The Cisco TelePresence System for Interactive Video Conferencing in Education

Angela Renee Smith-Faulkner

University of North Texas

Abstract

Many school districts are investing in expensive video conferencing systems so teachers and students can connect with other students around the world, collaborate with experts in their fields, experience virtual field trips, and attend professional development opportunities at a distance. Internet protocol or Internet-based video conferencing equipment such as the Cisco TelePresence System utilizes new technologies that deliver voice and video streams that affords the user the look and feel of real-time communication without latency problems. This paper will explain features of the video conferencing system, content sharing abilities, bandwidth requirements, transmission of video, video compression, video and audio standards, encryption and security, costs, and ongoing maintenance and sustainability. In conclusion, several key communication and learning methodologies gained by the use of a high quality video and audio conferencing system including, synchronous interaction without delay, reliable student face-to-face communications, and the ability to engage in personalized learning will be examined along with how these features improve student learning experiences.

Keywords: video conferencing, telecommunications, distance learning

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Teaching at a distance has progressed from asynchronous communications with the instructor such as mail, telephone, and one-way broadcast streams into a more secure and synchronous method that employs two-way interactive audio and video experiences. The Cisco TelePresence System for interactive video conferencing utilizes new technologies that deliver voice and video streams that affords the user the experience of real-time communication. The Cisco TelePresence System includes two sixty-five inch 1080p widescreen high definition LCD monitors which gives participants the capability to view and interact with other participants while also providing the ability to share and view files such as PowerPoint presentations, websites, spreadsheets, and multimedia resources simultaneously. The system is equipped with a PrecisionHD camera which provides a more realistic face-to-face conferencing experience and a Cisco Codec C90 which improves the visual quality of the video streams. The system is comprised of thirteen various video inputs and can receive five video inputs simultaneously to increase collaboration opportunities. The touchscreen interface is used to establish a connection for point-to-point or multisite video conferencing. And finally, the video conferencing system is designed to accommodate spacious conference rooms housing a large crowd of participants.

Transmission of Audio and Video

Bandwidth

The Cisco TelePresence System sends and receives live audio and video transmissions over an Internet connection; thus, the system is referred to as an Internet-based video conferencing solution. The system’s ability to send and receive video and voice via the Internet versus a telephone line is one of the key components to the improvements in the capabilities of video conferencing (Smyth & Zanetis, 2007). Sending information over the Internet increases the transmission speeds, therefore increasing the quality of two-way audio and video broadcasts. The Cisco TelePresence System has a default configuration to dial in to the Internet at 768kps. The default is set based on sending video and audio over a T-1 fiber optic line. Early video conferencing systems that utilized three telephone lines transmitted video at less than half of this speed (Smyth & Zanetis, 2007). However, the Cisco TelePresence System has the ability to stream video in a point-to-point configuration using up to a total of 6 Mbps or the ability to stream a total of 10 Mbps of bandwidth during a multisite connection ("Cisco TelePresence Codec," n.d.). The default configuration can be adjusted on the fly in the call control settings in order to achieve these higher bandwidth speeds; however, the user should consider other limiting factors that might be present in the architecture of each end point user's infrastructure.

Connection Protocols

Unified Communications emphasizes that all conference participants must be able to start and join a conference call that uses an identical connection protocol. The Cisco TelePresence has the ability to utilize the H.323 and Session Initiation Protocol (SIP) which are both considered an enterprise standard (TechTarget, n.d.). The International Telecommunication Union Telecommunication Standardization Sector (ITU-T) Recommendation for call signaling and bandwidth control when establishing a conference call session over an Internet Protocol (IP) network is the H.323 standard. In addition, the SIP standard has been developed and standardized by the Internet Engineering Task Force (IETF) and has been suggested as the new protocol that will eventually replace the H.323 standard (Galveta, 2013). Arguments on the advantages and disadvantages exist for each protocol; as a result, the Cisco TelePresence System has made concessions for the H.323 and the SIP standard to coexist, so video conferencing systems are compatible for end users utilizing either connection signaling and bandwidth control protocols.

Compression

Since video and audio broadcasts are very large when they are streamed in raw form, compressing the video while maintaining the quality of the video is a function of the Cisco TelePresence Codec C90. Codec is an abbreviation for compression/decompression and is the equipment or software responsible for compressing video so video can be delivered at a lower bandwidth while maintaining a high quality (Ackerman, Liu, Locatis, & Zhang, 2011). The Cisco TelePresence utilizes the C90 equipment codec which is considered a more effective method of compressing video than using a software codec. The Codec C90 has the ability to deliver up to 1080p60 end-to-end full high definition (HD) video. The 1080 denotes that the video resolution is delivered in the HD format standard. The sixty signifies how many frames are viewed each second. For example, video is captured by creating individual images which are known as frames. When each frame or image is displayed at a rate of thirty images a second, then the images emerge as full motion video. The C90 captures and produces sixty frames per second which provides a smoother and higher quality video experience (Ackerman, Liu, Locatis, & Zhang, 2011).

Video Compression Standards

The Video Coding Experts Group (VCEG) and the International Standards Organization Motion Picture Experts Group (MPEG) united together as the Joint Video Team (JVT) to create the H.264/MPEG-4 video compression standard which is currently the most widely utilized video standard for efficiently compressing video for transmission (Smyth & Zanetis, 2007). The standard is simply referred to as H.264 and provides parameters for programs such as video conferencing over wireless and wired networks and broadcasting and streaming video. H.264 consists of complex algorithms that are applied to raw video to compress it into a format which can be transported over the Internet in an efficient manner (Rajesh, 2011). Once the compressed video stream is transmitted to the endpoint, the video is then decompressed using reverse algorithms. The function of the algorithms is to identify redundant video and eliminate it from the next images until it is modified from its original frame. H.264 is a more robust compression engine than its early compression standard predecessors, H.261, H.262, H.263, and H.263+. While the H.264 standard of video compression operates similar to the older standards, it adds more detail to each operational component to improve the compression process (Kwon, Tamhankar, & Rao, 2006). Although this adds to the complexity of the implementation of the H.264 compression standard, methods to reduce the implementation complexity were introduced in this standard to ensure compression efficiency and to keep cost of deployment reasonable. The Cisco TelePresence Codec C90 is compliant with the H.264 video compression standard along with H.262, H.263, H.263+ previous standards. The codec delivers state-of -the-art visual quality by utilizing the H.264 standard for video compression; yet, it also ensures compatibility for users with equipment that employs the previous compression standards.

Audio Standards

The Codec C90 can operate using the G.711, G.722, G.722.1, and 64 and 128 kbps MPEG4 AAC-LD, and AAC-LD Stereo audio standards (“Cisco TelePresence Codec,” n.d.). These standards include audio compression algorithms made for the many high demand multimedia components found in music and speech audio transmissions over the Internet. The G.722 codec algorithms compress the audio in a non-complex manner in order to lower the bit rate and help deliver high audio quality and clarity without latency issues. However, the Codec C90 is compatible with earlier audio compression standards, so users with older equipment can communicate using the earlier audio compression standards.

Encryption and Security

In order to provide a secure video conferencing stream, The Cisco TelePresence System is comprised of an authentication and encryption system that uses the Transport Layer Security (TLS) for call signal authentication between each endpoint ("Cisco TelePresence Codec," n.d.). In addition, administrator passwords are required on the web-based configuration and call menu. Default administrative passwords provide security threats to the system; therefore, changing the default passwords to a strong password is recommended. In addition, extra network security measures are suggested such as creating a virtual local area network (VLAN) on the internal network dedicated to transmitting only audio and video traffic (Stutz & Uhl, 2012). Also, quality of service (QoS) settings can be applied to the VLAN to guarantee quality streams are delivered to the Internet. These precautions can prevent network intrusion from potential hackers.

Cost and Ongoing Maintenance and Sustainability

Educational pricing for the Cisco TelePresence System is in the ballpark of one hundred thousand dollars. Many schools have tapped into federal funding opportunities offered through the Universal Service Administrative Company for schools and libraries, otherwise known as E-rate, to help make this technology affordable. Once the technology is implemented, schools should take into consideration that staff with the technical expertise to upgrade firmware and run security updates will need to be employed in order to sustain the ongoing daily operations of the equipment. In addition, annual maintenance contracts can be purchased to ensure timely repairs and services on faulty equipment.

Conclusion and Use of Video Conferencing for Education

In conclusion, student learning can be enhanced through the utilization of a high quality video and audio conferencing system like the Cisco TelePresence System that affords the user synchronous interaction without delay, reliable face-to-face communications, and the ability to engage in personalized learning. With the improvements in the delivery of real-time audio and video, students can engage in learning at a distance without the previous distractions of latency issues and poor visual quality. Students can visit a hospital, view a live surgery, and hold a conversation with a doctor while he or she performs surgical procedures. They can visit the National Holocaust Museum and interact with a Holocaust survivor to personally hear about the atrocities committed during World War II. Teachers can collaborate with other experts to learn new teaching strategies eliminating travel expenses and time away from family members. And finally, with the multisite function, students can connect with a teacher outside of the walls of their classrooms with the intent to earn high school credit. Video conferencing equipment that utilizes new technologies to deliver voice and video streams that affords the user the look and feel of real-time communication can provide engaging learning experiences in education.

References

Ackerman, M., Liu, W.-L., Locatis, C., & Zhang, K. (2011). Internet-based videoconferencing coder/decoders and tools for telemedicine. *Telemedicine and e-Health*, *17*(5), 358+. Retrieved from http://go.galegroup.com/ps/i.do?id=GALE%7CA259590053&v=2.1&u=txshracd2679&it=r&p=HRCA&sw=w&asid=2814929a09a1b99a946807afec779b4a

Cisco TelePresence Codec C90. (n.d.). Data sheets and literature. Retrieved from http://www.cisco.com/c/en/us/products/collaboration-endpoints/telepresence-codec-c90/index.html

Galveta, A. (2013, December 20). Why SIP is better than H.323. [Web log comment]. Retrieved from http://blog.trueconf.com/reviews/why-sip-better-than-h323.html

Kwon, S. K., Tamhankar, A., & Rao, K. R. (2006). Overview of H. 264/MPEG-4 part 10. *Journal of Visual Communication and Image Representation*, *17*(2), 186-216.

Rajesh, K. (2011, January 6). Why H.264 AVC (MPEG-4 Part 10) video codec is critical for video transmission. Retrieved from http://www.excitingip.com/1041/h-264-mpeg-4-part-10-avc-video-codec-compression/

Smyth, R. (2005). Broadband videoconferencing as a tool for learner-centered distance learning in higher education. *British Journal of Educational Technology*, *36*(5), 805-820.

Smyth, R., & Zanetis, J. (2007). Internet-based videoconferencing for teaching and learning: A cinderella story. *Distance Learning*, *4*(2), 61-70. Retrieved from http://search.proquest.com/docview/230716420?accountid=7113

Stutz, T., & Uhl, A. (2012). A survey of h. 264 avc/svc encryption. *Circuits and Systems for Video Technology, IEEE Transactions on*, *22*(3), 325-339.

TechTarget. (n.d.). Conferencing and Telepresence. Retrieved from http://searchunifiedcommunications.techtarget.com/Video-conferencing-codec-primer