

ONLINE LEARNING GOES SYNCHRONOUS: PROJECT, PREPARATION, SETUP, ROLL-OUT AND USE OF A VIDEOCONFERENCE ENVIRONMENT IN HIGHER EDUCATION

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Abstract *¾ Videotraining is an interactive instructor-led program that connects virtual learners inside and outside the University of Brasilia. Videotraining topics range from foundation skills to proprietary knowledge applications. For this program, we implanted a videoconferencing environment. The implanted environment is based on the principle of availability of band pass to allow real time interactivity and good quality in a two-way transmission. Videoconferencing, due to its real time interactivity, is the class scenario where the educational strategy is developed and the instructor stimulates the learning process.*

The videoconference environment was designed, developed, and implemented by a core group in the laboratory “Núcleo de Multimídia e Internet” branch of the department of electrical engineering of the University of Brasilia. This is a case study showing how the network was structured for the past two years. The network used in this environment will be shown, as well as the topologies and typical characteristics. The videoconferencing structure was planned and built following two widely used international recommendations: the H.320 - Narrow-band visual telephone systems and terminal equipment – and the H.323 - Visual telephone systems and equipment for local area networks which provide a non-guaranteed quality of service.

The environment is detailed through a description of the local area network, access networks and the active elements, such as: terminals, gateways, multipoint control units and gatekeepers. The initiative of designing a videoconferencing network, especially under the H.323 recommendation, was born due to the constant increase in the use of multimedia services in Brazil such as voice, data, audio and video over IP.

All the setups that could be performed using this structure are shown using connections examples, that are: point to point IP (internet protocol), point to point ISDN (integrated service digital network), point to point integrating IP and ISDN networks and multipoint IP calls.

The purpose of such network is to offer support for the Videotraining program, where the videoconference becomes a classroom, for medicine, diagnostics and prescriptions

could be done virtually and, most of all, knowledge can be shared no matter one's location.

Index Terms *¾ H.320, H.323, learning, multiuse environment, videoconference, videotraining.*

INTRODUCTION

The videoconference (abbreviation of the term audio-videoconference), although one might misunderstand its concept as a technology, it's actually a collection of technologies that allows a live bi-directional audiovisual communication, meaning that, a person in a distant location and the ones in a near location will be able to receive and transmit audio and video.

The architecture of videoconference environment shows details of the processes and procedures on projecting and implementing all elements in this environment. The videoconference environment is complex, therefore beyond the adoption of communication standards (H.320 and H.323, for instance). Hence we have that to consider the harmonic configuration and operation of mains equipments, auxiliary equipments, local network, access network, access network interconnections, among others factors.

The local and access networks play a basic role, therefore the communication will be successful if the access and local networks are well dimensioned for the demanded traffic.

ARCHITECTURE OF A VIDEOCONFERENCE ENVIRONMENT

Local and Access Networks

The physical structure the implemented environment is distributed in two buildings: a laboratory in building SG11

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in the University of Brasilia and another laboratory in the College of Technology also in the University of Brasilia.

The local network of NMI is composed of a specific videoconference virtual network, with videoconference equipments, network management stations and a virtual computer network, which are connected with the other stations of the laboratory.

The networks use the same physical structure on cabling, but are separated by different virtual networks (VLANs). This decision was taken so there won't be traffic competition between stations and videoconference multimedia traffics; after all we are dealing with a link that gives no guarantee in quality of service. Fig. 2.1 shows the videoconference local network layout.

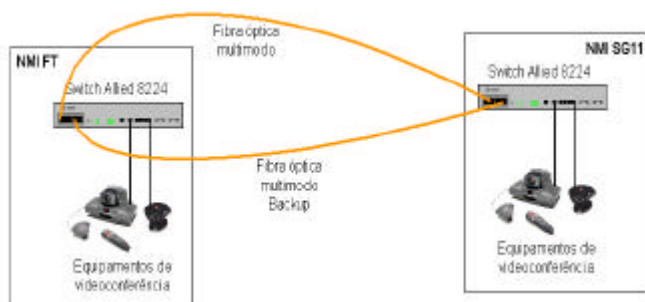


FIGURE 2.1 – VIDEOCONFERENCE LOCAL NETWORK LAYOUT.

The choice of an access network for multimedia environment, specially because there is audio and video traffic in real time, depends on several factors. The most important factors are: chosen protocols, the time expected for using the access link and the bandwidth available for this access.

So, we designed two distinct networks: a traditional network integrated by circuits (ISDN) and a network integrated by packets (IP). The integrated network service is supplied by Embratel – Brazilian Telecommunications Company – and is commercially called Digidial. This service is part of an integrated services digital network, and generates end-to-end digital connectivity for subscribers. Fig. 2.2 shows this layout.

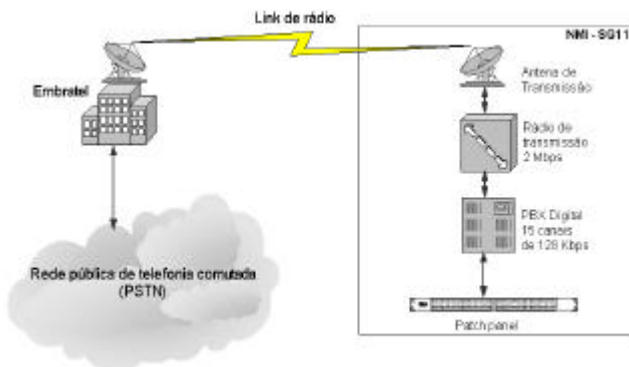


FIGURE 2.2 – LAYOUT OF EMBRATTEL'S ISDN SERVICE IMPLEMENTATION.

The packet integrated network service is also an Embratel's service commercially called Business Link Direct or Direct IP. This service is part of an Embratel's Internet backbone, which has worldwide connectivity. In the lab there is a 2 Mbps direct exit link. The layout of this service is shown in Fig. 2.3.

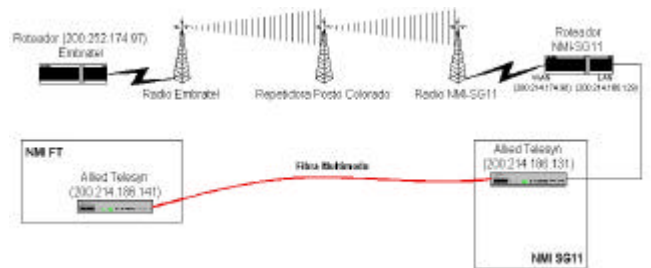


FIGURE 2.3 – LAYOUT OF THE DIRECT IP SERVICE.

Having this service in our hands we implemented a local network for videoconference based on IP protocol. This network has an output link for Internet being possible to make videoconference with any another point connected in the worldwide network, since there is availability of band for this.

Terminal Videoconference Equipments

The network terminal equipments refer to videoconference codecs. This codecs are devices that capture audio and video, codify and compress these signals for transmission in the available access network. To define the equipments, we analyze factors as well as cost, operation, configuration, upgrade capacity, installation and communication facility using the recommendations H.320 e H.323. Analyzing these factors was opted to acquire equipments from Polycom and PictureTel.

Interconnection Networks Equipments – Gateway

The gateway is an essential element in a network, therefore it has capacity to interconnect systems that utilize different communication protocols, being able to offer another supplementary services as well as model and manufacturer. The gateway used in NMI is an equipment of the Radvision brand, whose model is L2W-323. The gateway has 4 ports WAN ISDN BRI.

The gateway is a conference element that promote many services, being the most important the translation function of algorithm of videoconference terminals H.323 to others types of terminals (H.320 for example).

Multipoint Equipments – MCU (Multipoint Control Unit)

The MCU used in NMI is also of the Radvision brand and its model is MCU 323. This videoconference element allow users to participate in multipoint conferences, either only voice or with audio and video, without the necessity of advanced pattern. The user simply dials the service number and the MCU automatically configures the conference. All users who want to participate of this conference make the same procedure and the MCU, which is in charge of mixing the audio and video, promotes the multipoint connection.

The gatekeeper that manages the H.323 zone in NMI is a Radvision model NGK-100. It is an application in the form of a program that follows the recommendation H.323 version 2 of ITU-T and, although to be an optional element to videoconference, is essential for management of multimedia network under IP.

The NGK-100 is able to manager a zone with 300 users and 60 simultaneous calls. The gatekeeper has a graphic interface for the user (application programming interface) with navigation based in menus and buttons. Fig. 2.4 shows the general topology implanted in NMI, including all equipments and local network and access networks.

Network Control Equipment – Gatekeeper

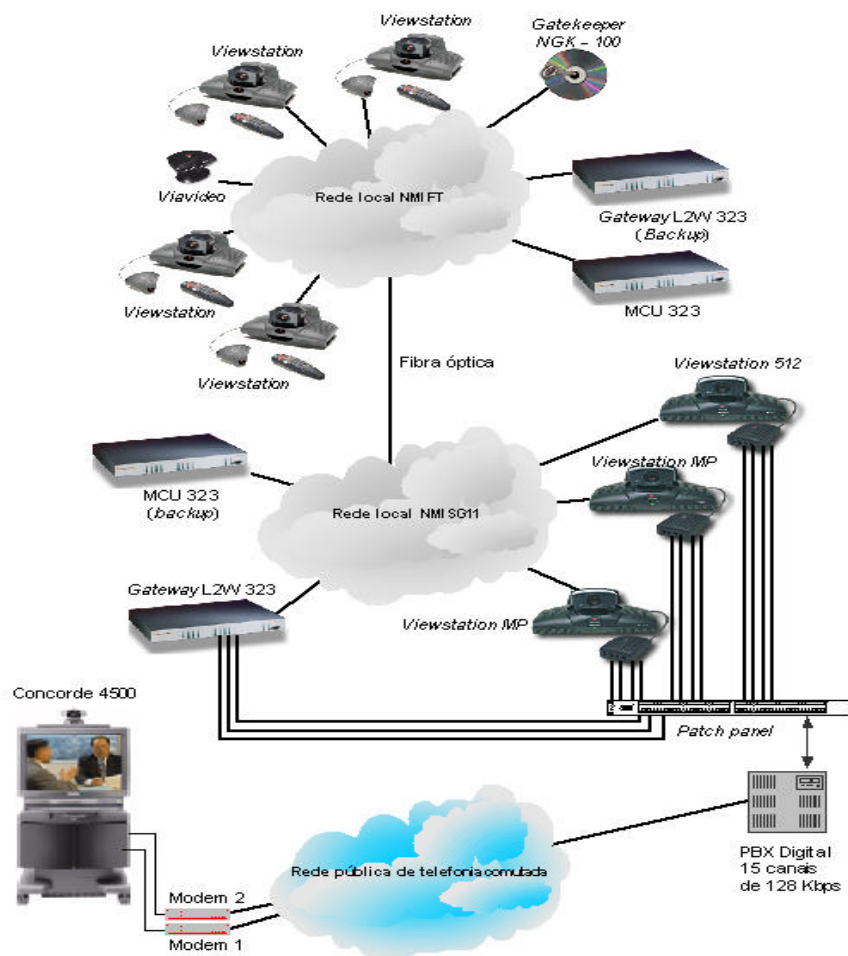


FIGURE 3.1 –TOTAL TOPOLOGY OF VIDEOCONFERENCE NETWORK IN NMI.

MULTIPLE USES ENVIRONMENTS

Usage examples of diverse videoconference environments in NMI will be shown in this item.

Audience Room

The prepared room to serve as an audience room has capacity for 58 persons seated in chairs with plane tables. This auditorium is divided in 6 rows with 10 chairs in each one, and these are in a platform 15cm upper the previous

platform, allowing an ideal visibility with seated people in the front.

The principal monitor and cameras, auxiliary monitors and cameras are disposed in a way to optimize the space and

provide a great view angle for all participants, both presenters and auditorium. Fig. 3.1 shows the layout of the audience room.

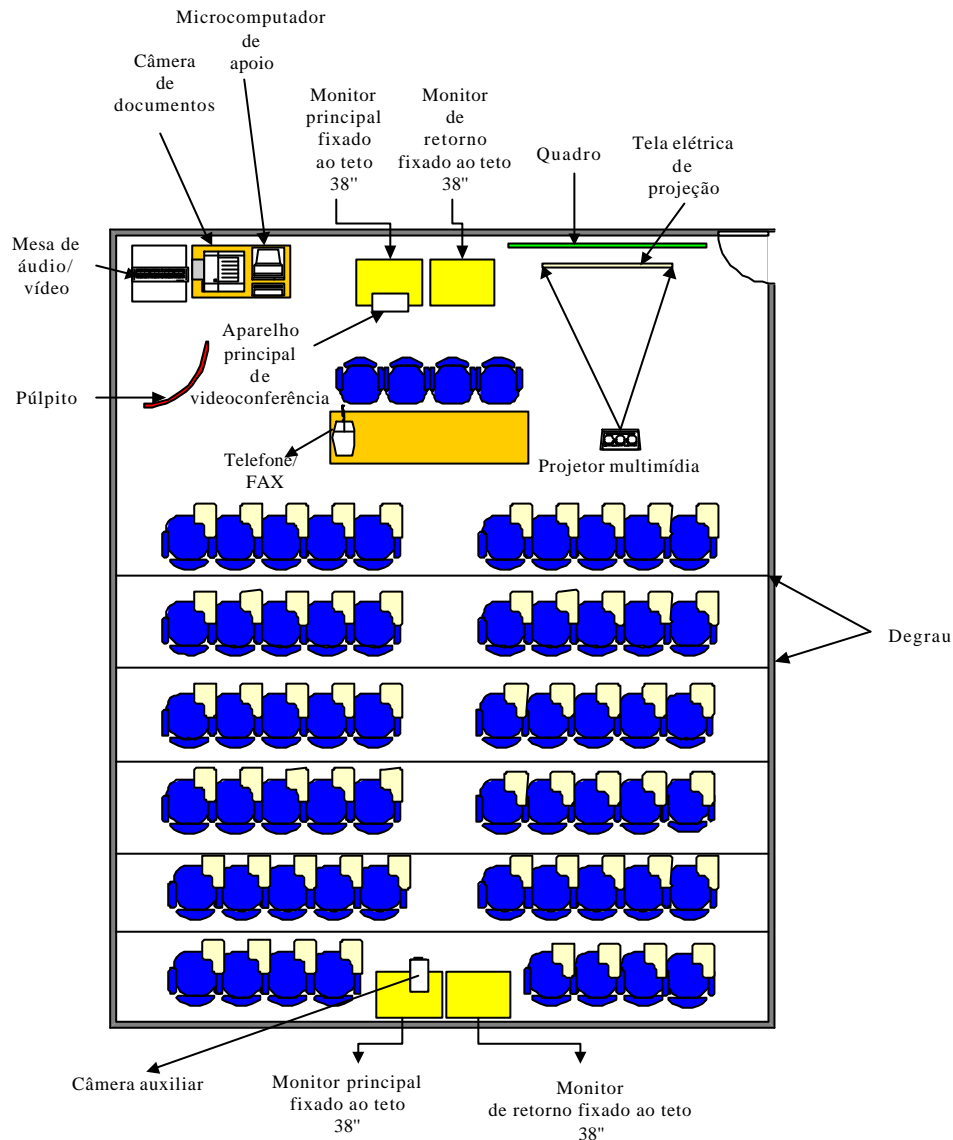


FIGURE .3.2 - LAYOUT OF VIDEOCONFERENCE ROOM ADOPTED INNMI.

Usage Example

The first usage example is in telemedicine field. The intention is to demonstrate a surgical technique called radial prostatectomy. The connection was in a speed of 384 Kbps speed enters University Hospital of Sorbone in Paris and the NMI audience room at University of Brasilia. This connection was made using switched network by digital circuits and the image quality was television-like (25 frames per second). The participants in NMI audience room could

have a view of the doctor as well as of the endoscope. The interaction between the surgeon and the participants was done in real time through two multidirectional microphones strategically located in the room.

The second usage example is an event for signing a scientific interchange accord between Brazil and Portugal. The NMI's auditorium in the University of Brasilia and the technological center in Belem, Portugal, were connected in a speed of 512 kbps. In this event there were presenters sited in front of the audience and by using auxiliary cameras we could visualize the authorities sited as well as the audience.

The interaction among the participants in Brazil and in Portugal was carried through in real time and the image quality was like television (30 frames per second).

Therefore this auditorium setup allows diverse usage for videoconference reception or videoconference presentation and reception.

Meeting Room

The room NMI setup to use as a meeting room allows people to have their meetings using various videoconference resources. The room was projected in a way that all participants could be in the camera angle, after all visualization of all participants is fundamental. Fig. 3.2 shows a sketch of the meeting room.

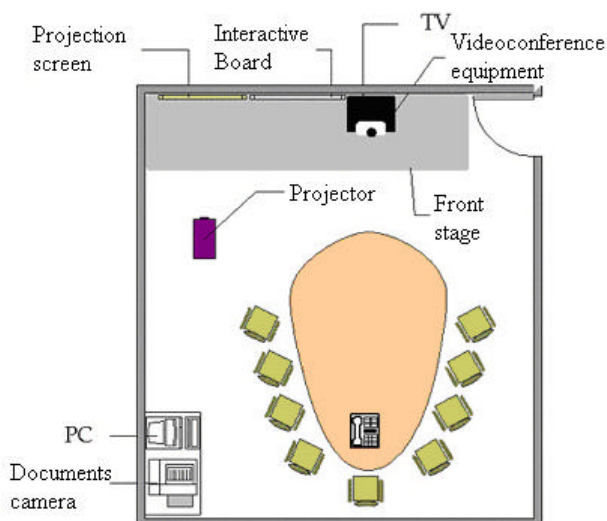


FIGURE 2.3 - LAYOUT OF MEETING ROOM IN NMI.



FIGURE 3.3 - PICTURES OF THE TRAINING ROOM OF THE CENTER OF MULTIMEDIA AND INTERNET.

Usage Example

The greatest application of this room is for training. The instructor teaches courses using the 54-inch screen as his station screen and the students can follow the steps.

The pattern of this room is optimized in such a way to use in meeting how much as distance meeting.

Usage Example

A usual example for this room usage is the meetings that happen among teachers from UnB and USP. The meeting happens from the NMI's meeting room in University of Brasilia to the LARC's room in Politechnique School of Sao Paulo. It was used an IP access network, that is, a connection via Internet in a speed of 384 kbps. Teachers interacted in real time and shared documents using the documents camera the same way as data sharing facilities.

Training Room

The environment prepared to be a training room for NMI has a mixed setup, that is, prepared for trainings and distant training as well. The room is equipped with 10 PCs, and all of them have multimedia kit and Internet access. Each station can be used for even 2 students. The instructor has his own station, which is capable to control the others.

For distant classes the training room has videoconference equipment, a 54-inch screen as the main monitor and 2 microphones located strategically in the room. Fig. 3.3 shows pictures of the NMI's training room.

Nowadays we have a Microsoft Project course for 15 people going on.

In distant training the students would visualize the teacher computer in the screen and, in the right corner, a frame with the teacher's image. This scheme is suggested for connection to be done with at least 384 kbps because with

this speed we could have Full Motion video from the teacher's computer image and his own. This is a typical setup using distance training room and transmission studio.

Transmission Studio

The videoconference transmission studio implemented in NMI's lab at the University of Brasilia is like a TV studio. There's a room with proper acoustic, lightning and scenario

in a way that transmission can have the best quality of audio and video.

Inside the studio there are some resources for the host, such as: computer, documents camera, digital board. The studio has two TVs, the main and the secondary, and a main camera, strategically located so it can have the best image of the host. The transmitted image is Dual Stream Video mode, that is, people will receive the teacher's image and an auxiliary camera image or the computer screen. Fig. 3.4 shows a picture of the NMI's transmission studio.



FIGURE 3.4 - CENTER OF MULTIMEDIA AND INTERNET TRANSMISSION STUDIO PHOTOGRAPH.

Usage Example

The main function of the transmission studio is generation of classes. Practical examples of the NMI's studio usage are Master degree classes given at distance to students from the Goiás Technological Education Federal Center (CEFET-GO). The classes are given using a point-to-point connection in a 128 kbps speed and the students can interact with the teacher in real time, although the image has low quality (15 frames per second). This way, the available resources are carefully used. The greater is the movement and exchange of cameras, the blurrier will be the image.

CONCLUSION

This article is about the projection and implementation of a videoconference environment following the internationally known and used standards in the lab of the Center of Multimedia and Internet from the Department of Electrical Engineering of the University of Brasilia. This environment is composed by a local network, an access network and for various equipments from different developers.

The access networks described here use services offered by Embratel. They are traditional services, which use the public commuted telephony network or packet services like, for example, the Direct IP service.

We have also shown the various implemented environments. Applications like distant education, virtual meetings, distant conferences and workshops and telemedicine are some of the ones already developed by this environment.

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