

# Distributed Classes: Convergence of distance learning and presence learning through a videoconference system

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## 1 Keywords

Multicast; Videoconference; Distance learning.

## 2 Extended Abstract

This paper presents “*Distributed Classes*”, a new videoconference system being implanted experimentally in the Brazilian Superior Network School (ESR) [1], using as infrastructure the *Rede Nacional de Ensino e Pesquisa* (National Education and Research Network – RNP) [2]. Training professionals in the field of networks in Brazil for more than 20 years, RNP has created the Superior Network Training Institute (*Escola Superior de Redes*) with the aim of spreading knowledge.

*Escola Superior de Redes* (ESR) - RNP's Network Training Institute is a non-profit organization responsible to provide in-depth technical training for government employees. ESR is a teaching excellence institute in the field of Information Technology and Communication. To reach this goal, the best professionals in the market and in the academia have been gathered. In this Institute, practical experience and theoretical knowledge walk side by side.

ESR is a governmental initiative aiming to improve the practical network knowledge of the graduated people, and this is done nowadays through high level classes of related issues, like Wireless, Virtualization, Videoconference Systems, Voip, Security, and so on. Each section is separated in three parts: the first theoretical, the second the practice with laboratory activities and the third is a review of the results achieved. ESR is located on Brasília/DF, Rio de Janeiro/RJ, Porto Alegre/RS, João Pessoa/PB and Cuiabá/MT with plans to expand to all 27 states in the next 5 years.

The methodology used in the courses at the Network Training Institute values the practical aspect, through the solution in class of typical problems making up the professional's routine. The course contents are designed by the greatest experts in Information Technology and Communication in Brazil. All the instructors have solid academic background and professional experience.

The main objective of “Distributed Classes” project is to extend the teacher's range from a local classroom to a national extent, allowing first level teachers to reach remote students which would never have the possibility of having classes with them, due to distance limitations and involved costs.

The most part of ESR students are employees of the Ministry of education (MEC) and Ministry of science and technology (MCT). Ministry of education has 60 federal universities [MECIFES] and 354 technical institutes [MECSETEC]. Ministry of science and technology has 19 research institutes [MCTUP]. The employees of MEC and MCT are located in all 27 states of the Brazil.

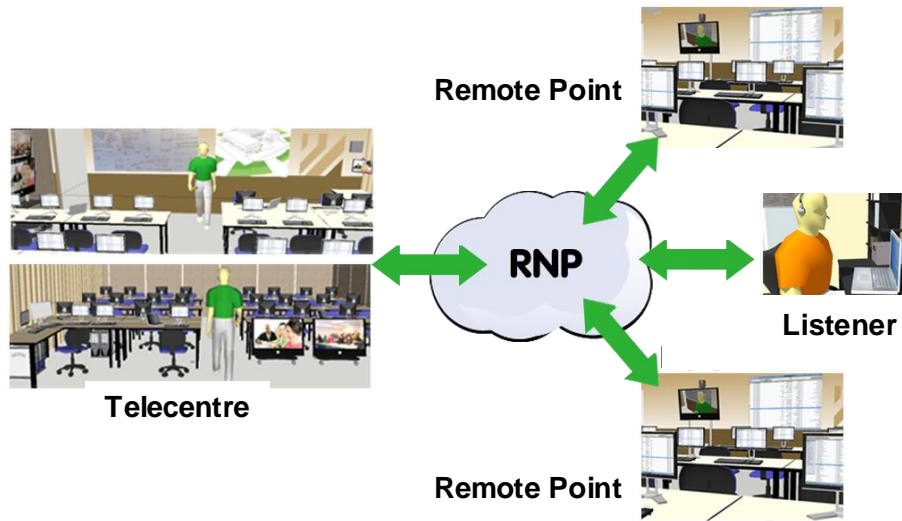
However, the student distribution among the brazilian states is not equal, and we can separate the states in three main groups:

- Group 1 – Just three states concentrating 40,1% of the employees
- Group 2 – Ten states concentrating 41,0% of the total employees
- Group 3 – Fourteen states concentrating only 18,8% of the employees

Group 1 concentrates the higher demand and are the first candidates to a new unit. Group 2 have a demand of the size of the group 1 but those students are divided in 10 states. Group 3 states are the challenging ones. They have a small demand for seats for each class and it is hard to find teachers. The following architecture is a solution that helps to normalize the students distribution.

The system architecture is depicted in Figure 1, showing one local “*Telecentre*”, where the teacher and local students stand, and many “*Remote Points*”, where the remote students stays. Telecentre and Remote

Points communicate through superior audio and video quality, allowing to the teacher perform his/hers classes synchronously keeping the class pedagogical quality.



**Figure 1: Distributed Classes main architecture**

The system aims to provide the teacher and the students with a “presence sensation”. In order to do that, Telecentre and Remote Points are permanently connected through superior quality videoconference, so, the teacher sees each remote class through a 46” television (Figure 2, on the left), and each remote class sees the teacher through a 46” television and also the teacher’s presentation (Figure 2, on the right). Besides that, the teacher’s computer screen is also transmitted, therefore, everything that the teacher present in his/her computer is sent to local and remote points, including slides, browser navigation, commands and videos. The teacher’s computer is also attached to a smartboard, which delivers more flexibility to the classes.



**Figure 2: Telecentre (left) and remote point (right)**

Each room has a robot camera, which allows zoom in any student when there is a question. In this moment, the system has a feature to exchange the transmission of the teacher’s screen by the image of the student asking the question. In that way, the teacher and remote student can talk “eye on eye”, and all remote points can follow the teacher-student conversation visually.

Additionally, in the laboratory part of each session, the teacher can log onto the remote students machine, if needed, helping him in some special configuration which the local tutor cannot solve.

The network support is very important to this system, due to its demand in terms of quality, which reflects in bandwidth. The video codec is h.264 with a bandwidth of 1.4 Mbps to each video stream. To maximize scalability, the system uses multicast, allowing many Remote Points without compromising the server or the network. In relation to one-way delay, the measured values were about 200 ms, allowing perfectly the natural interaction among the involved points.

The network infrastructure is obtained through the National Research Network (RNP), which provides a minimum bandwidth of 2.5 Gbps in the backbone to the selected points, with all routers supporting native multicast since the late 90's.

In the experimental service, launched in November, 2009, the system is connecting three remote places: Brasilia, Porto Alegre and Cuiabá. The distance between each one of them is about 2,000 km. The experimental service performed very well, and the system will expand year by year.

The project also has the possibility of sending the video transmission to an individual participant, through a unicast connection, which can receive the transmission using his/hers web browser. Another functionality is the possibility of session recording, which allows the posterior inclusion of the transmission in a learning environment or in a VOD (video on demand) server.

The main differentials of the Distributed Classes system related to other solutions are:

- The system is based on software, so it is very cheap. To create a minimum Telecentre one should spend about US\$ 20,000 at most, including the televisions, smartboard, computers, racks, robot cameras and so on. To create each Remote Point the cost is less than US\$ 10,000, including television, rack, computers, camera and projector.
- The quality observed in the system is clearly superior to other videoconference systems web based.
- The use of multicast allows scalability to many Remote Points without disturbing the network nor the server.

### 3 References

[ESR] Superior Network Training Institute. [www.esr.rnp.br](http://www.esr.rnp.br).

[RNP] National Education and Research Network. [www.rnp.br](http://www.rnp.br).

[MCTUP] MCT Research Units <http://www.mct.gov.br/index.php/content/view/741.html?execview>.

[MECIFES] IFES - Federal Institutes of Superior Teaching.

[http://portal.mec.gov.br/index.php?option=com\\_content&view=article&id=28:ifes-institutos-federais-de-ensino-superior&catid=102:prestacao-de-contas-1998](http://portal.mec.gov.br/index.php?option=com_content&view=article&id=28:ifes-institutos-federais-de-ensino-superior&catid=102:prestacao-de-contas-1998).

[MECSETEC] Federal Network of professional, scientific and technological education

<http://redefederal.mec.gov.br/>.

### 4 Vitae

**Valter Roesler** has Bachelor's degree in Electrical Engineering (1988), Master degree (1993) and PhD degree (2003) in Computer Science. Today he is a professor at Federal University of Rio Grande do Sul, Brazil. He has experience in Computer Networks, Multimedia, Digital TV, Video Encoding and Network Transmission. He coordinates the PRAV laboratory (Projects in Audio and Video) – [www.inf.ufrgs.br/prav](http://www.inf.ufrgs.br/prav), with about 30 researchers and projects related to Remote Education and E-Health, in traditional computers and mobile devices. He is the technical coordinator of the “Distributed Classes” project.

**Luiz Coelho** is with RNP (National Education and Research Network). He is the director and national coordinator of Superior Network Training Institute (ESR). He has Professional degree in Project Management from IAG/Master of PUC/Rio and Bachelor's degree in Data Processing from Pontifical Catholic University of Rio de Janeiro.