
HOW TO DEVELOP A LOW COST, IN-HOUSE DISTANCE LEARNING CENTER FOR CONTINUING MEDICAL EDUCATION

Part II

Vincenzo Lanza, MD

Lanza V. How to develop a low cost, in-house distance learning center for continuing medical education. Part II.

J Clin Monit 2002; 17: 421–426

ABSTRACT. The first part of this paper discussed the advantages and communication tools needed to create a Distance Learning Center for continuing medical education by using an Intranet or the Internet. This part continues with an explanation of the hardware, software (largely free) and human resources needed for videoconferencing as well as the costs. Suitable even for small hospitals Distance Learning Centers can be of higher quality than traditional methods of continuing medical education.

KEY WORDS. Continuing medical education, CME, videoconferencing, distance learning, intranet, internet, local area network.

VIDEOCONFERENCING SERVERS

Interactivity between all users is not always necessary because the primary function of a distance learning center (DLC) is communication between one presenter and the other participants. This is especially true for medical videoconferences where the interactivity is in the form of participant questions answered by the presenter at the end of the presentation. However, in a live videoconference it is important to allow as many participants as possible to avoid the need to repeat the presentation several times. It is possible to use the same networking technology, where several computers are able to download data from a single server, to build a videoconferencing system. This concept is illustrated in Figure 1.

The speaker uses a videocamera connected to a computer, in which an audio card has also been installed. A program is launched to capture the video images and

From the Department of Anesthesia, Ospedale Buccheri La Ferla Fatebenefratelli, Palermo, Italy.

Received July 23, 2003. Accepted for publication July 23, 2003.

Address correspondence to V. Lanza, Chief of Anesthesia Department, Ospedale Buccheri La Ferla Fatebenefratelli, Via M. Marine 197, 90123-Palermo, Italy.

E-mail: lanza@unipa.it

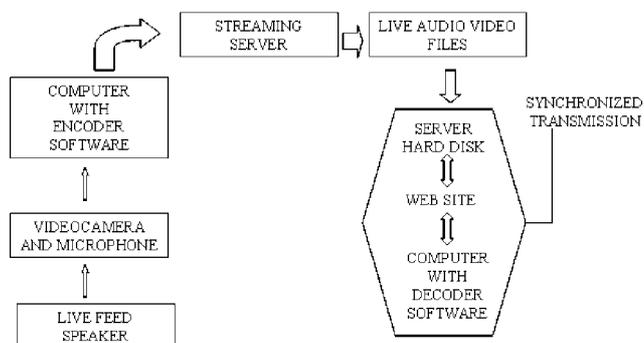


Fig. 1. Illustration of a simple videoconferencing system in a network.

the audio recorded via microphone, and compresses the data (encoding). The resulting file is transmitted to a web server computer in which a streaming program will store the files on its hard disk temporarily. This server allows participants on distant computers with a decoder program connected to the network to access the videoconference files at a synchronized speed for accurate motion. Some common programs available are Microsoft Windows Media Technologies and RealNetworks' tools. The latter offers a complete package of programs free on the Internet (for limited participants in a live broadcast) and is independent of the Operating System.

Microsoft Windows Media Technologies

The package of Windows media programs for videoconferencing (<http://www.microsoft.com/windows/windowsmedia/9series/server/helpdocs.aspx>) consists of 3 programs:

A) Windows Media Encoder

It is used to capture and compress audio and video input from the speaker. The compressed content is then sent to a server. The encoder is available in two versions: 9 for Windows 2000/XP and 7.1 for Windows 98. The earlier version is not suitable to capture digital video directly through a firewire port, but is capable of capturing video from many analog-digital cards. The resulting file is in mpeg format. The average size of a one-hour videoconference is approximately 120 Mbytes with highest quality Multiple bit rates video and Multiple bit rates audio (CBR) which means 282 Kbps bit rate, 30 frame rate and video size 320×240 . The encoder can produce output files (.wmv) of up to 30 GB. If the output exceeds 4 GB, you must use an NTFS-formatted hard disk partition.

B) Windows Media Server

Windows Media Server is included in the Windows 2000 server OS as well as in the Windows 2003 OS. A version for Windows NT 4.0 is downloadable from the Microsoft web site. This program functions in the background on the server computer receiving the files compressed by the Encoder and stores them in a Hard Disk directory you select. The participants connect to Windows Media Server and may access the videoconference file being stored on the server's selected directory and it is presented at the beginning regardless of other participants already viewing, and at the proper synchronized speed. The connection may be via an HTML link on the web page which the server has

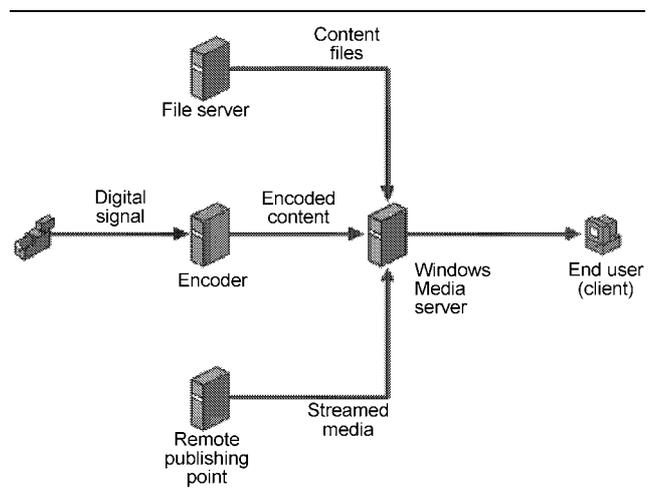


Fig. 2. Microsoft Windows Media Tools software.

created, or by using Windows Media Player with the path (server address and conference directory).

C) Windows Media Player

This program is included in Windows 98 and later versions of Windows. There are two ways to access a videoconference using Windows Media Player:

- Via Internet browser
 - You visit a web site, find the relative web page and by clicking on a link you open the videoconference streaming file which automatically launches Windows Media Player to view the video.
- By launching Windows Media Player
 - You insert the complete path of the videoconference in the file menu and the videoconference will appear in the program window without any need to launch the Internet Browser.

Windows Media Server allows you to save a live videoconference as an .AVI file while streaming to participants, and such files can be edited by most video editing programs. The disk space necessary is approximately 2 MB per minute of video with the following common characteristics:

- Window size: 240×180 pixels;
- Colors: 24 bit (16 million);
- Speed: 10 frames per second;
- Audio: 11Hz 8 bit mono.

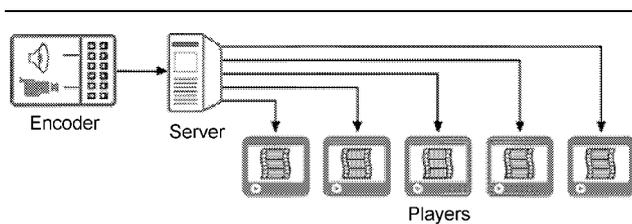


Fig. 3. RealNetworks Helix videoconferencing tools.

The encoder and the server may be used on the same computer, provided that it has at least a Pentium III 450 MHz with 256 MB of RAM.

RealNetworks tools

The software suite (<http://www.realnetworks.com/resources/documentation/index.html>) consists of different programs which function as illustrated in Figure 3.

A) Helix Producer

Helix Producer is the encoder to compress video and audio files. The program is compatible with many operating systems, analogical/digital cards and direct digital input also. The resulting files are in a Real Network proprietary format. There is a free downloadable version (Basic), and an affordable advanced version (Plus).

A1) PresenterOne

After the slideshow has been prepared (e.g. with PowerPoint) PresenterOne is used to synchronize the speaker's audio and video with the slides which are converted to JPEG images.

B) Helix Universal Server

The Helix Universal Server is compatible with most server operating systems (e.g. Windows NT 4.0, Windows 2000, Linux, etc.), and requires a minimum processor speed of 500 MHz (with Intel Pentium). The Helix server is available in a free Basic version and a Plus version. The Helix Basic is sufficient for videoconferencing but has a maximum of 1 megabit per second bandwidth. The software allows storage of the videoconference on hard disk for future viewing. To access the live videoconference you may enter the address directly in RealOne Player (described below), or the server may create an HTML page with a link to the live videoconference. The files thus created by the Helix server are in a proprietary format (.rm) which cannot be edited by common video editing programs. The

files have a size of 1.1 Mbytes/min when using the parameters previously cited in section 1.3.1 C.

C) RealOne Player

This program is used to view live and previously recorded videoconferences in .rm format on demand. The features are similar to Windows Media Player, but while you may use RealOne Player to view .avi files, you may not use Windows Media Player to view .rm files.

HOW TO USE A VIDEOCONFERENCING SERVER FOR CONTINUING MEDICAL EDUCATION

Such a system is currently in use at Buccheri La Ferla Fatebenefratelli Hospital (BLFH) in Palermo, Italy and will be described as a model.

The equipment

The hardware used to create an in-house videoconferencing center consists of several common and inexpensive devices.

The network

The local area network (LAN) in our ICU and anesthesia department adopted TCP/IP to become an Intranet. An Intranet web server was established using Windows 2000 Server on a computer in the network. Proxy server software (Microsoft) was also installed in the server computer to allow all computers on our LAN to connect to the Internet, and as security to prevent any intruders on our LAN from the Internet. The server computer is connected to a free Internet Service Provider (University of Palermo) via an ADSL router. The Internet connection is obviously necessary to allow participants outside the hospital to view your videoconference.

The speaker's tools

In the conference room a speaker gives his presentation using a unidirectional microphone (to avoid background noise) and a videocamera to record audio and video on a computer connected to the Intranet. A multimedia projector may also be used to project enlarged images of the computer video content.

- Using RealNetworks tools

Helix Producer software is used to present a speaker's audio and video, or video demonstrations.

To present a speaker and clear slide images at the same

time PresenterOne software is needed, as well as Helix Universal Basic Server installed on the same computer or another computer on the network.

- Using Windows tools
Windows Media Encoder 9 Series enables the speaker to broadcast audio and video or video demonstrations. If clear slides are desired alongside the speaker's video at the same time you need Microsoft PowerPoint 2002 also.

Tools needed by the remote participants

The remote participants need a computer connected to the Intranet, and at least a webcam connected to the USB port if a questioner's images are to be seen by the speaker and the other participants. In our hospital the speaker uses a Pentium IV 2.4 Gb computer with a 40 Gb hard disk and a firewire port. A digital videocamera is connected to the firewire port. An independent unidirectional microphone is connected to the computer for clear audio. The computer transmits the video images onto a large screen via a video projector for direct viewing by a live audience. The video images are also sent to the computer screen via the projector's output port for the speaker's own feedback. For internal videoconferences we use PowerPoint with either Windows Media Encoder 9 Series or Presenter One.

- Using Windows Media Encoder 9
The speaker prepares the slides by using Microsoft PowerPoint 2002, then Microsoft Producer, an add-on you can download free, is used to broadcast the slide images alongside the video of the speaker.

The encoded content may be streamed in two ways: "Push" the encoded content to a Windows Media Server, or "Pull" the encoded content from the encoder. To "Push" you obviously need Windows Media Server 9 (included in Windows 2003) but this allows you to divide the work between two computers and accommodate more participants. When you "Pull," your computer is both the producer and the streaming server of the presentation. The lack of a server limits you to ten participants at a time; however, if you have a powerful computer (Pentium IV 2GHz) you can increase the number of simultaneous users by editing a subkey in the Registry Editor. START, Run, type regedit and then follow this path: HKEY_CLASSES_ROOT\Software\Microsoft\Windows Media Tools\Encoder\MaxClientConnections, and change the default number from 5 up to 50. When using the Pull method the participants connect directly to the presenter's computer by typing the presenter's address in the Windows Media Player; open URL address bar (e.g. http://computer name:port number). The presenter sees his address when starting a new session.

- Using Real Presenter One
The slides are prepared with a graphics program like PowerPoint and streamed with the video using Helix Universal Basic Server. Participants connect to the Server by typing the address in Real Player One or by clicking an HTML link on a Web page. Although the Helix Universal Basic Server is free, quality is high only for audio and slide presentations due to the 1 megabit bandwidth, and the number of participants is limited.

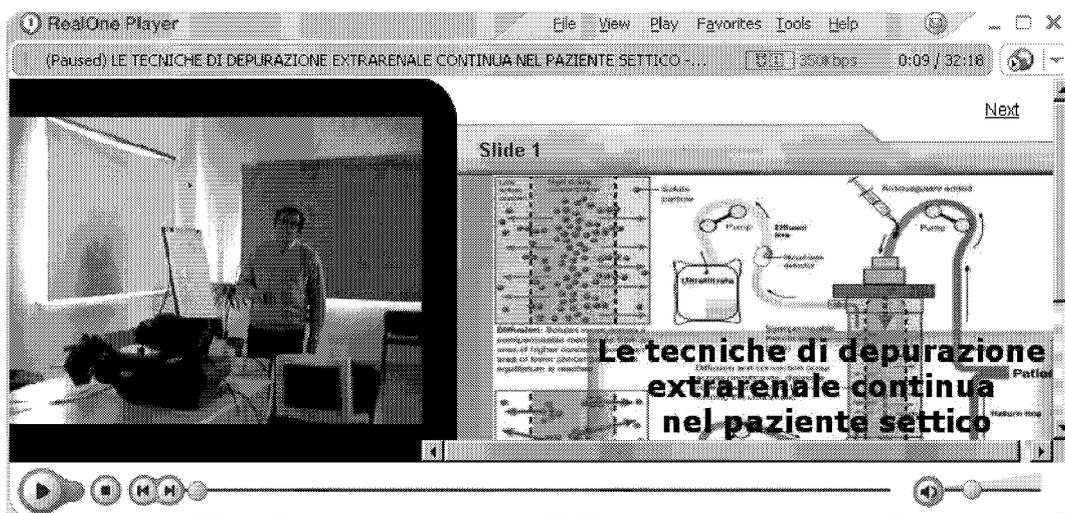


Fig. 4. Example of a videoconference image with the video of the speaker alongside a clear slide.

The videoconference in practice

In our hospital no special room is reserved for videoconferencing, and three remote workstations are used for viewing the presentation: ICU, the surgery recovery room and the obstetric recovery room. Normally a videoconference is offered once a month according to a six-month schedule. The videoconferences are divided in two parts: Presentation and Discussion.

Presentation

The anesthesia staff takes turns preparing a presentation after having been briefly trained in using videoconferencing tools. The following suggestions are useful for inexperienced presenters:

- Learn how to use a videoconferencing system (two hours);
- Speak slowly and loudly, pronouncing words carefully;
- Avoid unnecessary movements and gestures;
- Use slides or other attention-getting devices;
- Use simple and brief scientific language.

Discussion

At the end of the presentation the speaker closes the Encoder program and both the speaker and the remote participants open Netmeeting which allows them to ask questions.

System costs

- The speaker's workstation (computer, software, digital videocamera, microphone) is approximately 2500 euros.
- The video projector is approximately 1000 euros.
- Each remote workstation with a digital Web-cam costs about 1000 euros.

DLC DEVELOPMENT PLAN

Ideally, every DLC should aim for the most sophisticated level consistent with available resources as discussed in Part 1 of this paper [1], and summarized in Table 1.

Table 1. Levels of distance leaning centers form simple to advanced.

DLC 1	DLC 2	DLC 3	DLC 4	DLC 5
Interactive web	Simulation laboratory	1 plus 2 with CD/DVD distribution	Streaming residential courses	Streaming plus series programming

For example, an anesthesia department of a small hospital may find the second level adequate. The following are the resources needed for each level.

Developing level 1

This level requires one or more videoconferencing servers, an Intranet and a high bandwidth connection to the Internet.

Intranet and videoconferencing server

The advantage of videoconferencing servers connected to an Intranet is that each server may specialize in a specific training area. For example, one server may be occupied with infectious diseases, another with volatile anesthetics, another with intravenous anesthetics, etc. Each server on the Intranet may be assigned an easy-to-identify name to facilitate research, such as HTTP://infectiousdiseases which will connect you to the server that contains all the material stored on this subject. You may also use an Intranet Domain Name Server (DNS) with a numbered TCP/IP address.

Connection to the Internet

One server on the Intranet must be continuously connected to the Internet and host the DLC Internet web site. This site is necessary to offer an international contact point for publicity and feedback as well as to broadcast some conferences. To broadcast a videoconference to 35 participants you need a bandwidth of 1.5 Mbps assuming that each participant needs 28 Kbps (using Helix Basic Server) with some bandwidth left over for the general web site traffic.

Standardization of speaker presentations

Courses for the DLC should be prepared with popular programs which can produce Internet ready (HTML) documents, e.g. Powerpoint, Frontpage, etc.

Internet software

If you choose Realnetworks tools you need:

- ProducerOne to render the video content (\$200);
- PresenterOne to synchronize and broadcast the speaker's video and audio and the slides (\$400).

- Helix Universal Server to stream the presentation without interruptions (free up to 1 Mbps of bandwidth).

If you choose Windows Media tools you need:

- Windows Media Encoder to render the video content (free but requires Windows 2000 Professional OS);
- PowerPoint 2002 (included in Microsoft Office Suite) and Microsoft Producer for PowerPoint 2002 (free) to synchronize and broadcast the speaker's video and audio and the slides;
- Windows Media Server (optional) to optimize the broadcast (included in Windows 2003).

Human resources

Course preparation will require at least two persons: one with basic understanding of video camera operations and experience with Microsoft Office (or equivalent) who is available to videotape the presentations and assist the speakers with their slide images; another person competent to create web pages and administer a LAN. For secretarial tasks such as registration of participants, certification of online attendance etc. you may use another person part-time or existing staff. Since most administrative tasks may be performed online a full-time person is not necessary.

Developing level 2

This includes everything in level 1, plus simulators that allow participants to practice a single technique or a series of procedures to treat a condition such as cardiac arrest, etc. [2, 3]. For example, during anesthesia the effects of drugs on physiological parameters such as arterial pressure can be evaluated and doses modified to see the respective effects. On this level Macromedia Flash is useful but not indispensable.

Developing level 3

If you need to accommodate more participants but cannot easily increase your Internet presence, a staff person may learn to produce CDs or DVDs of the courses for distribution to offline participants who can still take exams online for course credits.

Developing level 4

Real time transmission of courses via Internet requires more experienced staff (including a professional video operator) and better video equipment because there is no opportunity for postproduction editing. Accordent PresenterOne (RealNetworks) is the most commonly used software for streaming speakers' slides, voice and video. You also need a point-to-point program to allow participants to question the speaker and each other.

Developing level 5

After your level 4 DLC has accumulated a video conference library over time you can schedule broadcasts of your recorded courses like a TV station. This requires funding for advertising in appropriate educational markets, and a full-time administrator and support staff.

REFERENCES

1. Lanza V. How to develop a low cost, in-house distance learning center for continuing medical education, Part I. *J Clin Monit Comput*, in press
2. Schubert A. Teleconferencing, distance learning, and tele-mentoring: New technology harnessed for perioperative education. *J Clin Anesth* 2000; 12: 250–251
3. Cooper, JB, Barron D, Blum R. Video teleconferencing with realistic simulation for medical education. *J Clin Anesth* 2000; 12: 256–261