# Interoperable Multi Conferencing Technology as a Basis for an Open, Global Web Conferencing Network

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## Abstract

Mconf is an open source, distributed, scalable and federated global web conferencing system, interoperable with SIP and mobile devices. The base for the system is an open source application called "Mconf: Multi conferencing with interoperable access for web and mobile devices".

This open source application explores a global approach to service provision. In June 2012 the Mconf Global Network [Roesler, 2012a] was launched, and by September 2013 had attained a global geographic distribution, with 23 servers distributed among three continents and about 1,500 communities and 5,500 users served worldwide through 10 web portals. This cooperating global network forms an open global web conferencing network that can support thousands of users daily.

The problem addressed in this paper is: how this open multi conferencing technology can enable an open global academic web conferencing network. The answer is given by examples of R&D results of the experimental phase, and by explanations of: 1. How to keep all the servers up-to-date and with the same software version, yet at the same time with custom themes and institution-based configurations. 2. How to generate real-time and historical usage statistics of the entire network and also for individual institutions. 3. How to guarantee availability in case of a server crash. 4. How to cope with surges in web conferencing traffic. 5. How to manage web conferencing recordings of such a large number of users and institutions scattered around the world.

## Keywords
Global Web conferencing Network; Distributed systems; Scalability; Availability.

# 1 Introduction

After going through earlier stages of the R&D cycle from the Brazilian NREN (National Research and Education Network) as part of its Working Groups Program [Stanton 2012], between 2010 and 2012, Mconf evolved its scalability, performance and management capabilities to a pre-production level in 2013, during the Mconf Experimental Phase activities, to fulfill the last stage of its R&D cycle. Meanwhile RNP's Service Team is modeling the service to provide an alternative web conferencing solution to RNP's clients as a production service in 2014.

Today Mconf is a solid platform to support web conferences and streaming with recordings for a large number of users. The main goal of the paper is to present our strategies to cope with such a large number of servers, users and institutions.

This paper is organized as follows: section 2 presents an overview of the Mconf global network. Section 3 details the challenges faced by the team to organize the management of such a big structure, preparing the network to become much larger than it is already. Section 4 brings the final remarks, and section 5 makes an open invitation to academic institutions to join the network.

# 2 Mconf Global Network

Mconf is a complete web conferencing system, with features such as real-time sharing of voice, video, slides, desktop and chat. It provides a distributed and scalable solution for communication that has proved to be useful in several distinct scenarios. An in-depth view of the Mconf system can be seen in the open access book chapter of Roesler [2012b].

The network was launched in June, 2012 [Roesler, 2012a], and by September 2013 had the geographic distribution shown in Figure 1, with 23 servers distributed among three continents and with some countries and states in a pre-deployment phase. In a few years we expect an increase in this number to hundreds of servers cooperating to form a massive global web conferencing network, serving thousands of users daily. Currently, any academic institution that agrees with the terms of use can become a member of the network (http://mconf.org/m/about/network/terms).



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Figure 1. Location of the Mconf global web conferencing servers (September, 2013).

Sharing the distributed servers are the users accessing their own web portals with their own visual identities. The web portals form a second layer of Mconf that runs over the top of the servers layer, allowing that the users enter the web conference in different ways, like a Learning Management System (Moodle, for example) or a dedicated web page (http://mconf.org or http://mconf.rnp.br, for example). Today the Mconf network has about 10 web portals around the world, serving around 5,500 users and 1,500 communities.

Figure 2 shows the Mconf architecture. On the left we can see the users connecting to the web portal of their own institution. When a user wants to create a new web conferencing room, he/she connects to the web portal and clicks a button to open the room. The web portal asks the Load Balancer which is the best Mconf-Live server to use. The Load Balancer has information of every Mconf-Live server gathered by the monitoring servers and, based on the geographical information of the user combined with the CPU load and available bandwidth of the different servers, chooses the best one to start the new web conferencing room, informing the web portal, which contacts directly this server and opens the room there. The Mconf-Live server is a fork of BigBlueButton[1], and the Mconf team works together and aligned with the BigBlueButton team.

This architecture allows hundreds of servers, hundreds of web portals and thousands of users simultaneously. The challenge is to manage such a network, and the next section will present some explored approaches.

[1] http://bigbluebutton.org/


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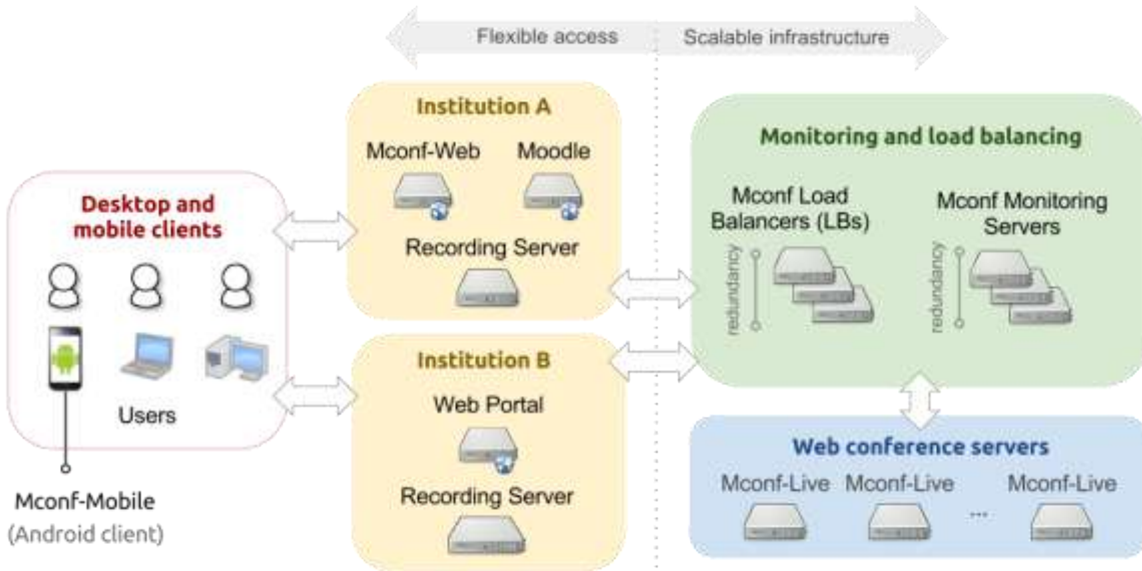


Figure 2. Mconf global network architecture.

# 3 Challenges and solutions for managing a Global Network

This section is divided in subsections, one for each of the questions posed in the beginning of the paper, which are: 1. How to keep all the servers up-to-date and with the same software version, yet at the same time with custom themes and institution-based configurations. 2. How to generate real-time and historical usage statistics of the entire network and also for individual institutions. 3. How to guarantee availability in case of a server crash. 4. How to cope with surges in web conferencing traffic. 5. How to manage web conferencing recordings of such a large number of users and institutions scattered around the world.

## 3.21How to keep all the servers up-to-date and with the same software version, yet at the same time with custom themes and institution-based configurations?

Distribution of software and configurations, dispensing actions by system administrators, is performed on Mconf through Opscode Chef (http://www.opscode.com/chef/), an open-source systems integration framework built specifically to automate the cloud. On Chef the developers write Ruby scripts, called *Recipes*, that are distributed over clients (Chef Clients) through a Chef Server. The framework is very flexible and enables assignment of different roles (a set of recipes and attributes) to clients, and the recipes may do anything, from software installation to fine tuning configuration.

With such a mechanism the user experience is preserved, since the software is dynamically installed and configured on all servers in a short period of time, but this doesn't mean that institutions connected to the Network won't be able to brand Mconf and use different configurations. On the contrary, institutions will still be able to use different themes and configurations, with the guarantee that in any server of the infrastructure their users will have the


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same user experience (with the same theme and configuration).

This is done through the Mconf Load Balancer API, which is the entry point for institutions to interact with the whole infrastructure. When a web portal from institution X requests the Mconf Load Balancer to open a web conferencing room, it may send a bunch of parameters that will be handled later by Mconf Live (on any server connected to the Network), that will apply the requested configuration. A configuration may be a start-up layout, the ability for any user or just the presenter to share a webcam, the default presentation, among others.

### 3.22How to guarantee availability in case of a server crash?

To manage a big cooperative network, it is paramount to have a good monitoring system to generate statistics and reports, in order to know better the web conferencing usage of each institution and of the whole system in a global way. The Mconf group has created a mechanism which generates graphics and reports to keep each server manager informed on how its users are using the system.

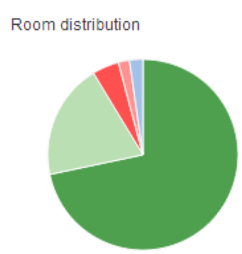
It is possible to filter the statistics for institution, group of institutions or the entire network. It is also possible to select a time interval, requesting information on how the users behave during some specific period of interest.

In order to understand how the users are using the system, some basic information is provided, like the number of meetings, average meeting duration, average maximum number of users and maximum number of simultaneous users, as shown in Figure 3.

| | |
|---|---|
| Number of meetings | 265 |
| Average meeting duration | 23.83 minutes |
| Average maximum number of users | 1.2516 |
| Maximum number of simultaneous users | 16 |

Figure 3: basic information of the meetings

Also one institution might use the information depicted in Figure 4 as a usage profile regarding the distribution according to the virtual room size (i.e. number of users).




| Room size (number of users) | Number of meetings | Percentage |
|---|---|---|
| 1 | 190 | 71.6981 % |
| 2 | 52 | 19.6226 % |
| 3 | 12 | 4.5283 % |
| 5 | 5 | 1.8868 % |
| 6 | 2 | 0.7547 % |
| 4 | 1 | 0.3774 % |
| 7 | 1 | 0.3774 % |
| 10 | 1 | 0.3774 % |
| 15 | 1 | 0.3774 % |

Figure 4: distribution of virtual room size

In addition, it is possible to request the number of meetings hosted by each server through a time



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interval. There are also graphics of CPU and bandwidth over time for each server, and there is an option to show the number of users per institution throughout time. The purpose of this information is to show how the servers in the network are being used, allowing the taking of administrative measures if an institution is "abusing" the network, for example.

Besides the generation of asynchronous reports like the ones explained above, the system also supports a real-time view, provided by a dashboard, presented in Figure 5. The dashboard provides instant knowledge of what is going on in the global network. For example, the figure shows that, in this particular moment, there are 13 users divided in three virtual rooms (6 users, 5 users and 2 users). The figure also shows the time distribution of the users for the last 4 hours, and statistics of users, CPU load, RAM memory and network bandwidth for each server.

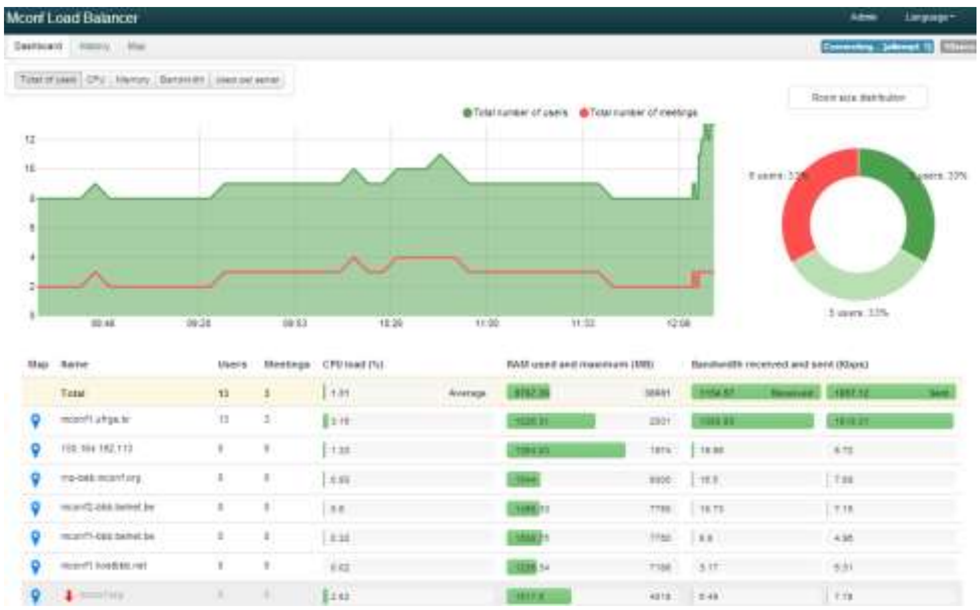


Figure 5: distribution of meetings per server

### 3.23How to guarantee the availability in case of a server crash?

A global distributed network can provide benefits in terms of availability and resource optimization. The Mconf global network provides the following benefits:
If one server crashes, the users connected to it will lose connection. Afterward, the natural instinct of the users is to try to connect again. The load balancer will provide a brand new server for that conference, and they will connect again. Besides, all users who try to open a virtual room after the server crashes will receive a good server to connect to, and they will not know that one server in the global network has crashed. Of course, one improvement for the system would be the detection of a server crash and the automatic reconfiguration of the user to reconnect immediately to a new server, but this is future work.

### 3.24How to cope with surges in web conferencing traffic?

A surge in the web conference traffic of one institution connected to the global network may occur due to a scheduled event like a big conference. This event may be streamed over the


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Internet, and many web conferencing rooms may be used at the same time. Instead of having to install more servers beforehand, the web conference managers of the institution can remain peacefully calm knowing that the global network will absorb such a traffic peak, providing the resources needed from other servers connected to the network.

Another benefit in a global initiative is that, while in one part of the globe there is daylight, in the other it is night-time. The tendency is that during daylight hours the servers will be more demanded, and, in case of too much demand, they will use the idle servers on the other part of the globe, and vice-versa. This will cope with traffic surges, optimizing resources in a collaborative way.

### 3.25How to manage web conferencing recordings of such a large number of users and institutions scattered around the world?

Another important issue in managing a global web conferencing system is to cope with hundreds of users recording their meetings using servers scattered around the world. There are two main issues related to this: one is information security, and the other is that the recordings must be associated with the user, and not with the server.

As seen in Figure 2, Mconf is composed of two layers: the first layer is the physical infrastructure that deals with web conferences and is composed of many distributed servers. The second layer is composed of each institution’s web portal, located in a separate server and protected by the local politics of each institution.

The recordings are associated with the second layer, i.e., with the web portal of each institution. It is the place to store the recordings and make them available to their users asynchronously, according to the politics of each institution. These recordings could be accessed simply by clicking a link in the institution’s web portal.

In fact, Mconf’s responsibility regarding this subject is only to generate the recorded video and move it to the institution´s web portal. Each web portal must have its own storage server for the recordings.

## 4 Final Remarks

This paper presented a management approach to deal with a global web conferencing network. NRENs who join the network can unite in an effort to discuss the global service governance as well as technical operations to raise a robust, flexible and practical platform, strengthening the communication among the partners.

The Mconf Global Network discussed in this paper is currently a rich source of experiments to establish a common multi conferencing network to enable collaboration between NRENs. Further discussion about the governance of the Global Network should be explored with the community of NRENs and other stakeholders in order to design the model and to improve the maturity of the technology and policies.

The source codes to add new nodes or contribute to this open network are available under open


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source licenses in https://github.com/mconf.

## 5 Open Invitation

Mconf Global Network is open to any academic institution that wishes to participate, and creates a possibility for global resource sharing that is unique in the web conferencing and video conferencing world. The greatest beauty of the system is that it is a real win-win situation for everyone involved, and the network gets stronger when grown. One institution does not have to worry about a temporary failure in the server or a traffic surge, because there are other servers supporting the system as a whole.

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## Biographies

**Valter Roesler** has a Bachelor´s degree in Electrical Engineering (1988), Master's degree (1993) and PhD degree (2003) in Computer Science. Today he is a professor at the Federal University of Rio Grande do Sul, Brazil. He has experience in Multimedia, Digital TV, Video Encoding, e-Health and Network Monitoring. He coordinates the PRAV laboratory (Projects in Audio and Video) – 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 coordinator of the Mconf project.

**Leonardo Crauss Daronco** has a Bachelor's degree in Computer Science from the Federal University of Santa Maria (UFSM), Brazil (2007), and a Master's degree in Computer Science from the Federal University of Rio Grande do Sul (UFRGS), Brazil (2009). Currently he is a researcher and developer in the Mconf project at the PRAV laboratory at UFRGS. He has experience in Multimedia, Video Encoding, Software Development, and Web Development.

**Felipe Cecagno** has a Bachelor's degree in Computer Science (2010). Since 2008 he works at the PRAV Laboratory (Projects in Audio and Video) as junior researcher and developer on many projects related to

Multimedia and Distance Education. He is the Mconf-Mobile project team leader, and he is part of the BigBlueButton development core team.

**André Marins** graduated in Computer Engineering at Pontifícia Universidade Católica do Rio de Janeiro – PUC-Rio (1996), with a MBA in Executive Management at IBMEC Business School (2001) and a MSc in Computer Science from PUC-Rio (2008). His previous jobs included: IT Manager at Cadê (internet catalog acquired by Yahoo) (1996-1999), IT Manager and Director at Starmedia (1999-2002), IT Consultant at Vogal (2003-2006), and IT researcher at TecGraf, PUC-Rio (2007). He is currently R&D project manager at RNP since 2008.

**Michael Stanton** is Director of Research and Development at RNP. After a PhD in mathematics at Cambridge University in 1971, he has taught at several universities in Brazil, since 1994 as professor of computer networking at the Universidade Federal Fluminense (UFF) in Niterói, Rio de Janeiro state. Between 1986 and 2003, he helped to kick-start research and education networking in Brazil, including the setting-up and running of both a regional network in Rio de Janeiro state (Rede-Rio) and RNP. He returned to RNP in 2001, with responsibility for R&D and RNP involvement in new networking and large-scale collaboration projects.


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