THE EVALSO PROJECT: SOFTWARE/HARDWARE ARCHITECTURE AND REMOTE TESTS RESULTS

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Abstract

The EVALSO (Enabling Virtual Access to Latin-America Southern Observatories) project, funded by the European Community, aims to create a physical infrastructure to efficiently connect the Latin-America Southern Astronomical Observatories (European Southern Observatory – ESO and Observatorio Cerro Armazones - OCA) to Europe. This infrastructure will be complementary to the international infrastructure already created in the last years with the European Community support.

A Virtual Presence (VP) system developed by the INAF - Astronomical Observatory of Trieste (AOT) will provide the astronomers with the tools to perform and control an astronomical observation from the user's site. This will be obtained re-creating selected components of the observatory environment at a remote site in order to allow the remote astronomer to interact with the on-site operators. The main objective of this activity will be to produce a low-cost, scalable, hardware and software system to be installed, without excessive efforts, in any operative situation where a suitable connectivity can be achieved. This paper will focus on the VP sw/hw architecture and the results of the tests with remote sites.

INTRODUCTION

In the Southern hemisphere the best observing facility for optical and infrared astronomy is widely acknowledged to be the ESO Cerro Paranal Observatory, where the Very Large Telescope (VLT) provides advanced observing facilities for astronomers in the 14 ESO Member States and beyond. Besides the four VLT 8.2-m diameter telescopes and the four 1.8-m auxiliary telescopes, Cerro Paranal will host the Visible and Infrared Survey Telescope for Astronomy (VISTA) and the VLT Survey Telescope (VST). VISTA and VST will produce after just one year of operation a volume of data that will exceed all the data collected by the VLT since the start of operations in 1999 [1].

About 20 km east of Paranal at an altitude of 2817 m is the Observatorio Cerro Armazones (OCA). This observatory is run jointly by the universities of Antofagasta and Bochum and has excellent observing conditions similar to Paranal. The observatory hosts currently 5 telescopes, two of which (40 cm and 84 cm) are mainly used for student education.

THE EVALSO PROJECT

The EVALSO project, approved by the European Community, aims to create a physical infrastructure (and the tools to exploit it) to efficiently connect the ESO Paranal and the OCA to Europe [2]. The project will use the international infrastructures created in the last years with the European Community support (RedCLARA, the network of the Cooperación Latino Americana de Redes Avanzadas and GEANT, the backbone which connects Europe's national research and education networks) to provide European Research a competitive edge having faster access to the collected data and use the facilities in an ever more efficient way.

The main tasks of the project, divided in workpackages, are:

- **Link upgrade.** Creation of the physical infrastructure, where not existent, or procurement of services in order to upgrade the connectivity to the observing facilities.
- **Fast data access.** Drastic improvement of the time needed for making the data available from the moment of the physical observation.
- **Virtual presence.** Planning and production of the tools that could be used to make possible the virtual presence of scientists, engineers, and experts at remote facilities and, at the extreme, the possibility to perform remote observations.

The main role of the AOT within the project is the development of the VP system, with the definition of the architecture, the implementation of the system and the integration of a prototype to be used as a demonstrator.

VIRTUAL PRESENCE SYSTEM

Virtual Presence can be defined as a set of technologies which allow one or more persons to feel as if they were present, to give the appearance that they are present, or to take an action, at a location other than their true location. In EVALSO this will be obtained re-creating the observatory environment at a remote site, either the control room, or the laboratory workbench, in order to allow the needed expert to interact with the local operators. Such a system will optimize the results from actual observations, allowing the remote observer to interact with the local staff present at the observing site, especially during troublesome nights when service mode observations are carried on.

The main objective of this activity will thus be to produce a low-cost, scalable, hardware and software system to be installed, without excessive efforts, in any operative situation where a suitable connectivity can be achieved.

VP System Requirements

A set of requirements that the VP system must satisfy has been defined:

- **Session management**. In order to allow the interaction through the VP system a session has to be established between the remote observer/engineers and the observing site. A ‘session’ can be defined as the act of establishing and starting, by the local staff, one or many simultaneous connections, then carrying out, by the remote observer(s) and engineers, the required actions, and at the end terminating them.
- **Desktop sharing**. The desktop sharing part will be in charge of replicating and sharing, between all participants to a session, a common desktop.
- **Audio and video connection**. The VP system should allow the interaction between the remote users and the operators and assistant astronomers present at the observing site, through an audio and video connection.
- **System engineering**. The VP system should be based on software, possibly under GPL licence, based on most common, widely used existing technologies. The session management as well as all the operations of desktop sharing must be as simple as possible. Concerning the security, the system should be based on secure connections both for desktop sharing and for audio and video connections.

VIRTUAL PRESENCE ARCHITECTURE

The current VP software architecture is divided in two main packages: server and client. The server runs on a dedicated machine at the observing site facilities, while the client is used by the users that need to connect to the observing site.

The server provides the facilities and services needed by the clients to establish and maintain a connection and perform the required actions. At the same time it provides the observing site operator (the moderator) with the tools to control and configure the session with one or more clients. A typical session is started by at least one client that connects to the server; then other clients are allowed to join the session. The client function is to provide the remote user with all the required facilities needed to establish a session with the observing site.

The general VP system architecture is shown in Fig. 1. In the example shown in this picture, at the local observing facility there are two PCs that runs the local applications. All the tasks required by the VP system are managed, on the server side, by a dedicated workstation (PC EVALSO). At the remote user site two client PCs connect to PC EVALSO in order to establish one or more sessions.

The server and client packages are a collection of open-source applications. On the server side a simple GUI is used in order to ease the way to manage the connections with the users.

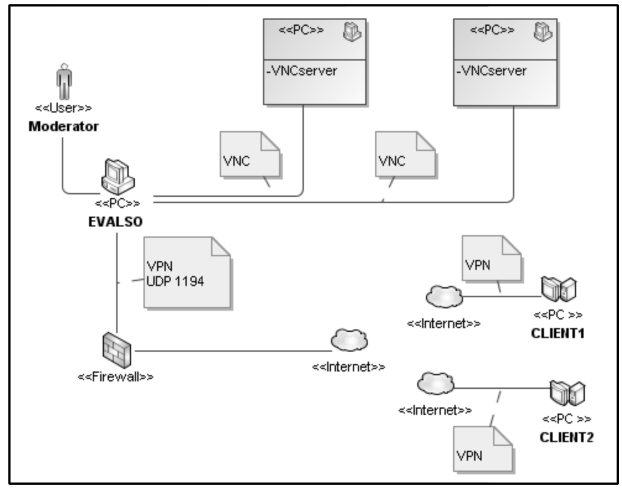

Figure 1: Virtual Presence system architecture.

To ease the deployment of the server packages a Knoppix LiveCD Adriane 6.0-pre, based on the GNU/Linux Debian OS distribution and containing all the needed VP system software, has been prepared.

The proper initialization of the whole server side software is achieved by a dedicated script. The configuration parameters (e.g. read-only or full access) are set-up by the moderator by means of a custom, dedicated Web-based GUI. The client software packages run both on GNU/Linux and Windows operating systems.

In the following subsections the adopted software packages are described.

Secure Channel (OpenVPN)

A secure communication channel is mandatory to guarantee an adequate security. A tunnelling protocol has been adopted among all the endpoints. This also provides only one point of access for all the connections, allowing a simple firewall configuration. The current adopted solution is based on OpenVPN which, in turn, is based on the SSL/TLS protocol [3].

Desktop Sharing (VNC Reflector)

The shared desktop may comprise more than one physical screen, and the shared screens may belong to more than one workstation of the observing site system. Participants may have a limit on which screen they can access; this access may be ‘read only’, where the user can only see what is happening and cannot interact, or ‘full access’, where the user may perform the same actions it would do if sitting physically in front of the workstation at the observing site.

The application currently best suited for this purpose is VNC (Virtual Network Computing), since its communication protocol is public and extensible. Many open source implementations of VNC exist today, ported to various platforms. To manage the permissions mechanism based on passwords the VNC Reflector software has been adopted [4].

VNC Reflector is a specialized VNC server which acts as a proxy sitting between a real VNC server (host) and a number of VNC clients. It supports full-control and read-only client connections.

Videoconference (VLVC)

For the videoconferencing the VLC (VideoLAN Client) media player with VLVC (Video LAN Video Conference) patch has been used [5]. On the server side the VLVC is configured as a server with appropriate audio/video parameters. On the client side the VLVC is configured as a client.

Videoconference Hardware

The videoconferencing application needs audio and video hardware to work properly (microphone, headset and webcam).

Server and Client Packages Deployment

On the PCs that run the local observing application the VNC server has to be installed.

The application needed on the server side (PC EVALSO) are:

- VPN server
- VNC Reflector
- VLVC configured as a server

The application needed on the client side are:

- VPN client
- VNC Viewer
- VLVC configured as a client

LONG DISTANCE TEST WITH OCA

In September 2009 a first long distance test was carried out between OCA (acting as a server) and AOT (acting as a client).

The test configuration is shown in Fig. 2.

The desktop of a local workstation at OCA (PC HPT-GUI) was accessed by a remote client PC running at AOT (PC CLIENT 1) through PC EVALSO. An audio-video conference system was set up as well. The standard VP system server and client packages were used.

The hardware setup at OCA was the following:

- PC HPT-GUI (OCA local interface via VNC)
- PC EVALSO (LiveCD under VMware running on a laptop)

At AOT the PC CLIENT1 run the Windows XP OS.

During the test a VPN session between the PC CLIENT1 and PC EVALSO was initiated. Since the standard VPN port on the OCA firewall was already busy, it was necessary to redirect the VPN connection to a free port. After this operation, the VPN connection was successfully established, with the VNC session and videoconferencing working properly.

In the same session a bandwidth test was also carried out using the Pathload utility [6]. The results showed that the available bandwidth range was 0.06-0.07 Mbps.

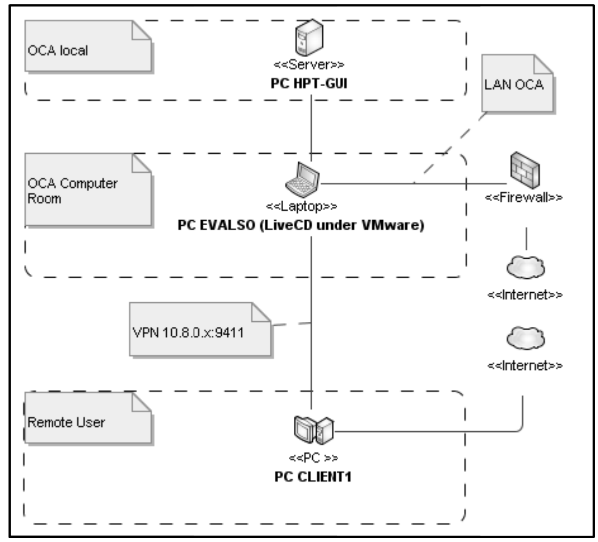

Figure 2: Configuration of the long distance test between OCA and AOT.

CONCLUSIONS

The VP system, developed at AOT, will provide the astronomers with the tools to perform and control an astronomical observation from the client site and will ease the instruments maintenance allowing the respective experts, usually located in Europe, to work in close interaction with the operators present at the observing site.

The results of the first test performed between OCA and AOT showed that even in the presence of a limited bandwidth the main communication flow between the client and the server worked as expected, with a sufficient videoconference quality.

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