamwork very difficult (Jarman, 2005).

Group dynamics in videoconferences are different than in meetings in-person. Discussion during videoconferences is more task-orientated and less social; therefore interactions are more orderly and polite. Generally there are fewer interruptions and less conflict in videoconference meetings (Wainfan & Davis, 2004). Researchers also found that members of virtual teams are judged more on performance than discriminatory or stereotypical cues (Rutowski et al., 2002).

However, multi-site videoconference technology can also have a negative affect on group dynamics, inhibiting participation by reducing group cohesiveness (Wainfan & Davis, 2004). In order to create a participatory atmosphere that leads to positive group outcomes during multi-site videoconferencing, there are several variables that need to be understood, including group task and issues pertaining to group dynamics such as trust, critical mass, norms and size, group leadership and the experiences of the individuals.

Task

Using technology that fits the task means there must be compatibility between the task at hand and the technology used to do the task (Webster, 1998). Multi-site videoconferencing is a very useful technology for brainstorming activities, negotiating and making decisions. When groups are cohesive multi-site videoconferencing can also be a useful tool for reporting status updates. Videoconferencing is also good to use when resolving disputes. For example, if one group member is dominating another, videoconferencing can be better than an in-person encounter because videoconferencing can create a less threatening environment than in-person meetings for resolving conflicts (Wainfan & Davis, 2004).

Social presence is the extent to which a technology used to facilitate a meeting can provide a social or personable feeling to the interaction. Videoconferencing allows for a higher social presence than other computer-mediated communications and is therefore a better means of communicating when dealing with ambiguous tasks requiring the resolution of multiple views (Yoo & Alavi, 2001).

At the same time, the increased social presence offered by videoconferencing can serve to distract from task participation if participants are not comfortable with the technology (Yoo & Alavi, 2001). Comfort levels are not static but generally rise with increased training and use of the equipment.

Videoconferencing may not be the best medium to use when first forming a new team (Wainfan & Davis, 2004); however it is sometimes impossible for teams to meet in person, even for an initial session. If in-person communication is impossible for the first meeting it is best to meet via videoconferencing so that all members can see each other and associate names with faces.

Group dynamics issues

The group dynamic also affects how users perceive and utilize technology. Group dynamics include the development of trust, the critical mass of users, and group norms and size.

Trust

Trust is one of the biggest critical success factors for virtual teams working via videoconferencing cited in the literature on videoconferencing and virtual teams (Mankin et al., 2004; Sonnenwald et al 2002; Wainfan & Davis, 2004; Anderson, 2006; Jarvenpaa, 1998; Mansour-Cole, 2001; Nemiro, 2000; Rutowski et al., 2002). Trust-building develops more slowly in virtual groups than in person (Nemiro, 2000). Also, researchers note that teams are more likely to report that their remote colleagues are less helpful compared to local team members (Anderson, 2006).

Building trust in virtual teams is more difficult and time consuming for many reasons. In videoconferencing it is difficult to maintain eye contact, which is one important way trust is developed. Body language and gestures are more difficult to interpret in videoconferences, especially when multiple participants are involved. In multi-site videoconferences gaining floor control to interject or ask questions can be challenging (Wainfan & Davis, 2004). Large group multi-site meetings are also more time consuming than in-person because of the need for more verbal acceptance, and therefore there can be less time for relationship building (Anderson, 2006; Jarvenpaa et al., 1998). Trust can also be inhibited because individuals may not have worked together before and may not expect to work together again (Jarvenpaa et al., 1998).
Trust building in virtual teams can be facilitated in several ways. Some researchers recommend that virtual groups are either created after members already personally know one another or that virtual team members should meet in-person

at least once before continuing to meet via videoconferencing (Rutowski et al., 2002; Wainfan & Davis, 2004).

Building trust can also be accomplished within groups that have never met in-person. In virtual group collaboration, trust is earned with the delivery of results, demonstrations that promises can be kept, and the finished product (Munn-Venn, 2006; Mansour-Cole, 2001). Therefore it is important that responsibilities are clearly set for each team member, and that members are striving towards objectives that are the right fit for them and are part of the overall goals of the team. Conflicts must be resolved as quickly as possible and team members need to keep each other up to date and seek and give feedback on the group's work (Jarvenpaa et al., 1998; Rees & Haythornthwaite, 2004).

Critical mass
Critical mass is determined by the number of users in the implementation stage of a technology; this number will indicate the success or failure of a new product (Kraut et al., 1994). If co-workers or friends lack access to the technology, or if there is a perceived lack of access, the technology will not become widely used and will not have the critical mass needed to become popular. As the number of users increase, the technology becomes used more often and subsequently becomes more useful (Webster, 1998).

The rate of use of multi-site videoconferencing is determined by the number of people using the technology. Critical mass is also dependant upon *group norms* and *group size*.

Group norms
Three norms affect an individual's perception and use of new technology: culture, social influence, and group influence.

Researchers have found that culture influences group decision-making. Some cultures have a collectivist outlook with tight-knit social networks; these cultures are more willing to adhere to group norms than cultures that follow individualism, or the idea that individuals are responsible for themselves (Guo et al., 2006). There can be problems in groups comprised of members with both outlooks that can be overcome with more tolerant perspectives (Rutowski et al., 2002).

Social influence also affects the attitudes, behaviors and perceptions of individuals vis-à-vis new technology. The theory of social influence is based on the idea that individuals want to conform to others' expectations, therefore leading to similar perceptions of new technology coupled with the willingness to conform to group norms. Groups themselves can also develop their own norms which affect the norms of the individuals within the group. Over time groups develop norms about why and how they are using technology, how they should perceive it, and the best strategies to maximize technology use (Guo et al., 2006).

Groups that meet on a regular basis are more likely to develop their own group norms, and individuals in these groups are more like to view the technology used for meetings in the same way; however, it is important to note that norms are not static but change over time. Researchers note that ad-hoc groups or groups that are not likely to meet again have no future expectations, resulting in a negative effect upon the group dynamic (Guo et al., 2006).

Group size
Opportunities for individuals to participate in videoconferences decline in larger groups meeting via multi-site because of fewer opportunities for interactivity and reciprocity (Blignault, 2000; Roberts et al. 2006). Participants in larger groups usually come from more diverse backgrounds than members of small groups, and therefore a rise in the number of participants usually means an increase in the potential for knowledge discrepancies, which can also have a negative effect on participation (Anderson, 2006). Participants in large group multi-site videoconferences may also feel they have limited power and authority in group decision-making (Shaw et al., 2004).

This does not mean that multi-site videoconferencing with large groups cannot be interactive, just that more time and effort is needed to facilitate the creation of a participatory environment. There are several ways to increase participation in large groups, including negotiation, soliciting feedback from participants, and recording videoconferences.

In large group collaborations decisions need to be based on negotiations between subgroups within the larger groups, allowing for all participants to contribute to the outcome (Shaw et al., 2004). Soliciting comments and feedback from participants during and after the videoconference is also another important way to make participants feel as if they are part of the team, and that their opinions and ideas matter to the group (Sonnenwald et al., 2002; Jarvenpaa et al., 1998).

Leadership

Virtual teams, like in-person teams, require an organizer or leader. Researchers note the importance of a system of rotating leadership in large group multi-site videoconference communication. When large groups meet on a regular basis not everyone will be able to attend every meeting. When the leader is unable to attend, the meeting has to be cancelled or postponed. Rotating leadership responsibilities can be beneficial - it can increase the possible number of group meetings, encourage leadership within the group, help participants develop meeting facilitation skills, and foster greater interaction between facilitators and presenters and equalize influence and participation, thereby leading to higher levels of participation, more productive meetings and successful collaborations (Sonnenwald et al., 2002; Hara et al., 2003; Steiner et al., 2000).

Individual experiences

Experiences of individual users in multi-site videoconferencing differ according to many factors including (but not limited to) culture, community membership and gender.

Culture
Groups with common cultural backgrounds exhibit fewer problems when collaborating. There can be more challenges to collaboration with group members from different cultural backgrounds exhibiting differing behaviours or showing different degrees of openness toward technologies. However, as researchers Rutowski et al. (2002) note, these factors can be overcome with time and greater exposure to the collaborative technologies (Rutowski et al., 2002).

Community membership
Differences in perspective are related not only to cultural differences but also community membership. For example, videoconference communication between researchers with public funding and industry-funded researchers can be challenging because the researchers are coming from two very distinct community backgrounds. However, interviewees in Munn-Venn's (2006) study on collaboration reported that they saw the different perspectives of other researchers as a benefit rather than a threat or an impediment to participation.

Gender
Few studies have investigated the effects of gender on the dynamics of groups using communication technologies, and researchers note that studies examining gender are sometimes contradictory or inconclusive (Wong et al., 2004). Becker and Goodwin, in their evaluation of virtual learning, state that women prefer collaborative environments while men react more favourably to individual learning. In their study women had higher rates of participation in a virtual collaborative environment, leading Becker and Goodwin to the conclusion that women may prefer a virtual pedagogy (Becker & Goodwin, 2005). In a study of First Nations multi-site videoconference use, O'Donnell et al. (2007a) determined that women were using the technology more often and more actively than men. Wong et al. (2004) suggest that virtual groups may exhibit higher levels of satisfaction and social presence in mixed gendered groups. More research needs to be conducted on the affect of gender on participation in videoconferencing.

Motivation

Motivation is an important factor determining participation within groups using videoconferencing. Researchers Becker and Goodwin (2005) note that motivation is key to promoting student interactivity because students who are motivated exhibit higher levels of satisfaction and use the technology to interact more with their peers and instructors. When intrinsically motivated activities are employed in virtual teams, participants exhibit increased creativity, increased conceptual learning, positive emotional health and higher self-esteem (Rutowski et al., 2002).

5 Scripting for success: A practical approach to organizing and facilitating participatory multi-site videoconferencing

Introduction

The planning and etiquette of multi-site videoconferencing is similar to in-person meetings; however, multi-site meetings require additional planning, and videoconferencing requires specific rules or etiquette for all parties.

The skill of all the participants involved in the production and delivery of the videoconference clearly affects the overall level of participation and success of the videoconference. Organization, structure and meeting etiquette can directly influence the extent to which participation is encouraged. For example, conference organizers skilled at creating (and following) agendas and sending out relevant materials prior to the conference give participants time to think about their contribution to the event. Likewise, well-organized presentations encourage participants to ask questions and give input.

Multi-site conferences where participants follow proper meeting protocol and group etiquette also foster a participatory environment. By allowing participants to provide feedback about the videoconferences, organizers can encourage participatory videoconferencing – if participants are able to comment after the videoconference and feel that their opinions matter, they may participate more in future videoconferences. A well organized and conducted videoconference enhances audience participation and engagement.

Organizer

Every meeting, be it in-person or videoconference, requires an organizer. Multi-site videoconferencing requires additional planning. The success of a multi-site videoconferencing depends on how well the organizer facilitates participation by planning the conferencing, articulating expectations, including all group members in the discussion and keeping to a set agenda. Organizers need to recognize that large group multi-site videoconferencing requires more time for communication that in-person meetings (UK eScience, 2002; Wainfan & Davis, 2004).

Planning well in advance
Several tasks must be completed well in advance of a multi-site videoconference. The first task is to define the purpose or the goal of the videoconference and determine the target audience and their needs. Next, the organizer needs to reserve the videoconference room or rooms and book the necessary equipment along with the multi-site bridge. Then the organizer needs to publicise the event and invite the target audience. If additional participating sites consist of large

groups of people then the organizer may need to appoint a site coordinator to book the equipment, determine the site's technical needs, and inform the organizer of the technical requirements needed by the site (Hjelm et al., 1998; Klutke et al., 1999).

Once the bridge and equipment are booked and the number of participating sites is determined, the organizer needs to create an agenda. The agenda will list the participating sites, identify the site coordinators, note the start and finish time for the conference as well as the time of each presentation, and provide a webpage or e-mail address for participants who have questions or comments. The organizer needs to include time for audience response to the presentations, either after each individual presentation or at the end of the videoconference. The number of sites and people at each site will determine how much time is needed for discussion. The greater the number of people and sites involved in the videoconference, the greater amount of time is necessary for audience participation.

When organizing videoconferences with members of different linguistic groups the organizer needs to determine if interpreters are needed and available for the participating sites. If translation services are required the organizer has to allocate more time for the presentations and discussions (Barlow et al., 2002).

Organizations will want to consider how they will present themselves to the remote participants; it may be appropriate to have an organization logo or banner in the background to project a formal, well-prepared look.

Several days prior

A few days before the videoconference, the organizer needs to decide the layout of the room – how the table and chairs will be arranged and where the microphones, camera and monitor will be positioned. At this time the organizer should also examine the equipment settings, rehearse the technology for the presentations, and get the phone numbers of the remote sites in case of equipment failure (Hjelm et al., 1998; Klutke et al., 1999).

15-30 minutes before

Directly before the videoconference the organizer should centre the microphones and make sure that the camera is positioned directly above the screen displaying the remote sites. The organizer or the bridge coordinator should connect to the other sites about 15-30 minutes before the session and mute the microphone until the start of the conference. Many videoconference systems automatically display the site name in text at the bottom of the image; however, it is a good idea to display the site name by making a name "tent" out of paper and positioning it on the table directly in front of the camera to ensure that the site name is visible at all times (Klutke et al., 1999), or to display the site name on the wall of the videoconference room directly behind the participants.

During the session

During the session the organizer is responsible for introducing herself or himself, the presenters, the participating sites and the site coordinators. Be sure to introduce people who are present but off-screen at other sites, especially when the camera is zoomed in on just the speaker (Barlow et al., 2002). This way participants can address their questions to all those at the remote site, and not just the person the camera is focused on. Organizers should acknowledge and thank participants attending the multi-site videoconference outside of normal working hours, a common occurrence with international videoconferences (Barlow et al., 2002). The organizer also needs to remind participants to mute the microphone when not speaking, keep to the presentation and discussion schedule as indicated on the agenda, and augment the discussion by including the remote sites (Klutke et al., 1999).

By encouraging participants at remote sites to give feedback to other sites as well as the presenter, the organizer can facilitate participation between sites (Rees & Haythornthwaite, 2004).

Videoconference interactions can be brief, spontaneous and incomplete due to interruptions. However, interruptions during videoconferences can also help participation and engagement because the feedback is immediate. Interruptions can be positive because participants can encourage others while they are speaking (Hernshaw, 2000). The organizer needs to guide and direct the discussion but not stifle the flow of ideas.

Directly afterwards

Participants will react differently to the multi-site videoconference due to a range of factors, including their gender, cultural background and comfort level with the technology. Therefore it is important that all participants are given the opportunity to provide feedback outside of the multi-site videoconference. Directly after the videoconference the organizer should ask participants for verbal comments and feedback and prompt them to fill out anonymous questionnaires (Klutke et al., 1999). The organizer should also remind participants of a website or email address listed on the agenda where participants can send questions or comments about the multi-site videoconference. After participants provide feedback the organizer should disclose the results to participants in an anonymous format. Encouraging participant feedback may encourage greater participation in future meetings and can help individuals develop trust and greater motivation because they know that their ideas and opinions matter (See Appendix: A3, A7).

Presenters

Typically multi-site videoconferences centre on presentations by one or several participants. Like organizers, presenters also have to plan for the videoconference. Delivering a presentation via multi-site videoconferencing requires different skills and tasks to be completed than a presentation for an in-person audience.

Planning well in advance

Presenters should first check with the bridge coordinator to ensure the network can support any hardware and software used for the presentation. When first planning the presentation, presenters need to keep in mind several key points that will enhance participation: presenters will have to establish a connection between locations by determining the knowledge level of participants and making the topic relevant to the lives and work of the participants (Petersen, 2000); when sending relevant documents to the organizer for distribution to participants, presenters must ensure that all texts are self-explanatory; also, the presentation should not be a mere recitation of these documents – they should be discussion starters rather than the main focus of the presentation.

Several days prior

Well before the videoconference presenters should finish any visual elements such as PowerPoint slides, paying close attention to guidelines to designing PowerPoint presentations (See Appendix A4). Presenters should also rehearse the presentation, both the slides and the text, to familiarize themselves with the equipment and ensure the presentation meets the time limit in the agenda, leaving additional time for unexpected delays and audience reaction and response (Rees & Haythornthwaite, 2004; Hjelm et al., 1998). Presenters should send a copy of their presentation to the bridge coordinator and participations prior to the session.

During the session

Presenters should introduce themselves by speaking clearly at a normal volume while looking into the camera. Presenters need to keep the participants' attention through visual aids, hands on activities and interactive dialogue. Presenters should review occasionally and ask questions to include participants early on in the presentation (Petersen, 2000; Klutke et al., 1999; Sharer, 2004).

Some ways presenters can involve the audience are by preparing questions in advance for the participants, speaking no more than 10 minutes before asking questions, and including the audience in some other way like incorporating problem-solving activities (Petersen, 2000). When using PowerPoint slides, presenters should include more discussion points because videoconferences can have reduced nonverbal feedback compared to in-person sessions. Presenters should assume that the visual feed is unreliable or less reliable that the audio feed and should explain the PowerPoint slides (Rees & Haythornthwaite, 2004).

Presenters should be sure to remember to switch the camera view back to themselves after showing visuals.

Directly afterwards
The presenters should thank the host site and audience and ask if there are any comments, suggestions or questions. The presenters should also let participants know their input in the process is important and offer a contact number or email for participants to give additional feedback (Petersen, 2000; Sharer, 2004: See Appendix: A4).

Participants

Participation in a videoconference includes watching, listening, speaking or presenting. All participants contribute to the videoconference by their physical presence. To ensure all participants can participate actively a few good practices must be followed.

Dressing for videoconferences
Videoconferences are by definition visual. The clothes participants wear will either contribute to or detract from the participatory nature of the videoconference; for example, participants wearing boldly striped, print, sparkly, or extremely bright clothing can distract others from the presentation or the task at hand (Sharer, 2004). Likewise, jewelry that makes noise should be avoided, as the sound creates unwanted background noise. To present a clear image to others in the videoconference participants should also avoid colours that contrast highly with skin tones (Trawner & Yafchak, 2007).

In general, the best colours to wear during a videoconference are colours that compliment rather than contrast with skin tones (Trawner & Yafchak, 2007). Ideal colours for clothing also depend on the individual participant's hair colour; for example, blondes look their best in light beige or dark blue; medium gray, light gray or dark blue compliment brunettes and redheads; and participants with white or gray hair should wear pink, rose, violet, or light blue clothing (Sharer, 2004).

In general, videoconference participants should wear attire appropriate to the environment. Multi-site videoconference participants, especially those meeting other sites for the first time, should dress as if they are going to meet the people at the sites in person (Barlow et al., 2002).

Meeting protocol
It is important for participants in multi-site videoconferences to follow a few group etiquette rules to allow for maximum participation. Participants should be aware of the importance of maintaining eye contact. Everyone should look directly at the camera when asking questions and at least occasionally glance at the camera when

watching and listening to other participants. Participants should remember that even if they are not speaking, their image is still transmitted to the other sites; therefore participants need to pay close attention to their own body language and limit their body movements (Sharer, 2004). Unnecessary movements during videoconferences can not only distract other participants, but could potentially offend others. Some gestures or symbols that are commonplace in Western culture have different, and sometimes offensive, meanings in other cultures (Barlow et al., 2002).

Participation in multi-site videoconferences can be difficult, and even anxiety-provoking. By following meeting protocol, participants increase their changes of being seen and heard. Participants should indicate that they wish to speak both verbally and visually, by waving their hands and un-muting the microphone to say "I have a question or a comment for the organizer, speaker or other site." Participants should not limit their questions or comments to the host site or the presenter. When participants are given the opportunity to speak they need to introduce themselves by stating their name and their location. Participants should limit their speaking time, be concise and get right to their main point or question. After participants have made their contribution they should indicate they are finished by either saying "Thank you" (Klutke et al., 1999) or asking a direct question to the organizer, presenter, or another site, and muting the microphone (See Appendix: A5).

Response
Videoconference organizers benefit from participant feedback given as soon as possible after the event. Participants should also feel that they can e-mail the organizer at a later date to obtain more information about how other participants reacted to the videoconference.

6 Interactions with technology: Using multi-site videoconferencing to encourage participatory behaviour

Introduction

Multi-site videoconferencing is a communication process requiring both technology and participants. The design attributes of the technology and the behaviour of the user both determine the viability of the technology (Cool et al., 1992). Technology alone does not guarantee successful videoconferencing; for example, studies on desktop videoconferencing systems conclude that the access to videoconferencing alone was not sufficient to encourage interactivity - participants using videoconferencing interacted with the technology according to pre-established social norms that were critical in determining how the videoconferencing system was used (Fish et al., 1992).

Access and awareness

Videoconferencing offers many benefits that can have a positive impact on governments, businesses and communities. The technology for multi-point videoconferencing is widely available but not everyone has equal access to the resources, services, bandwidth, networks, equipment and expertise needed to acquire and operate the technology. More awareness of videoconferencing is required so that individuals and organizations are comfortable with this method of communication.

Dedicated technical support

Once the videoconference system and services are in place, dedicated professional technical support is needed for groups to use multi-site videoconferencing. Larger organizations may have on-site technical support while smaller organizations may have technical support available by telephone. Organizations providing bridge services need a proficient bridge operator who will be in charge of creating, scheduling and overseeing multi-site videoconferences. Ensuring Quality of Service (QoS) for videoconferences will require a skilled network manager.

Training

Training is also needed so participants can use the technology by themselves in efficient ways without having to rely on technical support staff. Once people are more comfortable with using videoconferencing, it will be used more often, and a higher level of interaction and participation is achieved. Ho’s study of videoconference use in British Columbia’s telehealth system found that the patients unfamiliar with the equipment were less receptive to treatment and more likely to distrust health professionals. Over time these patients learned to use the equipment and reported higher levels of satisfaction with videoconference consultations (Ho et al., 2005).

Ease of use / ease of viewing

To increase awareness and encourage videoconference use, videoconference systems have to be easy to use. The way people view the technology will affect their use of the videoconferencing system. The way people see the remote locations, and see their own image, are potential hindrances to participation.

In traditional one-on-one videoconferencing there is a local view and an off-site view. Participants may be self-conscious about seeing not only the remote site but also their own image on the screen or may be unaware of how their own image is being transmitted to the other site. However the transmission of a single site onto a screen is similar to a computer or television, and discomfort with the system can lessen over time.

Multi-point videoconferencing is challenging for participants used to seeing just one image on the screen as they would on a television set. Participants have greater difficultly paying attention to and looking at multiple sites displayed on one screen (Locatis et al., 2003). For large group multi-site videoconferencing a larger screen is recommended. When the multi-site videoconferencing bridge is scheduling the call, the bridge operator will choose between showing one site at a time on the screen or multiple sites on the screen.

Multi-site videoconferencing systems generally uses voice-activated switching – a device that automatically switches the image on the screen so that only the site where the active speaker is located is shown at any given time (Locatis et al., 2003). This technique could enable higher levels of both viewer participation and engagement; however, voice activated switching could also serve to alienate participants in multi-site videoconferences by rendering them invisible. The multi-site conference would have to be organized so that feedback and discussion occurs from all of the sites involved, thereby giving all sites representation during the multi-site videoconference.

Audio quality

For most videoconferencing situations, the audio quality is more important than the video quality. Most meetings cannot take place if the audio is poor. It is important that videoconference rooms have telephones, and that the organizers have the off-site rooms' phone numbers in case the audio fails during the videoconference. If it is known in advance that a participant will join the multi-site videoconference by audio only, the audio connection should be made directly with the set-top unit or the videoconferencing bridge. Having a participant connect via a speakerphone in one location will likely result in poor audio quality and a frustrating experience for many participants.

Microphones

Microphones are necessary for videoconferences but can create problems. They can pick up the slightest noise – from coughing, sneezing and background discussions to clicking pens, shuffling papers and tapping the table. Multi-site videoconference participants need to be aware of how noise carries and restrict their actions accordingly.

A room used often for videoconferencing should ideally have a ceiling-mounted microphone which reduces many of the potential problems with desktop microphones. When ceiling-mounted microphones are not used, most group videoconference units require microphones of two main types: desktop and lapel microphones.

In order to pick up audience response during lectures, presentations, meetings and group discussions, desk or table top microphones are needed. Of the many different types of desktop microphones, the two most commonly used are octagonal or round in shape. Their placement is important. Octagonal microphones pick up sound only from the front and round microphones pick up sound from all sides (Sharer, 2004). In multi-site group videoconferences the microphone should be positioned on the table in front of the participants. A standard from Tandberg for telehealth videoconferencing is to keep the microphone three feet away from the set-top unit and not to move it.

Lapel, lavaliere or hands-free microphones are either clipped to clothing or worn around the neck. Lapel microphones are used during lectures and presentations. The presenter has to remain aware of the microphone, avoid unnecessarily handling of the microphone and remember to turn the microphone off during breaks (Sharer, 2004). Major drawbacks of the lapel microphones are very poor spectrum reproduction, ancillary noise due to interaction with clothing during movement, and large variations in volume depending on the orientation of the wearer's head. Some form of microphone which is attached to the head and maintains a fixed position with respect to the mouth is far superior to the lapel type.

In larger rooms with large numbers of participants multiple microphones may be required; for example extra microphones on the table, or a lapel microphone for the person presenting or chairing the meeting. However it is important to use as few microphones as possible during a multi-site videoconference because multiple microphones increase the likelihood that other sites will hear more background noises (PictureTel, 1998).

For large groups the use of automated equipment is suggested as a good practice. On the Videoconference Cookbook website (2007) the authors note that communication should be kept as “natural” as possible by hiding the equipment. Automated equipment would eliminate the necessity for participants to continuously mute and un-mute their microphones and zoom in and out on each other during the videoconference – actions that necessitate time and practice, and can ultimately distract participants from the task at hand (Trawner & Yafchak, 2007).

However the best way to eliminate background noise is to mute the microphone at sites where no-one is speaking. Most of the literature on videoconferencing best practices states that the microphone needs to be muted (Trawner & Yafchak, 2007; RVH, 2003). However, muting the microphone could create barriers to trust formation and therefore have a negative affect on participation (Mansour-Cole, 2001). Participants not speaking and muted might feel unable to participate. Some researchers suggest that microphones should be left on during videoconferences and that, rather than muting microphones, participants should become more aware of the audio, and cover microphones when necessary (Mansour-Cole, 2001; Sonnenwald et al., 2002).

In smaller groups with only two or three participants communicating, having only one or two sites leaving the microphones on would be a good practice. However, in larger groups leaving the microphones on at all sites would greatly add to distracting background noise, and reduce the efficiency of both the audio and visual equipment. Multi-screen views are usually voice activated, therefore for multi-site videoconferences muting the microphone while not speaking is a critical factor for the initiation of the multi-screen view.

Acoustic echo cancellation

Echo is a function of the distance between sites with respect to time and the speed of light. A videoconference between Fredericton and Calgary for example will experience a round-trip latency of ~20mS which is perceptible. Such latency is merely a slight annoyance during meetings but it will impair musicians' ability to play in unison. Echo is a constant, so the greater the distance, the more pronounced the echo becomes.

Acoustic echo is the reflection of a sound signal. If person A talks at location L1, his or her voice gets transferred to another location L2 through the speaker(s); the microphone at L2 may pick up the sound from the speaker and send back to L1. In this case, person A will hear his or her own voice being bounced back. This sound needs to be cancelled, or it will become very distracting. Unfortunately, conference phones such as Polycom's Soundstation or installed room systems which use ceiling speakers and microphones on the table often pick up echoes.

Echo can be reduced or even avoided by rearrangement of the microphone and speaker settings. As a rule of thumb, try to point the microphones away from the sound system's speakers, so the audio from the speakers is not being picked up by the microphones. Choosing a low sensitive and narrow directivity microphone can also help to reduce echo.

The design of the videoconference room can also affect the audio of the videoconference. Windows, floors and ceilings can reverberate, distorting the participant's voices and making it harder for other sites to hear them. There are several solutions to this problem. If the room has windows, install blinds or put up curtains. Covering the windows is also necessary in order to optimize the video. Floors in videoconference rooms can be carpeted to avoid echo. Acoustic ceiling tiles can also be installed (PictureTel, 1998).

Acoustic boards or sound boards have been used successfully when setting up videoconferencing rooms in older facilities that have plaster-cement walls and high ceilings. They reportedly work wonderfully in eliminating echo in the room - you just add as many as required until the echo is gone.

There are also software or hardware solutions called "echo cancellers" that aim to suppress echo. To work, an echo canceller needs to be able to recognize the originally transmitted signal that re-appears and remove only that signal without removing the sound from the far end. This is a challenging task; when echo cancellers don't work correctly they produce a variety of unwanted side effects. However today's technology has built-in echo cancellers, and standards are present to ensure they work properly to eliminate echo.

In addition to acoustic echo, hybrid echo can be a real problem. For example, a good hardware echo canceller is essential when external PSTN (public switched telephone network) end points join multi-site video/audio conferences. The PSTN has many hybrid circuits that can cause perceived echo for all conference participants.

Visual quality

Meetings can occur if the video quality is low, poor or non-existent; however videoconferences with poor-quality video take longer as visual cues are lost and trust may be more difficult to develop. Early studies on video suggest that while the addition of audio improves communication, the addition of video to audio provides limited benefit (Williams, 1977). However, newer research indicates there are conditions where adding visual is beneficial and even critical to virtual group work; for example, in group collaborations people benefit more from shared work spaces than from being able to see one another, especially when group tasks are visually complex (Kraut et al., 2002).

In a new study of 1,060 adolescents, Peter, et al. (2007) discovered that 57% of the adolescents occasionally use webcams while instant messaging and 32% sometimes use microphones (Peter et al., 2007). These findings indicate the growing emphasis on the visual in computer-mediated communication.

The visual feed contains important visual cues to the viewer including not only those given by the participants - the visible reactions of people onscreen and their body language - but also the atmosphere of the videoconference room itself. Several factors contribute to the transmission of visual cues, including the lighting, the colour and the layout of the furniture and equipment in the room. Longer explanations are needed when visual quality is low in videoconference because participants cannot read these visual cues (Anderson, 2006).

In the telehealth literature, the term *telepresence* is used to describe the impact of being able to see - not just hear - a person in a session. The relative importance of telepresence is what helps health professionals determine when visual communication is required from a clinical point of view. For example, in mental health, clinicians know they must see the patient.

Camera views

Researchers note that in large group videoconferencing, dynamic camera operation is needed so that all participants can see who is talking. A static camera could prove problematic when interactive and spontaneous discussions are required. The larger the group, the more difficult it becomes to read facial expressions and see who is speaking. Focusing on the person speaking can enable participants to engage with the speaker but this requires constant camera operation, which could be distracting and even detract from the content of the videoconference (Sonnenwald et al., 2002). Focusing on the speaker could serve to limit participation because those not shown on screen might feel excluded and be less inclined to ask questions or make comments.

In smaller groups it would be a good practice to leave the camera zoomed out to show all participants. However, in larger groups of more than four people it might be a good practice to focus in on the area where the person is speaking, especially if that person is giving a presentation. When large groups are having discussions it might be a good practice to focus the camera on smaller groups, for example, three people sitting together. In a large group videoconference this will enable participants to see who is speaking and will also include some of the other members of the larger group on screen.
When no one at the site is speaking it might be a good practice to zoom out and show the group as a whole. Showing the entire group could hinder participation by

limiting the visual detail the other sites will see, such as the facial reactions to presentations at others sites. However zooming out while no one is speaking will ensure that no one person feels singled out and has to remain conscious of body language and facial expressions the entire time. During videoconferences, especially long videoconferences, it is difficult to completely limit body movements and restrict facial expressions. By zooming out to show the entire group, the other members of the group will also feel included in the videoconference.

In order to simplify the process of zooming in on the presenter and then back out during the discussion organizers can set remote control presets prior to the videoconference. Automated camera movements that zoom in on speakers and participants can increase participation in videoconferences because it can capture the dynamics of the presentation (Havelock & Green, 2005). Camera presets programmed on the remote give participants the ability to zoom in on a particular point in their room automatically with the push of a single button (for more on remote functions see Appendix: A3).

Lighting

Lighting is another critical factor in effective videoconferencing. Poor lighting produces reduced visual cues, creating the need for more audio prompts. Poor lighting can lengthen the time required to hold a videoconference and can inhibit the growth of trust.

There are a few general tips for lighting videoconference rooms. There needs to be a dark area around the screen but the room itself must be well lit. Do not place participants with natural light sources behind them, and cover windows during videoconferences. If there are windows in the room that cannot be covered, the camera needs to be placed in front of and pointing away from the windows with the participants facing the windows.

Natural light needs to be eliminated in videoconference rooms to ensure the lighting is uniform (Trawner & Yafchak, 2007). The most typical types of lighting used in rooms, incandescent and halogen lamps, are not the best types of lights to use for videoconferencing as they draw more power than other types and also give off heat. In a small conference room the heat produced from these lights could be quite uncomfortable.

For videoconferencing hard light is also an issue. Hard lighting creates shadows on faces; these shadows reveal every imperfection on the participant's face, revealing all of the imperfections on the skin. While this could be a good thing for some videoconferences, for example, a clinical consultation with a dermatologist, it is not ideal for most types of videoconferences. Soft light, created when the light source covers a larger area, is the ideal lighting for most videoconferencing (ITRIX, 1998a). Diffused fluorescent or soft lighting will help minimize glare or the “whitewash” effect that overly bright lighting can have on videoconference participants (Trawner & Yafchak, 2007).

Ceiling lights, if they are the only source of light in the room, create shadows on the face and are generally unflattering. The lighting source needs to be located in front of the participants, preferably just above eye level (Trawner & Yafchak, 2007). When participants are lit from behind they are seen in videoconferences as silhouettes, and it is very difficult for viewers to make out any of their facial features.

Wall and floor lights are more preferable in videoconferencing rooms than traditional ceiling-mounted light sources. Ideally lights should be soft lighting and positioned at a 45 degree angle (ITREX, 1998b).

Role of colour in videoconference rooms

The colour of the walls in the room affects the room lighting. Different colours can also affect the mood and behaviours of participants. For example, soft colours can have a calming effect while bright vibrant colours are more invigorating. There is some debate over the best colour for videoconference walls; generally there are recommended colours for videoconference walls depending on the application of the videoconference.

Some authors of videoconference guides argue that the walls of videoconference rooms need to be painted in muted earth tones or pastels, because dark-coloured walls will affect the lighting of the room and distort participants’ facial features (Trawner & Yafchak, 2007). Rooms used for telehealth videoconferencing are usually painted in muted or pastel colours because strong bold colours distort visual cues such as skin colouration which are important in the clinical context (Ho et al., 2005). However other researchers state that the walls of videoconference rooms need to be painted in a fairly dark shade, and that a royal or robin’s-egg blue is the best colour for the lighting conditions (ITREX, 1998b). The telehealth rooms in Salt Spring Island, BC, for example, are painted sky blue, a colour that is eye-catching, soothing and bright (VideoCom, 2007a). A good practice to keep in mind when painting a videoconference room is that colours that are either too light (bright whites, pale beige), too dark (black, dark brown or purple), or too saturated (fluorescent colours, sunshine yellow) should be avoided.

While 18% grey is considered a perfect neutral shade in human colour perception, videoconference systems often perform colour matching adjustments that attempt to balance skin with backgrounds. This can lead to unexpected results.

Room configuration

The best layout for tables in videoconference rooms is the “U” or “V” shape that enables all participants to have the same view of the monitors and gives them all the same opportunity to look into the camera. This layout also makes it easier for voice-activated cameras to focus on the speaker. By giving all participants equal visibility, this layout helps to encourage interaction during videoconferences (Trawner & Yafchak, 2007).

The room described above, with “U” or “V” shaped tables, works best for small to medium sized groups. Not all rooms can be designed this way – larger-sized groups may need to meet in videoconference rooms that look more like traditional classrooms. The problem with the classroom layout - where the speakers stand at the front of the room and face the audience and the camera - is that the audience members have their backs to the camera and cannot make eye contact with the other sites (Trawner & Yafchak, 2007). A camera that changes angles could help with this situation. This camera could either be voice activated or manually operated and could focus in on the speaker during the lecture or presentation but also on the on-site audience when questions are asked. This way the audience at the host site can see the audiences at the remote sites when they are all participating in discussions (See Appendix: A2).

Creating a room specifically designed for videoconferencing optimizes the environment. The physical space is controlled and all elements of the room, including colour, lighting and furniture placement can be placed in a precise manner that creates the best possible videoconferencing environment. However, the use of a specific videoconferencing room could also discourage widespread use of videoconferencing because the unit would always have to be used in that particular room. What, for example, if users wanted to show immovable objects located in another location over the videoconferencing unit? Ferguson (2006) suggests the ideal solution is a videoconference unit on a movable trolley.

Videoconferencing systems need to be set up so that the technology is easy to use. However, in order for organizations to encourage participation and engagement in multi-site videoconferencing the participants need to have access to the equipment, training and dedicated support. The next variable is the technical infrastructure.

7 Technical infrastructure: types of videoconferencing and multi-site videoconferencing systems and equipment

Introduction

This chapter describes different aspects of the technical infrastructure. Technical infrastructure refers to more than the videoconference system itself; it also includes the hardware and software, the potential for multi-site bridging, and the availability of a network with the requisite bandwidth. While multi-site videoconferences can be participatory, the systems alone do not automatically create a participatory environment. Some technologies are more valuable than others for multi-site videoconferencing, and these technologies can facilitate interaction (Peterson, 2004).

Many different types of videoconferencing systems are available at different price levels and are designed for various purposes. Videoconference systems used by organizations and groups include set-top and integrated or dedicated systems. Other systems can be used primarily for personal videoconferencing, such as desktop videoconferencing and 3G mobile phones.

Group videoconferencing

Set-top videoconferencing
Set-top videoconference systems are complete systems that sit on top of a computer or television monitor. The two most popular brands of videoconferencing equipment in the world are Tandberg and Polycom. Sometimes set-top systems are located in small boardrooms but often set-top systems are placed on carts and can be moved to different rooms for different videoconferencing purposes.

Set-top systems are often used for small groups, including business and administration meetings and small group educational sessions. Set-top systems are also used in telehealth for clinical sessions. Although set-top systems can be used for one-on-one communication, they are more commonly used for group communication.

Many group videoconferencing units contain the hardware and the software necessary for videoconferencing. For example Tandberg and Polycom units provide an integrated or embedded "firmware" solution. Sometimes referred to as blackbox design, this allows for a more turnkey system, with the technical details removed from the user experience. The software is always "firmware," non-volatile memory that is electronically programmable and erasable.

Pre-packaged audio and video hardware include a conference room camera, with tilt, pan and zoom, a wall mount or tripod (although it is better to position the camera directly above the screen displaying the off-site locations in order to simulate eye contact), video cables, and a conferencing system that includes an audio mixer, microphone distribution box, microphones and speakerphones, XLR connectors and a controller.

Integrated videoconferencing
The second type of group videoconferencing system is known as integrated, dedicated or room-based systems. In integrated systems all components are incorporated into a single piece of equipment, not intended to be moved. The wiring and processor for the system is centralized and the camera is mounted on the wall of the room. This provides more stability and allows for greatest potential functionality. When the wiring, cameras and system control are permanently installed they can be optimized for ease of use and performance.

Integrated systems are ideal for large group communications and commonly used for administrative meetings, distance education - including medical education and academic and medical conferences. Most integrated systems are capable of connecting to both H.320 and H.323 end points on ISDN and IP based networks.

A high-end and high-cost type of integrated videoconferencing systems is a Halo room. Halo rooms were developed by Hewlett-Packard and launched in 2005. Halo rooms are designed for six people and have three plasma displays, studio quality lighting and audio equipment, and three cameras situated in the middle, left and right sides of the room. Centralized software allows participants to switch the rooms displayed on screen and share documents on their laptops. Participants see remote sites as life size and can zoom in on objects on the tables of remote sites (Yu, 2005).

Personal videoconferencing

Desktop videoconferencing
Desktop systems - videoconferencing through a desktop or laptop computer - are popular because of their low cost and easy installation. However, desktop videoconferencing systems do have their drawbacks for multi-site videoconferencing. Most desktop systems cannot accommodate group communication and interact with multiple sites (see Appendix A6). In addition, many videoconferencing network managers will not allow or do not like to allow personal videoconferencing units to be included on a multi-site videoconference with set-top units.
It is technically possible to link a site using a desktop system such as Polycom PVX into a multi-site videoconference with other sites using set-top systems like Polycom and Tandberg – however, the quality of the audio-visual signal from the

sites using the desktop system will generally be inferior to the signal from the sites using the set-top units, especially if the desktop system is using inadequate bandwidth. This can create challenges for the bridge operator attempting to maintain a high-quality videoconference for all participants. Participants at the sites using the set-top units may find it frustrating to be linked up with sites having inferior audio and video. Degraded video may be acceptable but degraded audio will not be acceptable.

Ports used by many desktop videoconference solutions are often blocked by corporate firewalls, making them difficult to use in a business environment. Integrated and set-top systems are more feasible because network administrators can create specific firewall rules for each system. Firewalls can also cause problems for videoconference systems that use a large number of random ports or are not compatible with NAT (network address translation).

In remote communities, especially those serviced by satellite networks, the bandwidth available is limited. Videoconferences need to be scheduled with the network operator and the provision of quality of service (QoS) needs to be supported on the network to ensure the quality meets acceptable standards. In these communities, the set-top videoconferencing systems are known to the network operators and videoconferences using the set-top systems are scheduled and supported. If many individuals start using desktop videoconferencing in these communities without scheduling them, the networks can be disrupted for other purposes.

However, despite the potential problems of including desktop systems in a multi-site videoconference, the need to do so will continue as multi-site videoconferencing increases in popularity. Many potential participants who may want to be connected to a multi-site videoconference do not have access to set-top systems and there is no other way to have them participate.

Desktop systems are the most popular means of personal videoconferencing. MSN Messenger reported more than three billion webcam sessions up to 2006, and MSN is only one of more than 40 different systems used to conduct a video call over a personal computer (Gough, 2006). Desktop systems can be used for business as well as personal communication with friends and family. Most desktop videoconference systems are used only for one-to-one meetings, although with most desktop systems single participants can videoconference with a group.

Desktop videoconferencing systems require several basic pieces of equipment and software, first of all a desktop or laptop computer, a full-duplex audio card and a video card capable of a minimum of 1,024 by 768, 24 bit colors. Auxiliary hardware includes a webcam, microphone and speaker. Some webcams have built-in microphones but if they do not then head set units with headphones and a microphone or a combination of microphone and speaker units are used for videoconferencing (Gaugh, 2006). Various types and sizes of screens can be used with desktop computers, such as projection screens, but computer monitors are the standard type of viewing screen for desktop videoconferencing. Special webcams that clip onto laptops are available, and the latest Apple Macbooks and PCs manufactured by Dell have integrated webcams.

Personal videoconference systems also require software. Videoconferencing activity on personal computers is implemented in software which can be downloaded from the internet and be either open source or proprietary. Open source software is similar to free software because it can be downloaded free of charge. Users of open source software are usually allowed viewing access to the source code and are able to change and re-distribute software. The second type of online software is proprietary, usually owned by the company or individual that created the software. More restrictions are placed on proprietary software; for example, the source code is usually kept confidential.

One example of online software is Skype, which costs nothing to use some features and requires paying a fee for other features. Skype allows video calling through an internet connection. The quality of the videoconference on Skype will vary with the broadband bandwidth used - it has a varying level of service on satellite connections and different desktop systems (see Appendix A6). Skype software alone cannot support multi-site videoconferencing, and the two images (onsite and offsite images) are displayed as picture-in-picture.

Windows Live Messenger is another popular desktop communication software. Like Skype, Messenger is a free downloadable software and is also designed for dual audio and videoconferencing only. The videoconferencing functions of Messenger are meant to augment the text capabilities, and therefore onsite and offsite images are not full-screen but are featured to the right of the text box. Like Skype, Messenger requires a minimum level of system requirements for videoconferencing (see Appendix A6).

iChat is a program designed specifically for Mac computers for text messaging, audio conferencing and videoconferencing. Unlike Skype and Windows Live Messenger, iChat has the capacity to videoconference with up to three other sites, as long as the other sites meet system requirements (for iChat multi-site system requirements see Appendix A6). iChat displays dual videoconference images full screen, while multi-site are shown simultaneously.

Not all software for desktop videoconferencing systems is free of charge; for example, Polycom PVX software offers a free trial period, after which the software is available at a cost per user, with a reduced price for group packages. Such software is useful for organizations; all members of a group can have compatible videoconferencing software, the PVX software has a webcam hardware compatibility list. The Polycom PVX boasts DVD quality image.

Web-based video and audio conferencing solutions such as Lotus Sametime, Cisco WebEx or Adobe Connect are software-based systems that are more firewall-friendly because they run on a central web server and use a limited number of ports to communicate. Many businesses use web conferencing software for desktop videoconferencing because they are so firewall friendly and, in addition to sharing audio and video, they allow users to share presentations, applications, whiteboard sessions, or entire desktops over the internet in web-based virtual meeting rooms.

Medium to enterprise sized organizations can also purchase more expensive specific systems that include both hardware and software; for example, the Cisco Unified Video Advantage system, which includes a Cisco webcam, Cisco IP phone and software that connect to a desktop computer. With this system group members can conduct dual-site videoconferences with colleagues.

3G mobile phones and video phones

Currently video phones are not suitable for multi-site videoconferencing but this could change in the future. Video phones were released to the public in the 1990s. Video phones for the home are important tools for people who are hearing-impaired and members of the Deaf community but most members of the general public prefer the relative ease and low cost of desktop video conferencing. 3G mobile phones, the 3rd generation technology in mobile phone standards, operate services that include wireless broadband. Video telephone is viewed by some analysts as the "killer application" for 3G mobile phones.

Video phone systems require the phone itself which includes a built-in screen. Ring-signalled devices that light up to signal a call can be purchased and are useful for members of the Deaf community and people who are hearing-impaired. Video phones also require a minimum level of service. Video cell phones require the necessary technical infrastructure to support the video application, provided by telecommunication companies charging a fee for service. A few problems with supporting the video application include the necessity of building the infrastructure, the high fees and the lack of coverage provided by telecommunication companies. Video phones also cost the consumer extra money both for the phone and the video call.

Multi-site videoconferencing bridge

Multi-site videoconferencing can be established via a Multipoint Control Unit (MCU), a concept introduced by the H.323 standard. The MCU thus becomes the congregated point of contact for all the participating units. An MCU unit is also commonly referred to as a "bridge."

Videoconference systems can be linked in four ways: the first and most traditional way is via a stand-alone bridge device; the second is with MCUs embedded into integrated videoconference units; the third way is through a multipoint service provider (MSP); finally, some new desktop videoconference software has the capacity to link a limited number of sites. Thus an MCU could be implemented purely as a software solution or as a combination of software and hardware.

A good selection of MCU systems can bridge IP and ISDN-based videoconference sessions. Dedicated standalone MCUs can act as a gateway between different communications media, accommodate hundreds of concurrent connections, and utilize varied protocols depending on the “option” package purchased. For example, standards such as SIP allow these units to integrate into an organization’s VoIP system. A selection of set-top units will also provide limited bridge functionality to multiple endpoints.

A stand-alone MCU bridge is a central point of contact for all audio and video endpoints. The bridge supports many simultaneous sessions so it is used to interconnect videoconference units and other end points in one or more multi-party conferences. The integrated MCU in a set-top videoconferencing unit can be used to increase the total number of supported sessions by joining everyone connected to that unit.

There are different methods of selecting which audio/video stream(s) to return back to the sites. A common method used is called audio switching – the site has on-screen presence when someone there is talking. This method could be problematic when multiple sites are talking simultaneously if only one site can be captured by the MCU. Another alternative is called chairperson control, which allows the chair of the meeting to control which site is active. Some newer MCUs use combined methods allowing the chair of the meeting to have the continuous on-screen presence while the other sites are selected to show on-screen by using the audio-switching methods.

Purchasing or renting MCU services can be too costly (River Valley Health, 2006) and therefore it may be more cost-effective for an organization or community to own its own MCU rather than pay a fee for the bridge service. However managing a stand-alone MCU is a major commitment that requires dedicated expert staff for ongoing maintenance and day-to-day operation.

Typically the cost of an MCU is determined by the following aspects:

- the number of concurrent calls it can handle (# of ports for video and # of ports for transcoded audio) and the bandwidth range for each call;
- The number of protocol standards (e.g. H.323, H.320, SIP, H.243, H.264, H.281, H.235, H.239, SDP…); an MCU can act like a gateway bringing systems using different protocols together;
- The number of audio transcoding codecs it supports (e.g. G.711A/µ Law, G.722/G.722.1, G.723.1, G.728, G.728, g.729 A…);
- Compatibility with other proprietary solutions (e.g. Radvision's Gatekeeper, Cisco's H.320-H.323 Gateway)
- Other functions, such as interoperability with VoIP systems, using an on-board audio transcoder to accelerate the process, scheduled or real-time conference control via a user controlled web interface support for simultaneous display of presenter (continuous presence layout) and presentation material, voice-activated video switching, ad hoc multipoint calls, encryption schemes used for the data/audio/video streams.

Multi-site videoconferencing is not something that only IP systems can do. Typically ISDN systems also have built in multi-site capabilities providing the ability to have four sites in one call without the need for an external bridge.

Multi-site videoconferences can still be possible without the presence of a MCU. One alternative is to enable IP multicasting at each participating site. In this case, each site sends a stream of packets to all the participating peers. Therefore, the bandwidth requirement for IP multicasting is lower than using a MCU, where copies of the same packets are sent to each of the receivers. Nonetheless, not every local area network supports IP multicasting, and even when the network has the capability, the network administrator may choose to disable it because of bandwidth or security concerns. Challenges include a lack of interoperability between vendor-specific implementations of multicast protocols; network administrators' lack of exposure to and experience with multicast systems; and downstream service providers not accommodating multicast for a variety of reasons, including but not limited to a desire to charge a premium for the extended functionality.

Networks and bandwidth

To conduct a technically successful dual or multi-site videoconference, network and bandwidth requirements must be met. The network provides the connection or link between the end points, and the bandwidth refers to the amount of electronic information which can be transmitted each second between two end points. From a technical perspective, videoconferencing can be seen as a type of synchronous communication between two or more locations over some telecommunication lines. A videoconference session uses the appropriate encoding and decoding tools (including peripherals) to integrate the audio and video system with the transmission lines to relay the information for all the participating parties in a simultaneous fashion.

Bandwidth requirements
The bandwidth of a connection denotes the data capacity of the transmission line. Larger bandwidth allows for higher quality videoconferencing. Videoconferences can be held on a variety of bandwidths, depending on the task type. There are three general quality levels for multi-point videoconferencing: business quality, enhanced definition and high definition. Business quality bandwidth is from 128Kbps to 256Kbps and is generally the accepted quality for meetings and collaborations (Kbps stands for Kilobits per second; 1Kb is equal to 1024 bits). Enhanced definition, between 384Kbps and 768Kbps, is a good visual and audio quality for meetings and customer interactions, especially when showing visual material. The highest level of visual quality, high definition resolution requires 1Mbps or more, and shows a high visual level of detail needed for some types of clinical consults and product developers (Tandberg, 2007b).

For interactive videoconferencing, it is important to know the upload speed, the rate at which the information is sent, and the download speed, the rate at which the information is received. Full participatory videoconferencing would require similar upload and download speeds so that all participants can communicate equally.

Network costs and availability
Videoconferencing was always quite expensive in the past as the cost of using the telecommunication lines was high. Many were run on T1, ATM, or ISDN lines. Now TCP/IP networks are becoming prevalent, and the cost of videoconferencing has been substantially reduced where these networks are available.

In Canada the federal government maintains the CANARIE network, a national optical research and education network. CANARIE connects the provincial research networks and, through them, universities, research centres, government research laboratories, schools, and other eligible sites, both with each other and with international peer networks, through a series of point-to-point optical wavelengths, most provisioned at Multi-Gbps speeds. All major cities in Canada can access the CANARIE network either directly or via smaller network connections. The CANARIE network and the smaller networks connecting with it support IP videoconferencing.

In many remote and rural areas, TCP/IP networks adequate for videoconferencing are not readily available. Ironically, rural and remote communities have perhaps the greatest need for bandwidth capable of supporting videoconferencing, as this has the potential to increase access to services and resources unavailable in these communities. However, rural and remote communities are underserved by digital networks and are thus obligated to pay for expensive connections in order to gain the necessary bandwidth for videoconferencing. This situation has developed primarily because of a political decision to make the telecommunications infrastructure the responsibility of the private sector, unlike health infrastructure or other essential social and community infrastructure funded by the public sector. Telecommunications companies in the private sector claim they cannot make a "business case" to provide adequate bandwidth for videoconferencing in many rural and remote areas and so do not provide adequate bandwidth to these areas.

To offset the geographical imbalance resulting from the private sector control of telecommunications infrastructure, the Canadian government – primarily Industry Canada and Infrastructure Canada - has programs to develop network infrastructure in rural and remote areas. Some of the most innovative rural and remote networks capable of supporting videoconferencing are run by communities and community-based organizations working in partnership with government to build their networks. Good examples of community-based networks in Canada are the K-Net network in Northwestern Ontario, Atlantic Canada's First Nations Help Desk in Cape Breton, Nova Scotia, and the other Regional Management Organizations of the First Nations School Net program funded by Indian and Northern Affairs Canada.

ISDN

ISDN lines are digital networks that support the exchange of information over a wide area network (WAN). A WAN, consisting of telephone lines, network cables, satellite signals or radio waves, covers a larger geographic area than a local area network (LAN) and can operate over both fixed and mobile wireless media. ISDN lines are usually offered by telephone carriers and transmit data over pre-existing telephone lines.

ISDN was originally used by the US military and is still used today for telehealth, although some telehealth providers have changed to TCP/IP networks or a mixture of both. There are several benefits to ISDN lines: they are not connected to the internet and therefore are more secure than TCP/IP, and they use digital rather than analog transmission so no analog conversion is needed, resulting in a clear transmission. ISDN lines also have guaranteed bandwidth and can thus ensure a continuous quality of service (QoS). This is important in medical uses of videoconferencing where high image quality and secure continuous transmission is vital. The bandwidth - the data capacity of the service - can be increased by adding more ISDN lines.

There are several problems with using ISDN lines for multi-site videoconferencing. ISDN lines cannot communicate with IP lines without a gateway, a device that can connect different networking technologies together (H.320 -ISDN and H.323 –IP). ISDN lines are also very expensive; while the bandwidth can be increased by adding new lines, each additional line is an extra cost. Each time ISDN lines are used there is a cost involved for the site making the call, which can be considerable for a high-quality ISDN multi-site videoconference lasting a few hours. In addition, ISDN is difficult to configure and manage. It is subject to service interruptions as ISDN users must dial in to a provider that offers ISDN internet service, which means that the call could be disconnected. Also, video calls on ISDN cannot be put on hold nor be forwarded.

TCP/IP

An alternate to ISDN and more commonly used type of network is internet protocol and transmission control protocol (TCP/IP). Internet networking, or internet protocol networking, sends data between computers via a packet-switching network or virtual circuit switched networks such as MPLS, X.25 or Freme Relay.

TCP/IP is used for videoconferencing by organizations, communities and by the general public. Unlike ISDN, TCP/IP can be used over a heterogeneous network – it can connect computers using different types of networks. TCP/IP is generally cheaper to use than ISDN because once the network is in place it can be used for no additional cost.

There are three variations of IP networks. The first type is the overall internet in common use. Intranets, the second variation of IP networks, are used within specific companies and organizations; outside access is forbidden. The third type is extranet which links multiple companies and organizations together using private digital networks; many organizations connecting with the CANARIE network would do so via an extranet. Both the Intranet and the extranet use firewalls to prevent unauthorized access.

There are several types of high-speed IP connections available. These include DSL, cable modem, satellite, wireless broadband and fibre optic. DSL and cable modem are two widely used broadband options for home users.

DSL is the acronym for Digital Subscriber Line; it provides a high speed internet connection that operates through digital signals sent over telephone lines. Even though the connection works over the phone line, it does not tie up or interfere with the phone line. The bandwidth that is available through phone lines has a much larger capacity than is typically used; therefore, a DSL line can send out digital pulses over the telephone connection at ultrasonic frequencies above the range of human hearing. The downstream rates usually run between 128 Kbps to 6 Mbps. The majority of upstream rates range from 128 Kbps to 512 Kbps. These speeds are representative of asymmetric DSL, where the upstream and downstream rates differ. Symmetric DSL, where the upstream and downstream rates match, is also available through some internet service providers (broadbandinfo.com, 2007).

Cable modem connections are also a popular option for home users as most homes have the cable connection already in place. While cable modem technology can theoretically support up to about 30 Mpbs, most providers offer service with bandwidth between 1 Mbps and 6 Mbps for downloads and between 128 Kbps and 768 Kbps for uploads.

Satellite internet services are used in locations where terrestrial internet access is not available and by people who access the internet from various locations. Internet access via satellite is available worldwide, including vessels at sea and mobile land vehicles (Wikipedia, 2007b). However, with its inherent high latency, satellite internet is tricky for real-time interactive applications such as videoconferencing. To ensure quality satellite videoconferencing, the process should be coordinated by a skilled bridge operator who can manage the network and support quality of service (QoS) so that adequate bandwidth is available for the videoconference call.

Wireless broadband service is readily available in many areas. Depending on the implementation technologies, the speeds vary widely. Yet the connection is less reliable compared to the wired connection due to obstructions of signals and also because the download speed is normally asymmetric to the upload speed.

In recent years fiber optic connections have become available directly to home users in some selected urban areas. These are called Fiber-to-the-Premises (FTTP) or Fiber-to-the-Home (FTTH). Normally there are tiers of service and availability depending on the location of the customer; service ranges from 5Mbps to more than 1Gpbs, although the offered services are normally asymmetrical in their download and upload speed.

Most businesses today are connected to the internet through wired Ethernet. The service can be delivered via a fiber optic connection or through the telephone network. The connection speeds generally range around 10, 100, or 1000Mbps. The wired Ethernet is fairly reliable and has low latency.

Organizations and communities can also obtain dedicated connections via, for instance, T1 or ATM services. T1 is a dedicated connection supporting data rates of 1.544Mbps, while T3 lines are operating at 45Mbps. ATM (Asynchronous Transfer Mode) is also a dedicated connection switching service that organizes digital data into equal sized 53byte cells over a medium using digital signal technology (DSL). ATM speeds are ranging from 155Mbps to 2488Mbps.

There are potential problems with IP lines related to bandwidth sufficiency, quality of the network, consistency of the connections, reliability and, of particular interest in telehealth, the problem of keeping the transmissions secure and confidential

(Masters, nd). Firewall configuration is always an additional problem when using a TCP/IP network for videoconferencing. Since H.323 applications use quasi-random dynamically allocated sockets for audio, video, and data channels, the firewall must be configured to allow the traffic through in real-time.

Security concerns and QoS

For TCP/IP videoconferencing for telehealth, for business, and for linking remote communities with limited bandwidth, good practice includes a consistent implementation of Quality of Service (QoS) and some level of network performance management to ensure optimal performance.

Single or multi-party videoconference sessions in a business or telehealth context are usually private in nature and may contain sensitive information. Videoconferencing security policies must address issues of reliability, integrity and confidentiality. Message reliability, when connecting remote endpoints across a TCP/IP wide area network, can be particularly problematic if session information must compete for bandwidth with other network traffic.

In this scenario, Quality of Service (QoS) techniques should be implemented within the LAN to properly classify traffic, and Gatekeepers must be deployed for bandwidth and priority queue congestion control. In IP-based networks, videoconference sessions are susceptible to the same integrity issues as other traffic. Standard IP network attacks like spoofing, eavesdropping and denial of service must be considered when designing security to protect data/audio/video streams. A firewall is one example of a typical technology deployed by organizations to protect inside systems from unauthorized access. However, perimeter security systems like firewalls do not address security within the local area network (LAN). Since many videoconference sessions occur within a LAN or between trusted wide area network zones via leased telecommunication lines, additional measures must be taken to ensure the integrity and confidentiality of videoconferences.

For example, AAA (authentication, authorization and accounting) policies should be implemented to prevent unauthorized participation in videoconferences and to track session history on a per-user basis. This can be particularly important when using multicast technologies as the potential audience can be large with little way to confirm group member participation. Finally, confidentiality security policies must address live session traffic and saved sessions stored on digital media for future viewing or redistribution.

Encryption is a common technology deployed to secure data/audio/video streams or digital files. Encryption standards like DES, 3DES and AES are commonly used in virtual private network systems to establish secure IPSec tunnels across public

TCP/IP networks. Encryption may also be available within the videoconference MCU and can be used to secure session information between endpoint participants.

A videoconference on a TCP/IP network can run into bandwidth shortages which adversely affect the performance of not only the videoconference but also other services like email and file transfers sharing the same bandwidth on the network. Gatekeeper software, on a switch, router or server, is used to provide quality of service (QoS) - to regulate the videoconference so that it does not use up all the bandwidth and block the transmission of other data.

QoS is complex to configure and must be deployed within the LAN at the layer 2 and 3 before audio/video traffic traverses call zones. Bandwidth control via a Gatekeeper is only effective if the traffic has been classified so that strategies like class-based weighted fair queueing (CBWFQ) and low latency queueing (LLQ) can work. Additional QoS strategies are often deployed to prioritize voice traffic by keeping video out of the priority queue.

Codecs

Typically there is a critical step involved in videoconferencing. It is the conversion of voice and image data stream from their native analog format to digital format, and from digital to analog at the other end of the communication line. This is the function of the Codec, which is short for "Compressor-Decompressor", "Coder-Decoder", or "Compression/Decompression algorithm". Codecs are often used in videoconferencing and streaming media applications. For example, a video camera's analogue-to-digital (ADC) converts its analogue signals into digital signals, which are then passed through a video compressor for digital transmission or storage. A receiving device then runs the signal through a video decompressor, then a digital-to-analogue converter (DAC) for analog display (Wikipedia, 2007a).

In the encoding and decoding processes, the continuous signals are converted into ones and zeros, packaged in discrete packets to go through the digital communication lines and then unpacked and decoded at the other end. Depending on the compression ratio, various degrees of loss of clarity and delay are introduced in these encoding and decoding processes. Generally, higher compression ratios result in smaller data size, which in turn requires less bandwidth for transmission but has a higher degree of loss of audio and video quality. Compression also introduces delay.

Delay or latency

Real-time communications such as videoconferencing are sensitive to delay and variation in packet arrival times. Delay or latency is inevitable as it takes time for packets to travel across the network. Compression also introduces another layer of delay. The delay budget for a reasonable two-way conversation is about 150 milliseconds round-trip (RT); more than 150RT can be annoying to users.

Another disturbing factor is jitter, which occurs when packets arrive early, late, or out of sequence. Excessive jitter causes the users to experience quality degradation during a call. Some videoconferencing systems employ uncompressed audio and video in order to present users with a jitter-free low-latency high quality videoconference experience; this, however, requires both high bandwidth and priority Quality of Service (QoS) implemented in the network to accommodate these uncompressed data streams.

Archiving videoconferences

Videoconference archives can be useful for participants of multi-site videoconferences, especially multi-site videoconferences with groups. Archives can allow people to view the videoconference even if they are unable to attend for technical or scheduling reasons. Conferences conducted over videoconference can be archived for the organization or institution for future reference, and even streamed on the internet for public viewing.

Archiving videoconferences for future viewing can also lead to an increase in participation. In large group videoconferences where regular meeting occur, recording the conference and making the archive available allows group members who miss a meeting to review the recording afterwards and process the information before the next meeting, giving them the ability to discuss the meeting with their colleagues. Archiving the videoconferences reduces or eliminates the need for summarizing the previous meeting and can prevent confusion. Videoconference archives can be helpful for groups that meet on a regular basis and for large conferences where not everyone has the time to attend the sessions when they are scheduled (Kouadio et al., 2002).

Few set-top and dedicated videoconferencing systems have integrated recording units built into the system. In some cases DVD or VCR units can be hooked up to the system to record the videoconference. Screen capturing programs such as Camtasia Studio, software that records video and audio, are available for desktop computers. The videoconference can then be streamed to the internet or saved. Some video cards have an S-video out, which means that they are capable of recording onto DVR or VCR (Gaugh, 2006). Using a videoconfererence bridge, the videoconference can be streamed directly to an archive server; in this case the server is added as an additional meeting site. Another option is to run a video camera as a capture and also a recording device for archive and post-processing purposes.

There are a few factors to consider when archiving videoconferences: there are privacy issues involved; participants need to be informed that the videoconference is being archived, where the archive is stored and how it can be accessed, and the length of time the archived videoconference will be stored and accessible. What needs to be archived should also be considered. It may not be as important to archive the videoconference in its entirety – for example, is anyone going to watch several hours of archived videoconference featuring your group's discussion of the annual budget? How are these videos going to be indexed for easy retrieval?

It may be useful, and more practical, to archive shorter summaries of the videoconference; for example, the last two or three minutes of the meeting where the chair summarizes the outcomes of the meeting. This archive could serve as the minutes from the meeting and could be posted for the group to view and give comments. Video annotation software is available that can be applied to make it easier to sift through long archives of videoconference meetings or sessions to find specific events or segments of the meeting.

8 Conclusion: Assessing the situation - how is successful participation measured, and how can it be achieved?

Introduction

Success criteria differ according to who is defining "success." For example, technical support staff might consider a videoconference event successful if there are no technical glitches. They are not basing the success of the event on the level of interaction, collaboration or potential outcomes (Barfurth et al., 2002). In a review of multi-point telehealth videoconferencing in Australia, Blignault (2000) noted that there were two types of recorded failures: technical errors, resulting from the equipment itself, network connection and bridge problems; and human errors, including non-attendance, late connections and operator errors.

Problems related to technology and attendance are more likely to be recorded than barriers to participation that are more difficult to measure such as problems with group dynamics or motivational or trust issues. That is not to say that technical and human errors are not important – they do affect the quality and success of multi-site videoconferencing. However, multiple success factors are involved in participatory videoconferencing. Participatory multi-site videoconferencing depends upon the technical infrastructure, the interaction between users and the technology, the group dynamics and the structure and content of the videoconference itself. Success criteria depend upon successful outcomes of the videoconference on individual, group and organizational levels.

Success outcomes

How are successful outcomes measured? Researchers can examine group success on an individual level by measuring the knowledge growth and well-being of group members as well as their satisfaction with the technology. On a group level the interactions of individuals can be recorded and analysed, and on an organizational level the productivity outcomes of the meeting and the group's capacity for future work are measures of success (Jarman, 2005). There are several ways this information can be gathered.

Individual level

To measure the success of a multi-site videoconference at the level of the individual participants, organizers can gather or solicit feedback at the end of the videoconference verbally or by using a questionnaire that asks participants questions related to access, involvement, participation and the technology (see Appendix: A7). Organizers can also give participants an e-mail address or a link to a website where participants can give feedback after the videoconference.

Group level
Success on a group level can be gleaned through feedback from individuals who note the success (or failure) of their interactions with others within the group. Group dynamics can also be observed during the videoconference by analyzing the visual and spoken interactions between participants – their body language, facial expression, tone and verbal contributions. Such observations can take place afterwards if the videoconference is recorded and archived.

Organizational level
Success at the organization level can be measured by asking participants questions about the organizational impact of the session, such as: Were decisions made during the meeting? Were the goals set out in the agenda reached?

Concluding thoughts

Successful participatory multi-site videoconferencing depends upon individuals, group dynamics, organizational outcomes, and the effectiveness of the technology and of user interaction with that technology. Different groups meeting via multi-site videoconferencing have different needs, and good practice techniques need to be adjusted accordingly.

Time is a factor in good practices for multi-site videoconferencing. Success needs to be measured over time, and good practices need to be adjusted based on continued audience feedback and ongoing evaluation findings.

At the end of this report is an appendix with guidelines of good practices for participatory multi-site videoconferencing. The authors encourage readers to use these guidelines for specific contexts of multi-site videoconferencing, and to continue ongoing research aimed at developing good practices.

Annotated bibliography

Anderson, A. H. (2006). "Achieving Understanding in Face-to-Face and Video-Mediated Multiparty Interactions." *Discourse Processes, 41*(3), 251-287.

Anderson's article discusses the impact of videoconferencing on mutual understanding. Anderson notes several issues faced when using videoconferencing for large group participation and the need for expanded effort to promote interactivity and additional time to achieve meeting goals.

Barfurth, M. A., Singer, J., Emond, B., Vinson, N., Brooks, M., & Spence, J. (2002). "Evaluation factors for multi-stakeholder broadband visual communication projects." Proceedings of the Eleventh IEEE International Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises.

Document outlines factors affecting the evaluation of BVC. The authors note that the success criteria of the event differs according to what is being evaluated, and that for success both social and technical aspects need to be well planned and executed.

Barlow, J., Peter, P., & Barlow, L. (2002). *Smart Videoconferencing: New Habits for Virtual Meetings*. San Francisco: Berrett-Koehler Publishers, Inc.

Smart Videoconferencing is a practical guide to videoconferencing for business that focuses on the effectiveness of the organizer as well as the individual participant's appearance, behavior, and oral presentation. The book also contains a glossary of terms, and a list of commonly mispronounced words.

Becker, E. A., Godwin, E.M.. (2005). "Methods to Improve Teaching Interdisciplinary Teamwork Through Computer Conferencing." *Journal of Allied Health, 34*(3), 169-176.

Becker and Goodwin implement evaluation strategies to promote student interactivity. They note that online discussion promotes interactivity and is more democratic than face-to-face discussions. Orienting students and promoting student interactions improved interdisciplinary teamwork skills.

Blignault, I. (2000). "Multipoint Videoconferencing in Health: A Review of Three Years' Experience in Queensland, Australia." *Telemedicine Journal 6*(2), 269-274.

The article reviews videoconferencing for education and administration in Queensland Health from 1996 to 1999. The article looks at the patterns of use and the results of user surveys. The authors offer suggestions for improving multi-site videoconferences.

Broadbandinfo.com (2007) "Compare T1, T3 and DSL Connections. Accessed October 1, 2007 from http://www.broadbandinfo.com/internet-access/dsl/t1-t3-compare.html

This online article compares various types of internet connections.

ClearOne. (2002). *A Guide to Multipoint Conferencing: White Paper*: ClearOne Communications, Inc.
A white paper published by ClearOne communications, a company that manufactures and markets personal desktop conferencing systems. This document outlines the technical infrastructure required for videoconferencing and defines the common terminology used to discuss videoconferencing technology.

Cool, C., Fish, R., Kraut, R., & Lowery, C. (1992). "Interative Design of Video Communication Systems". Proceedings of the ACM CSCW 1992.
A review and case study of the design and implementation of two separate video telephone systems.

Creech, H. (2001). *Strategic Intentions: Principles for Sustainable Development Knowledge Networks*. Winnipeg: International Institute for Sustainable Development.
Creech notes the need for strong objectives and a narrow focus for successful collaborations. She stresses the importance of relationships in understanding virtual teamwork.

Diamond, L., & Roberts, S. (1996). *Effective Videoconferencing: Techniques for Better Business Meetings*. Menlo Park, California: Crisp Publications Inc.
Effective Videoconferencing details the importance of videoconferencing for two way communication, the system used for videoconferencing and how to plan for a videoconference.

Ferguson, J. (2006). "How to do a Telemedical Consultation." *Journal of Telemedicine and Telecare, 12*, 220-227.
Ferguson provides a definition of telemedical consultation and notes the types of media used. Factors involved in successful videoconferencing include "the environment, session initiation, dialogue, and session closure."

Fish, R. S., Kraut, R.E. , Root, R.W. (1992) "*Evaluating Video as a Technology for Informal Communication."* Proceedings of the ACM CHI 1992.
Fish and Kraut note importance of informal communications because they are expressive, frequent and interactive– all key elements in forming relationships. The article evaluates a version of a desktop videoconferencing system to support informal communication, and then notes the requirements needed for successful informal communication technologies. The authors note the particular importance of video to 1- help increase frequency and spontaneity of communication 2- to support social connections 3- to cope with more complex problems 4- help integrate members, support for work, especially for development groups.

Gou, Z., Turner, T., Tan, F. (2006). "The Effects of Normative Social Influences and Cultural Diversity on Group Interactions." Proceedings of the 39th Hawaii International Conference on System Sciences, Hawaii.
Gou, et al explore how culture and social influence affects the attitudes, behaviors and perceptions of individuals vis-à-vis new technology.

Gough, M. (2006). *Videoconferencing over IP: Configure, Secure and Troubleshoot*. Rockland MA: Syngress.

Gough focuses on personal videoconference calls but also discusses videoconferencing for business and web videos. This book defines terminology and lists the equipment needed for personal, or desktop, videoconferencing.

Greenburg, A. D. (2004). *The Evolving Role of Videoconferencing in Healthcare: Pushing the Boundaries of Knowledge Transfer*. Pleasanton, CA: Polycom Inc.

A US report that discusses the uses of two-way videoconference in healthcare as well as the benefits. Greenburg mentions interactivity as key to successful knowledge retention.

Hara, N., Solomon, P., Kim, S.-L., & Sonnnenwald, D. H. (2003). "An Emerging View of Scientific Collaboration: Scientists' Perspectives on Collaboration and Factors that Impact Collaboration." *Journal of the American Society for Information Science and Technology, 54*(10), 952-965.

Hara and Solomon outline their findings of a study of four geographically dispersed multidisciplinary groups with 14-34 members each. They note the characteristics that embody a successful collaboration and outline strategies to enable such collaborations.

Havelock, D.I., Green, D. (2005) "Measuring the Dynamic Performance of Video Conferencing Systems." Proceedings of The Canadian Acoustical Association Conference, London, Ontario. NRC 48275.

Havelock and Green's short paper discusses the diverse technical factors that determine the effectiveness of videoconferencing systems. They then give their methods and observations on talking trackers.

Hearnshaw, D. (2000). "Towards an objective approach to the evaluation of videoconferencing." *Innovations in Education and Training International, 37*(3), 210-217.

The article discusses the need for more objective data gathering methods in order to identify the educational impact of videoconferencing.

Hjelm, N. M. (1999). "Telemedicine Videoconferences - Often Chaotic but can be Orderly." *Journal of Telemedicine and Telecare, 5*, 203-204.

Hjelm's brief article notes the factors needed for a successful outcome from videoconferencing. The article references Klutke's study on best practices while giving additional guidelines for videoconferencing.

Hjelm, N. M., Lee, J. C. K., Li, A. K. K., & Hazlett, C. B. (1998). "Planning Criteria for Multicentre, Multilingual Telemedicine Conferences." *Journal of Telemedicine and Telecare, 4*, 47-55.
Hjlem et al. report on three-way teleconference in London, Beijing and Hong Kong. They note criteria and guidelines for improving future multi-site conferences. This document includes a detailed checklist, things to do from one year before the conference. Some participants felt problems resulted from the conference spanning Eastern and Western countries but authors note that site and location factors are only part of the larger equation involving sound planning process and its execution.

Ho, K., Jarvis-Selinger, S. (2005). *Identification of Best Practices for Evidence-Based Telehealth in British Columbia*. Vancouver, British Columbia: University of British Columbia.
This document promotes evidence of user-satisfaction in order to build enthusiasm about videoconferencing. The goal of the authors is to empower patients (and participants) by discussing the benefits of videoconferencing for telehealth.

ITRIX. (1998a). "Lighting a Videoconferencing Environment (Part One)." Retrieved August 7, 2007, from www.tipsnews.org/newsletter/98-09/lighting1.html
This document is a short online guide to the different types of lighting available for videoconference rooms and the characteristics of these lights.

ITRIX. (1998b). "Lighting a Videoconferencing Environment (Part Two)." Retrieved August 7, 2007, from www.tipsnews.org/newsletter/98-09/lighting2.html
A short online guide to lighting, including a discussion of furniture and colour effects as well as best practice tips.

Jarman, R. (2005). "When Success Isn't Everything - Case Studies of Two Virtual Teams." *Group Decision and Negotiation, 14*, 333-354.
This article presents an interpretive case study of two virtual groups, examining critical measures of success, including productivity outcomes, enhancing capability for future work, growth and well-being of group members and technological outcomes. Jarman notes differences to what constitutes success depending on the evaluator, and that in both cases technology was only an issue when the technology did not work.

Jarvenpaa, S. L., Leidner, D.E.. (1998). "Communication and Trust in Global Virtual Teams." *Journal of Computer Mediated Communication, 3*(4).
In an attempt to explore virtual teams and their specific challenges with regards to trust, Jarvenpaa and Leidner (1998) conducted case studies of strictly virtual teams who only collaborated with each other through email. The virtual teams were comprised of graduate students from various countries, formed into teams of four to six people required to solve three tasks. Their findings indicate that a clear set of responsibilities need to be set, and that regular high-quality feedback is necessary for trust in virtual teams.

Keewaytinook Okimakanak. (2007). *How to Prepare and Deliver an Effective Videoconference Presentation*. Balmertown, ON: KO Telemedicine.
This short document contains tips for videoconference presenters on creating PowerPoint slides, engaging the audience, working with a coordinator, and other general presentation suggestions.

Keewaytinook Okimakanak. (2007). *Online Conference Best Practices*. Sioux Lookout & Thunder Bay: KORI & K-Net.
Online Conference Best Practices is a two page document that lists tips for presenters, guidelines for website implementation, suggestions to increase viewer engagement, and strategies for advertising events.

Klutke, P. J., Baruffaldi F., Mattoli P., Toni A., Englmeier, K.H. (1999). "Guidelines for Multipoint Videoconferencing Using Low-cost, PC-based Equipment." *Journal of Telemedicine and Telecare, 5*, 198-202.
The article contains guidelines and video etiquette for effective multipoint videoconferencing.

Kouadio, M., & Pooch, U. (2002). "Technology on Social issues of videoconferencing on the Internet: a survey." *Journal of Network and Computer Applications, 25*, 37-56.
This study outlines group behaviour that needs to be understood in order to reach best outcomes in videoconferencing. The authors also note the need for archiving videoconferencing sessions.

Kraut, R. E., Rice, R.E. ,Cool, C., Fish, R.S. (1994). "Life and Death of New Technology: Task, Utility and Social Influences on the Use of a Communication Medium." Proceedings of the ACM CSCW 1994.
The article details an 18 month trail of two desktop video systems, Cruiser and MTS. The authors note that fit between task and communication medium is not the only reason for the success or failure of new technologies – social components of critical mass (high number of users early in implementation of technology) and social influence (high degree of use creates norms within groups, and attitudes develop re: the technology) are two key factors that explain the success of new technologies. The authors note that "Interactivity is high when communication partners can exchange information rapidly, adjusting their messages in response to signals of agreement, understanding, questions or interruptions."

Loane, M., & Wootton, R. (2002). "A Review of Guidelines and Standards for Telemedicine." *Journal of Telemedicine and Telecare, 8*, 63-71.
Investigates international standards for telemedicine focused on clinical applications. Article briefly mentions the use of videoconferencing in telemedicine.

Locatis, C., Fontelo, P., Sneiderman, C., Ackerman, M., Uijtdehaage, S., Candler, C. et al. (2003). "Webcasting Videoconferences Over IP: A Synchronous Communication Experiment." *Journal of the American Medical Information Association, 10*, 150-153.
Report on the outcomes of a multipoint videoconference conducted via webcast and chat between various US locations. Participants could log onto a chat server to type questions and comments for the panelists and other viewers. The report details the results of the multi-site videoconference.

Mankin, D., Cohen, S., & Fitzgerald, S. P. (2004). "Developing Complex Collaborations: Basic Principles to Guide Design and Implementation." *Advances in Interdisciplinary Studies of Work Teams, 10*, 1-26.
The article outlines critical success factors in collaborations and proper structure for collaborative meetings as well as the various skills individuals need to develop to facilitate effective collaborations.

Mansour-Cole, D. (2001). "Team Identity Formation in Virtual Teams." *Virtual Teams, 8*, 41-58.
This article outlines important steps required to achieve good relationships in virtual groups. Also mentions barriers present in videoconferencing that could hinder team identity formation.

Masters, S., ed. *Telehealth Handbook*: Centre for Telehealth @ Mheccu.
The "Telehealth Handbook" is a resource for telehealth in British Columbia, with an emphasis on mental health and additions. The document also discusses the application for videoconferencing technology in telehealth.

Monk, A., & Watts, L. (2000). "Peripheral participation in video-mediated communication." *International Journal of Human-Computer Studies, 52*, 933-958.
Monk and Watts' article notes the importance of peripheral participants – participants who have a vested interest in monitoring a joint task but not actively involved in the task – for example, a mother listening in on the consultation the GP has with a specialist about her child. The goal of including peripheral participants is to increase awareness.

Munn-Venn, T. (2006). *Lessons in Public-Private Research Collaboration: Improving Interactions Between Individuals*. Ottawa: The Conference Board of Canada.
The 2006 Conference Board of Canada report investigates collaborations between business and publicly funded organizations, focusing on the drivers and barriers to collaboration. The report offers potential solutions to barriers as well as suggestions for more effective collaborations.

National Resources Canada. (2007). "ecoACTION." Retrieved August 8, 2007, from http://ecoaction.gc.ca/tools-outils-eng.cfm
A Natural Resources Canada website that has links to calculators so you can calculate your impact on the environment.

Nemiro, J. E. (2000). "The Climate for Creativity in Virtual Teams." *Team Development, 7*, 79-114.

Nemiro notes the factors that undermine creativity and the problem of developing trust in virtual groups, while suggesting strategies for developing trust and outlining the traits needed for virtual team workers to communicate effectively.

O'Donnell, S., Perley, S., Walmark, B., Burton, K., Beaton, B., & Sark, A. (2007). "Community-based broadband organizations and video communications for remote and rural First Nations in Canada." Proceedings of the Community Informatics Research Network (CIRN) 2007, Prato, Italy.
This paper explores how two community-based First Nations organizations in Canada support the development of remote and rural First Nations communities by using video on broadband networks. Broadband use is situated within a broader social movement working towards self-determination for First Nations communities in Canada.

O'Donnell, S., Singer, J., Milliken, M., & Fournier, H. (2007). *BVC-SI - Technical Update Report*. Fredericton, NB: National Research Council, ERB-1150, NRC 49868.
Their report, based on data from the user community participating in the Virtual Classroom Diet and Body Image session held April 2007, provides the Broadband Visual Communication Strategic Initiative (BVC-SI) with an initial social analysis of the usability and effectiveness of the Broadband Virtual Camera (BVCam) and videoconferencing technologies for large group participatory communication.

Ontario Telemedicine-Network. (2006). *Best Practices for a Successful and Interactive Webcast Event* (Handouts and checklists): Ontario Telemedicine Network.
A paper prepared by the OTN that gives webcast users tips for effective use of the technology. The document includes workshop and videoconferencing checklists and a practical guideline for presenters, which outlines the proper guidelines for projected PowerPoint presentations, tips for effective presentations and advice on how to involve the audience. The OTN report also includes sample introductions for moderators of educational sessions conducted via videoconferencing and videoconferencing with a live webcast.

Papakostopoulos, D., A. Williams, V. Ramani, Hart, C.J.D, Dodson, K., Papakostopoulos, S. (1999). "Evaluation of the First International Teleconference in Ophthalmology." *Journal of Telemedicine and Telecare, 5*(Supplement 1), 17-20.
The authors report on a five-site conference with 500 members, from the USA, UK Greece and Malaysia, a two-day conference, 10 hours each day. They discuss the planning of the conference and the outcomes, recommendations, measures of success and benefits.

Perley, S., & O'Donnell, S. (2006). "Broadband Video Communication Research in First Nation Communities." Paper presented at the Canadian Communication Association Annual Conference.
The paper details the policies and strategies for broadband access and development in First Nations communities in Canada.

Peter, J., Valkenburg, P. M., & Schouten, A. P. (2007). "Precursors of Adolescents" use of Visual and Audio Devices during Online Communication". *Computers in Human Behaviour, 23*, 2473-2487.
The authors challenge the idea that computer based communication lacks auditory and visual cues through their study of 1,060 adolescents. The study reveals that 57% of adolescents occasionally use webcams while instant messaging and 32% sometimes used microphones. Their findings suggest that the nature of computer-mediated communication may be changing, as youth are using visual means of communication.

Petersen, R. (2000). "'Real World' Connections through Videoconferencing - We're Closer Than You Think." *TechTrends, 44*(6), 5-11.
Peterson's article examines NASA's collaboration with K-12 schools and the use of videoconferencing in education. The author stresses the importance of interactivity, facilitated by guidelines and trainings sessions for presenters and pre and post conference activities.

Peterson, C. (2004). "Making Interactivity Count: Best Practices in Video Conferencing." *Journal of Interactive Learning Research, 15*(1), 63-74.
This article is a case study of interactivity in a classroom setting. It includes survey questions addressing interactivity and provides educators with a source of best practices and strategies that accentuate the "quality" of interactions in a video conferencing environment.

PictureTel. (1998). "TIPS on Videoconferencing." Retrieved August 7, 2007, from www.tipsnews.org/newsletter/98-09/TIPS_on_video.html
This is a short online guide to camera and microphone placement in order to maximize the conference room atmosphere and acoustics.

Rankin, K. (2007). "ePresence Interactive Webcasting." Retrieved Sept. 20, 2007, from www.epresence.kmdi.toronto.edu/Presentation/2ePresenceTV
A six minute online presentation that demos and explains the benefits of ePresence Interactive Webcasting

Rees, C. S., Haythornthwaite, S. (2004). "Telepsychology and Videoconferencing: Issues, Opportunities and Guidelines for Psychologists." *Australian Psychologist, 39*(3), 212-219.
Telehealth application is dominated by mental health and the discipline of psychiatry. This Australian study notes that telepsychology has not developed as quickly as telepsychiatry. The paper states the reasons for this lag, while updating psychologists about the uses of the technology and identifies four challenges for psychologists while providing guidelines to overcome these challenges.

River Valley Health. (2003). "Videoconferencing - A Guide for Meeting at a Distance". Unpublished Guide. Videoconference Implementation Committee: River Valley Health.
A guidebook produced by RVH for its employees providing tips and etiquette for videoconferencing. The document includes checklists for videoconference organizers as well as a post-conference survey for participants.

River Valley Health. (2006). *Benefits Evaluation and Future Planning Strategies for the River Valley Health Tandberg Multi-Conference Unit* Fredericton NB: Park Consulting Group: for River Valley Health.
A report detailing the findings of a videoconferencing user impact survey with River Valley Health users.

Roberts, T. L., Lowry, P. B., & Sweeny, P. B. (2006). "An Evaluation of the Impact of Social Presence Through Group Size and use of Collaborative Software on Group Member: Voice in Face-to-Face and Computer Mediated Task Groups." Proceedings of the IEEE Transactions on Professional Communication.
This article looks at the importance of the "voice effect" on successful group collaboration. Voice effect" is the ability of group participants to articulate thoughts and concerns and provide input on decisions. The authors conducted a study where tasks were preformed by groups over different web-based interfaces to determine if different group settings impact voice. Their results state that four factors influence voice: group size, social presence, proximity, media richness, and collaborative software.

Rutkowski, A. F., Vogel, D. R., van Genuchten, M., Bemelmans, T. M. A., & Favier, M. (2002). "E-Collaboration: The Reality of Virtuality." *IEEE Transactions on Professional Communication, 45*(4), 219-230.
The results of a four-year study between Hong Kong and the Netherlands involving 268 participants are presented in this article. The study identifies problems with building and maintaining virtual teams, in particular motivational issues. Article also outlines potential solutions to enhance group communication.

Sharer, S. (2004). "Skills for Effective Use of Videoconference." Savanna, Georgia: Communication Design Group.
A practical guide to the social and technical infrastructure needed for effective videoconferencing. Also includes detailed information of videoconferencing as well as a "checklist" for the preparation and execution of successful videoconferencing.

Shaw, D., Westcombe, M., Hodgkin, J., & Montibeller, G. (2004). "Problem structuring methods for large group interventions." *Journal of the Operational Research Society, 55*, 453-463.
Shaw and Westcombe's article suggests negotiation models (strategies) for the resolution of issues within large group in order to empower all participants.

Sonnenwald, D. H., Soloman, P., Hara, N., Bolliger,R., Cox, T. (2002). "Collaboration in the Large: Using Video Conferencing to Facilitate Large Group Interaction" In Gunasekaran, A. Khalil, O. (Ed.), *Knowledge and Information Technology in 21st Century Organizations: Human and Social Perspectives* (pp. 115-136). Hersey, PA: Idea Publishing Co.
This chapter outlines strategies to maximize collaboration within large groups.

Steiner, M., Tsudik, G., Waidner. M. (2000). "Key Agreement in Dynamic Peer Groups." *IEEE Transactions on Parallel and Distributed Systems, 11*(8), 769-780.
The authors note the various settings of group communications, including videoconference, and emphasize the complexity of large group communications. They recommend rotating leaders for enhanced interaction and involvement in group communications

Tandberg. (2007a). "See: green." Retrieved August 8, 2007, from http://www.seegreennow.com/
A website created by the Tandberg Company that notes the environmental benefits of videoconferencing and includes a carbon footprint calculator.
Tandberg. (2007b). "See: Performance." Retrieved October 1, from http://www.tandberg.com/
The Tandberg Company's website.

Trawner, M., & Yafchak, M. (2007). "Videoconferencing Cookbook. version 4.1." Retrieved May 31, 2007, from http://www.vide.net/cookbook/cookbook.en/
The Videoconferencing Cookbook website outlines best practices and etiquette for videoconferencing and the best room layout for videoconferencing. Website also briefly mentions multicast broadcasting and the importance of archiving videoconferences.

VideoCom. (2007a). "Advancing the Green Agenda Via Videoconferencing".Retrieved July 12, from http://videocom.knet.ca
The website contains the archived streamed multi-site videoconference on the topic of green videoconferencing, which also addresses the uses and problems with videoconferencing for research, government initiatives and for First Nations communities across Canada.

VideoCom. (2007b). "Digital Storytelling: Grassroots Online Video". Retrieved July 24, from http://videocom.knet.ca
This website contains the archived streamed multi-site videoconference on the topic of Digital Storytelling that also addresses broader issues of the preservation of First Nations language and culture, community development, and youth empowerment.

Wainfan, L., & Davis, P. K. (2004). *Challenges in Virtual Collaboration: Videoconferencing, Audioconferencing, and Computer-Mediated Communication*. Pittsburg, PA: RAND Corporation.
This book evaluates virtual collaboration while asking how various types of communications affect group outcomes. The authors outline different factors that influence the outcome of collaborations and suggest strategies to mitigate collaborative problems.

Webster, J. (1998). "Desktop Videoconferencing: Experiences of Complete Users, Wary Users and Non-Users." *MIS Quarterly, 22*(3), 257-286.
This paper examines the use of desktop videoconferencing in one organization. Webster's findings are informed by the theoretical perspectives of communication media choice, systems analysis and design, and privacy.

Wikipedia contributors (2007a). "Codec." Retrieved October 1, 2007, from http://en.wikipedia.org/w/index.php?title=Codec&oldid=160744371
Definition and discussion of Codec.

Wikipedia contributors (2007b). "Satellite Internet Access." Retrieved Oct 1, 2007 from http://en.wikipedia.org/w/index.php?title=Satellite_Internet_access&oldid=161090182
Definition and discussion of satellite internet access.

Wilcox, J. (2000). *Videoconferencing: The Whole Picture*. New York: Telecom Books.
Videoconferencing: The Whole Picture introduces videoconferencing terms, discusses applications and case studies and presents videoconferencing standards. The author focuses on the technical infrastructure of videoconferencing, and mainly discusses videoconferencing over IP networks, and personal videoconferencing.

Williams, E. (1977). "Experimental Comparisons of Face-to-Face and Mediated Communication: A Review." *Psychological Bulletin, 84*(5), 963-976.
A review of early research that suggests the additional of audio benefits communication, but adding video to the audio offers little benefit. More recent studies indicate that there are conditions under which the addition of video is important.

Wiredred. (2007). "Video Conferencing History".Retrieved July 11, 2007, from www.wiredred.com/video-conferencing-history.html
"Videoconferencing History" is a short online article that outlines the global history and uses of videoconferencing.

Wong, Y. K., Shi, Y., Wilson, D. (2004). "Experience, Gender Composition, Social Presence, Decision Process Satisfaction and Group Performance." Paper presented at the Winter International Symposium on Information and Communication Technologies Cancun Mexico.
The authors conducted a study with 72 volunteers in order to examine relationships among perceptions of social presence, group satisfaction, and gender on task performance. While the results were inconclusive, the study suggests that groups comprised only of women experienced higher levels of group cohesion.

Yoo, Y., & Alavi, M. (2001). "Media and Group Cohesion: Relative Influences on Social Presence, Task Participation, and Group Consensus." *MIS Quarterly, 25*(3), 371-390.
This article contains a theoretical discussion of social presence and media "richness" theories. The article notes that social factors and media conditions are needed to enhance participation and that group cohesion is important.

Yu, E. (2005). "HP's Halo Seeks to go Post-videoconferencing" [Electronic Version]. *www.silicon.com* from http://www.silicon.com/cxoextra/0,3800005416,39155033,00.htm.

This online article announces the release of HP's Halo videoconferencing system, and gives a brief description of the system.

Glossary

ADC – Analogue-to-digital converter – Converts analogue signals into digital signals.

Bandwidth – The data capacity of a service. Larger bandwidths allow for higher quality videoconferencing.

Best Practices – A technique that is proven to provide the best end result.

BVC – Broadband visual communication.

BVC-SI – The NRC-IIT project large group participatory broadband visual communications.

CANARIE network – The Canadian national optical internet research and education network.

Codec – Compression/Decompression algorithm – used in video and streaming media applications.

CP - Continuous Presence – The view on screen during a multi-site videoconference that displays the last site with a participant or participants speaking.

DAC – Digital-to Analogue Converter – Converts digital signals into analogue signals, allows for analogue display.

Download speed – The rate at which information is received.

DSL – Digital Subscriber Line – Provides a high speed internet connection operating through digital signals sent over telephone lines.

FTTP/FTTH – Fibre-to-the-Premises or Fibre-to-the-Home – Fibre optic connections that run directly to home users in selected urban areas.

Gatekeeper – Software on a switch, router or server that regulated LAN videoconference calls so that the conference doesn't use up all of the LAN bandwidth and block other data (like e-mail).

Gateway – A device that mixes different videoconference formats together (for example ISDN and IP).

Good Practices - The interactions of various elements determine the “best” practices needed for a specific context; therefore we propose “good practices” in order to acknowledge that there are various best practices for multiple situations.

Guidelines - A set of qualitative, voluntary and flexible recommendations.

ISDN – Integrated services digital network - Information sent over a wide area network (WAN), often offered by regional telephone carriers, involves the transmission of information over pre-existing telephone lines.

IP – Internet Protocol – Information sent over the LAN.

LAN – Local Area Network.

MCUs, or MCU/Bridge – Multipoint control units, or Multi- conference unit.

MPVC - Multi-site videoconference – Occurs when more than one site is involved in the videoconference.

MSP- Multipoint service provider.

Participation - In the context of multi-site videoconferencing, participation is the interaction between the participants. Participation includes verbal communication and gestures that communicate identification, understanding, and openness to new ideas or information. Participation in videoconferencing also includes the potential engagement of participants who interact with others before during and after the videoconferencing and engage in learning, empowerment, the formation of identity or self definition, as well as individual or group action leading to individual, group or community change.

Point-to-point videoconferencing – Videoconferencing from one site to another.

QoS – Quality of Service.

RVH – River Valley Health is a regional health board, an integrated network of hospitals, health centres and speciality care programs located in west-central New Brunswick.

Transcoding – A Process that allows videoconferencing that has different data rates to be linked.

Upload speed – The rate at which information is sent.

VAS- Voice Activated Switching – The view on screen during a multi-site videoconference where the site participants are shown according to who is speaking.

Video Codec – A type of software that enables video compression for transmission over ISDN and IP lines.

WAN – Wide area network - A communications network that uses telephone lines, radio waves or satellite devices to span a bigger area than LANs can cover.

Appendix: Guidelines for Participatory Multi-Site Videoconferencing

National Research Council Canada
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Canada

Appendix Introduction

The report appendix includes checklists of the guidelines for quick reference. Everyone is at a different stage of understanding multi-site videoconferencing - from first-time users to people having used it multiple times a day for years. For novice users, the important thing is to just start using it - it does not have to be a complicated process. The authors encourage readers to try out these guidelines when they are ready and to modify them to suit their own specific circumstances and their particular needs. Ideally this report will encourage the development of a large community of users aiming for good practices for participatory multi-site videoconferencing. A community using good practices will benefit all of us.

Our goal in creating this appendix was to develop effective, empowering and contextually sensitive charts and checklists to help encourage participation in multi-site videoconferencing for organizers, presenters and participants. Multi-site videoconferencing does not necessarily require high levels of participation. However, after an extensive literature review, we have come to the conclusion that a higher level of participation leads to a better retention of material as well as higher levels of participant satisfaction.

We use the term "good practices" in recognition that "best practices" depend on the specific context of the multi-site videoconference and the technology used, the individual circumstances surrounding the task at hand, the content of the videoconference, and the group and organizational dynamic. Every group is different; likewise every multi-site videoconference is different and may require various levels of planning and execution. The charts and checklists proposed in this appendix are voluntary and flexible recommendations. Readers can adopt the recommendations they feel are most appropriate to their own multi-site videoconferencing situations at a rate they are comfortable with. We encourage readers to print their own copies of the appendix and to modify the guidelines according to their own needs. If further publications are made from material in this report or appendix, the report should be referenced. The suggested reference for this report: Molyneaux, H., O'Donnell, S., Liu, S., Hagerman, V., Gibson, K., Matthews, B. et al. (2007). *Good Practice Guidelines for Participatory Multi-Site Videoconferencing*. Fredericton: National Research Council. ERB-1151. NRC 49869.

This appendix contains six charts and a questionnaire:

1. Types of multi-site videoconferencing
2. Guidelines for setting up the room
3. Guidelines for organizers
4. Guidelines for presenters
5. Guidelines for participants
6. Types and attributes of videoconferencing systems
7. Questionnaire measuring participation in multi-site videoconferencing

1: Types of multi-site videoconferences

VC type	Characteristics	Technology	Organization	Behaviours	Potential outcomes
Conference with many participants, many sites (one-time or annual meeting)	Often an academic conference, medical conference or for educational purposes. Formal atmosphere.	- Record and post conference abstracts prior to the conference (BV Cam) - Mute inactive sites (voice activated) -Record the videoconference (for those unable to attend or wanting to review) -Display locations on the screen at each location	- Content and technology needs to be planned in advance. - Set up and dial into all sites in advance - Conference leaders need to keep participants on task and on time	- Need to include people at the remote sites the conference leaders need to ask directed questions	- The formality may inhibit interaction, but a high level of planning is needed
Small group meetings (regular meetings)	For business, administration, education and medical consults. Three or more sites, with 1-5 people at each site. In regular multi-site small groups meetings can allow for more informal discussion.	- Contact, via e-mail, between members before meetings (circulate information) and after meetings in order to provide feedback - Shared white board for brainstorming activities	-Meetings can be arranged and organized quickly. Recommendations prior to videoconference: – Schedule 15 minutes prior to the conference in order to dial into the bridge before starting to ensure that all equipment is operational.	- More casual atmosphere and behaviours	- Closely resembles in-person interactions
Large group meetings (regular meetings)	For business, administration, education and grand rounds (medical). Three or more sites with more than 5 people at one or more site(s)	- Contact via e-mail before meeting to circulate relevant information, e-mail afterwards to provide feedback - Record meetings (for those unable to attend or wanting to review) - Mute inactive sites (voice activated)	- Need for rotating leadership and multiple leadership Recommendations prior to videoconference: -Schedule 15 minutes prior to the conference in order to dial into the bridge before starting to ensure that all equipment is operational.	- Need to include people at the remote sites the leader needs to ask directed questions	- Higher level of formality needed than small group meetings.
Small and large group one-time meetings	Same as regular meetings	-Same as regular meetings - Need to give participants the means to give feedback and discuss with others after the meeting in order to encourage higher levels of participation	-Same as regular meetings - Need to give participants the means to give feedback and discuss with others after the meeting in order to encourage higher levels of participation	-It may be more difficult to get members to participate in these one-time only groups	-One-time only groups may exhibit lower levels of participation

2: Guidelines for setting up the room

Check	**Lighting:**
	Cover windows, block natural light
	Room lights should be positioned on the wall (not ceiling)
	Cool or blue light
	Ideally positioned at a 45 degree angle
	Multiple and evenly distributed light sources
	Area of shadow for the monitor for easy viewing
	Wall colours:
	Avoid colours that are too light – bright white
	Avoid overly saturated colours – sunshine yellow
	Avoid dark colours – black
	Ideal colours are muted earth tones, pastels, sky or robin's egg blue
	Furniture:
	Try to avoid chairs that swivel, rock or are on casters
	Space chairs, and participants, at a comfortable distance from one another
	A U shaped table works best for medium sized groups
	Avoid tables that are brightly coloured or shiny
	Equipment:
	Make sure that the camera is located on top of the monitor displaying the other sites
	Place one microphone in the middle of the table in front of every three or four participants
	Ideally each site should have a visible clock so participants will stick to the agenda
	Each site should have a telephone installed in case of technical difficulties

Includes material adapted from Diamond, 1996; Trawner & Yafchak, 2007; "Lighting" Part I & II, 1998; Ho et al., 2005

3: Guidelines for organizers

Check	**Well in advance:**
	Define the purpose or goal of the session
	Define the audience and the needs of the audience; for example, is an interpreter needed?
	Reserve the videoconference room
	Book the MCU bridge
	Advertise the event and invite the sites
	Identify site coordinators
	Check the technical requirements at all sites
	Determine the number of participants and the length of the session
	Create an agenda and circulate relevant materials
	Several days prior:
	Decide the layout of the room
	Set up the equipment – for more information on the remote settings and camera presets see: http://www.tandberg.com/collateral/product_brochures/MXP_Training_QuikSheet.pdf http://www.edison.cc.oh.us/its/polycommanual.pdf
	Rehearse presentations and technology
	Get the phone numbers of participating sites in case of equipment failure
	E-mail a list of participating sites to the presenters
	15-30 minutes before:
	Center microphones and make sure the camera is directly above the screen displaying the other sites
	Connect with the sites prior to the session
	Put the name of the site on-screen
	Mute the microphone until the start of the conference

3: Guidelines for organizers (continued)

	During the session:
	Introduce yourself, the presenters, the participating sites, and site coordinators
	Remind participants to mute the microphone when they are not speaking
	Focus the camera view on the person speaking at the site
	Mute the microphone when no one is speaking at the site
	Keep to the timetable
	Avoid technical language
	Augment the discussion and include remote sites in the discussion
	Directly afterward:
	Ask for verbal comments and feedback
	Have participants fill out anonymous questionnaires (if applicable)
	Provide a website bulletin board or e-mail address where participants can send feedback
	Provide the results of any surveys, or comments, to participants

Includes material adapted from RVH, 2003; Hjelm et al., 1998; Klutke et al., 1999; Sharer, 2004; ONT, 2006; Barlow et al., 2002; Keewaytinook Okimakanak, 2007a; Keewaytinook Okimakanak, 2007b

4: Guidelines for presenters

Designing PowerPoint presentations

Check	
	Create a horizontal layout using a landscape format
	Be concise and keep it simple
	Do not use more than 5 points of information on each slide
	Use simple transitions, avoid special effects and animation
	Avoid rich colours like deep red, violet or blue for fonts and lines, and watch the colour contrast
	Chose only one font
	Use font size 30 pts. or larger
	Make sure your line size is 3pt. or wider
	Avoid fill patterns and colours – they can be blurry and distracting
	Use interesting visual stimuli
	Include multiple discussion points
	Include citations for reference material
	Use your PowerPoint presentation as a handout for participants
	Forward your handout to the organizer via e-mail for distribution to participants prior to the videoconference

Includes material adapted from Rees & Haythornthwaite, 2004; Peterson, 2004; Klutke et al., 1999; Sharer, 2004; ONT, 2006; RVH, 2003; Keewaytinook Okimakanak, 2007a; Keewaytinook Okimakanak, 2007b

4: Guidelines for presenters (continued)

Check	**Well in advance:**
	Make sure the multi-unit bridge and networks can support any tools you are going to use for the presentation – check with your bridge operator
	Determine the knowledge level of participants
	Make the topic relevant to the lives and work of the participants
	Include visual aids or hands-on activities to keep the attention of participants
	Several days prior:
	Prepare and send background documents to participants
	Ensure that documents sent out to participants are self-explanatory, and limit time spent on these documents during the meeting – they should be discussion starters and not the main focus
	Organize and practice the presentation – stick to the time allotted on the agenda so that time is available afterward for audience participation
	Familiarize yourself with the equipment
	15-30 minutes before:
	Arrive early to organize equipment and review presentation
	During the session:
	Speak clearly and at a normal level
	Look into the camera when speaking
	Introduce yourself and your work
	Avoid the use of technical language if possible (depends on the audience)
	Remember to switch the camera back after showing visuals
	Stop to review
	Involve the audience frequently
	Do not speak for more than 10-15 minutes without interacting with participants
	Encourage questions and ask direct questions to all sites
	Pause and wait for comments from other sites
	Directly afterward:
	Thank host site and audience
	Provide the means for the participants to contact you and provide feedback

Includes material adapted from Rees & Haythornthwaite, 2004; Peterson, 2004; Klutke et al., 1999; Sharer, 2004; ONT, 2006; RVH, 2003; Keewaytinook Okimakanak, 2007a; Keewaytinook Okimakanak, 2007b

5: Guidelines for participants

Dressing for videoconferences

Check	Avoid saturated colours, yellow and white, and colours that contrast with skin tones
	Avoid patterns and fabric that are shiny or sparkle
	Ideal colours are based on skin and hair colour, but generally shades of beige, gray and blue transmit well over video
	Avoid accessories that reflect light and make noise
	Avoid dark or brightly coloured makeup

Meeting protocol

Check	**In advance:**
	Familiarize yourself with the equipment before the meeting
	Decide how you are going to dress
	During the session:
	Eye contact is important – be sure to look at the camera
	Keep your face in the upper 3rd of the screen when the camera is zoomed in
	Mute your microphone when you are not speaking to the group
	Limit side conversations while your microphone is turned on
	Pay close attention to your own body language – limit your body movement; for example, if your chair has casters, do not swivel
	Avoid gesturing with your hands while speaking
	When your microphone is on, make sure you and others at your location are not making any noises - such as shuffling papers, clicking pens, etc.
	If you have to move equipment such as microphones and computers, lift them off the table, do not drag them across which creates an annoying noise for remote participants
	Indicate you wish to speak both verbally and visually - wave your hand and say "I have a question/comment"
	Introduce yourself and state your location when speaking
	Do not limit your questions and comments to the host site
	Limit your speaking time – be concise
	After the session:
	Submit comments via e-mail or written survey shortly after the videoconference

Includes material adapted from Trawner & Yafchak, 2007; Klutke et al., 1999; Sharer, 2004; Diamond, 1996; Keewaytinook Okimakanak, 2007b

6: Types and attributes of videoconference systems

	Company Name/ Software	Hardware	System attributes	System requirements	Setup	Cost
Group videoconferencing: set-top videoconferencing						
1	Polycom	-VSX 5000 unit -Two monitors	-Used for small meeting, small to medium sized videoconference rooms - Good for group use -Unit to be mounted on a television monitor -Can add DVD, VCR. Recording devices and document camera -Firewall solutions available	-Data rates of 64-768 kbps -IP or ISDN compatible -128 kbps ISDN -768 kbps IP	-More difficult to set up -Online user guide	-Mid-range pricing -price on request
2	Tandberg	-Tandberg set-top 900 MXP -Two monitors -Tandberg management suit 9 or newer	-Used for small meetings, small to medium sized videoconference rooms -good for group use -embedded multi-site functionality allows the unit to join 4 video, 3 audio sites -remote, camera, microphone and cables included -Firewall solutions available	-512 kbps ISDN/ External network - 2 Mbps IP	-More difficult to set up -Online user guide	-Mid-range pricing -price on request

6: Types and attributes of videoconference systems (continued)

Group videoconferencing: integrated videoconferencing						
3	Polycom	- VSX 8000	-For large meetings, in boardrooms -monitors included -separate monitor of self view and off-site view -Good for large group videoconferencing -voice activated camera -Can add DVD, VCR. Recording devices and document camera -Firewall solutions available	-24-48 kbps bandwidth -Data rates of 256 kbps to 15 mbps -IP or ISDN compatible -2Mbps IP -512 K ISDN	-More difficult to set up -Online user guide	-Higher end pricing -price on request
4	Tandberg	- Tandberg Profile 8000 -Tandberg management suit 9 or newer	- Boardroom application -Dual 50" plasma screens with monitors, camera, remote, microphone and cabling (optional satellite stereo speakers) -embedded multi-site functionality allows the unit to join 6 video, 5 audio sites -Firewall solutions available	-2 Mbps ISDN/4 Mbps IP (6 Mbps in multi-site) -H.320 up to 2 Mbps -H.323 up to 4 Mbps point-to-point -SIP up to 4 Mbps -Up to 6 Mbps total multi-site bandwidth	-More difficult to set up -Online user guide	-Higher end pricing -price on request
5	HP Halo Collaboration Studio HP Halo Collaboration Meeting Room	-All inclusive system (hardware and software)	-For small group meetings (6 or less) -Multi-point capacity with up to 4 studios -50 inch collaboration screen -Access to audio conference bridge interpreters -Constant availability and connection - Share documents and data from notebook PCs -High magnification, high zoom camera -In-room phone -Availability of fiber optic circuits presents limitations of service	-HVEN – Halo Video Exchange Network -High bandwidth -dedicated fiber-optic network -AES 256 encryption -Dedicated high-definition collaboration channel (for multi-media materials) -Proprietary Graphic User Interface (GUI)	- Company installation -Halo "concierge" always on-call to answer questions -Diagnosis and calibrations remotely handled	HP Halo Collaboration Meeting rooms start at $249,000, Collaboration studios start at $349,000; $18,000 monthly network and service fee per room

6: Types and attributes of videoconference systems (continued)

Personal videoconferencing: desktop videoconferencing						
6	Skype	-Computer -Skype-supported webcam -Microphone -Speakers	-Meant for one-on-one videoconferencing -One or two people at a site communicating with one or two people at another site -Software itself does not allow for multi-point -Free downloadable software -Free video calls -Image displayed as picture-in-picture -runs on network behind a firewall, no special firewall rules/exceptions are necessary	**P.C.** -Windows 2000, XP -Broadband recommended -1 GHz processor, 256 MB Ram -recommended 800 MHz processor 256 RAM and 50 Mb free disk space on hard drive **MAC** -G4 800 MHz processor, Mac OSX v.10.3.9 Panther and 512 MBRAM -Broadband recommended -400 MB free disk space on hard drive -download drivers for webcam	Easy, self-setup	Free software
7	Windows Live Messenger Other similar types include: Windows Messenger 5.1; MSN Messenger 7.0; AIM; Yahoo Instant Messenger	-Computer -Webcam -Microphone -Speakers	-Meant for one-on-one videoconferencing -One or two people at a site communicating with one or two people at another site -Software itself does not allow for multi-point -Free downloadable software -Free video calls -On-site and away images featured separately on the right hand third of the screen -Works behind most firewalls and routers	**P.C.** - Multimedia PC Pentium 233 MHz processor (500 MHz recommended) -Microsoft Windows XP - Minimum 128 MB of RAM (256 MB recommended) -Up to 50 MB of hard disk space for installation, 15 MB to run the program -Microsoft Internet Explorer Version 6 SPI and Internet (dial-up or broadband)	Easy, self-setup	Free software

6: Types and attributes of videoconference systems (continued)

8	iChat	-MAC computer -Webcam (if not already built-in) -Microphone -Speakers	-Can videoconference with up to three other sites (note – additional sites need additional system requirements) -Three dimensional viewing -Full screen view - High quality video -Scales to available bandwidth and hardware for improved overall performance -Mac OS X includes a personal firewall, iChat works with most household routers, although certain ports need to be open and the firewall may need to be reconfigured	**MAC** **One-to-one video** ***Requirements to initiate (host)*** -600 MHz G3, any G4, G5 or Intel core -100 kbps internet up/down ***Requirements to participate*** -600 MHz G3, any G5, any Intel core -100 kbps internet connection **Four person video** ***Requirements to initiate (host)*** - Dual 1 GHz G4, and G5 or Intel core - 384 kbps internet ***Requirements to participate*** -1 GHz G4, duel 800 MHz G4, and G5 or any Intel core -100 kbps internet connection	Easy, self-setup	Free software
9	Polycom PVX Software Other similar types include: Isabel, Adobe Acrobat Connect; SameTime, WebEx, Raindance; Xmeeting	-Computer -Microphone -Speakers	-Used for small sized rooms, offices -Does not need a software specific webcam -Company boasts DVD quality resolution -Supports calls behind office network firewalls	-Windows 2000 with service pack 4+ -Windows XP with service pack 1+ -USB 1x or 2x webcam -1.2 GHz Intel Pentium 4 compatible with SSE -256 MB RAM -16 MB video memory card -62 MB hard drive space -Requires broadband IP -Internet Explorer version 6.0+ -Windows Media Player 9.0+ -Microsoft DirectX 9.0b+	-Online user guide	-Free trial -Costs $149.00 per user
10	Cisco Unified Video Advantage	-Cisco webcam -Cisco IP phone -Computer -Microphone -Speakers	-Used for small sized rooms, offices -For small and medium sized organizations -Firewall ports may need to be reconfigured	-Windows 2000 professional with service pack 4.0+ -Windows XP professional with service pack 2.0+ -1.0 GHz or higher Pentium III or compatible processor -256 MB minimum system memory (512MB recommended) -100 MB free disk space -1free USB port (1.1 or 2.0 compatible) -Minimum DirectX 9.0 graphics card -64 MB video RAM -10/100 Mbit Ethernet NIC Network	-Usually set up by a technician or the system administrator -Online user guide	-price on request

6: Types and attributes of videoconference systems (continued)

11	ePresence	-1 media station -video camera -1 host server -Turnkey hardware and software can be purchased (server stations, accessories)	-ePresence Media Station is used to edit files and publish ePresence archives -ePresence Server provides the Web interface, and send the streaming media -Webcasting and webconferencing system -Supports full duplex, multi-point audio and videoconferencing, and desktop sharing -Supports Windows Media, Real Media and Quicktime -Number of concurrent viewers depends on the network capacity -Firewall ports may need to be reconfigured	**ePresence Media Station** - Windows XP, Microsoft.NET Framework 2.0, Quicktime 7+, Windows Media Encoder 9, Windows Media Player 10+, Real Player 10 +, MS Power Point XP or 2003, ePresence Producer 4,0 -Pentium D-2.6 + (Dual Core or Dual CPU recommended), 1+ GB MB RAM, 200+GB HDD -Fast internet connection (2+ Mbit/c) -Windows XP **ePresence Server** -Windows 2003 Server or Linux, Web server, Helix Server or Helix DNA Server, Windows Media Services, Darwin Streaming Server, ePresence Server 4.0 --Pentium 4 3 Ghz or faster, 1 + GB MB RAM, 200+ GB HDD -Fast internet access (5+ Mbit/c) -Windows 2003 Server or Linux	-software downloads available online -membership packages include technical support	-Free software available online -packages run from $499 - $4399 per year

Includes material adapted from www.skype.com; www.get.live.com/messenger/overview; www.apple.com/macosx/features/ichat; www.polycom/usa/en/products/video; http://www.tandberg.com/products/video_systems/index.jsp; http://www.cisco.com/en/US/products/sw/voicesw/ps5662/prod_release_note09186a00806cbe7d.html http://www.cisco.com/application/pdf/en/us/guest/products/ps5662/c1616/ccmigration_09186a008032b23e.pdf; www.epresence.tv/products/faq ; http://www.polycom.com/common/documents/support/setup_maintenance/products/video/pvx_setup.pdf ; www.code.epresence.tv/wiki/MediaInstallationGuide http://www.cisco.com/application/pdf/en/us/guest/products/ps556/c1031/cdccont_0900aecd804ea2c7.pdf; www.hp.com/halo/pdf/Halo_fact_sheet.pdf

7: Questionnaire measuring participation in multi-site videoconferences

1. Would you have been able to attend the event if you did not have access to the multi-site videoconference system?
__Yes
__Neutral/Not sure
__No

2. Has the multi-site videoconference system allowed you to become more involved in meetings/professional development/educational sessions?
__Yes
__Neutral/Not sure
__No

3. When you were talking to another member at a different site did you feel like they were actually in the room with you?
__Yes, very much
__Yes, somewhat
__Neutral/Not sure
__No, not much
__No, not at all

4. What could have helped you feel their presence more?

____

5. Did you feel comfortable sharing ideas and suggestions about the work you were discussing with people at the videoconference?
__Yes, very much
__Yes, somewhat
__No, not so much
__No, not at all
__I did not share any ideas or suggestions
__I did not share any ideas or suggestions, but I would have felt comfortable doing so

6. During the videoconference session did you: (please check all that apply)

__Talk to people at your site
__Talk to people at other sites
__Talk about the meeting to committee members after the meeting
__Take notes
__Present material
__Actively listen

7. What would have helped you participate more?

____

8. In your opinion, did local and remote sites actively communicate with each other in the videoconference session?

__Yes, very much
__Yes, Somewhat
__Neutral/Not sure
__No, not much
__No, not at all

9. What would have helped the sites communicate better?

____

10. Please rate the quality of the videoconference session on a scale of 1-5 with 1 being poor and 5 being excellent.

	Poor/	Fair/	Good/	Very good/	Excellent
Performance of equipment	1.	2.	3.	4.	5.
Organization of the session	1.	2.	3.	4.	5.
Opportunity to contribute	1.	2.	3.	4.	5.
Overall experience	1.	2.	3.	4.	5.

11. Please provide any other comments on your videoconferencing experience, and on anything that you think hindered or helped it.

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Thank you very much for your feedback! (Includes material adapted from Gibson et al., 2007; RVH, 2006; RVH 2003)