EVALSO: ENABLING VIRTUAL ACCESS TO LATIN-AMERICA SOUTHERN OBSERVATORIES

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In the field of observational astrophysics, the remoteness of the facilities and the ever increasing data volumes and detectors poses new technological challenges. As an example, the VISTA and VST wide field telescopes, which are being constructed at the ESO's Cerro Paranal Observatory and will be ready in the next few years, have cameras which 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. This sets serious limitations if such large quantities of data must be transferred and accessed in a short time by the participating European Institutions.
The EVALSO project, approved by the European Community, addresses these targets in two major ways. It will create a physical infrastructure to efficiently connect these facilities to Europe. This infrastructure will be complementary to the international infrastructure already created in the last years with the EC support (RedCLARA, ALICE, GEANT). Besides this, it will provide the astronomers with Virtual Presence (VP), i.e. the tools to perform and control an astronomical observation from the user's site.
The main role of INAF - Astronomical Observatory of Trieste (OAT) within the project will be the definition of the architecture, the development of VP system and the integration of a prototype to be used as a demonstrator.

The EVALSO project

The EVALSO project aims to create a physical infrastructure (and the tools to exploit it) to efficiently connect the ESO Paranal and the Cerro Armazones Observatories to Europe. The main tasks of the project are:

- **Link upgrade**. Creation of the physical infrastructure, where non 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.

Participant organizations

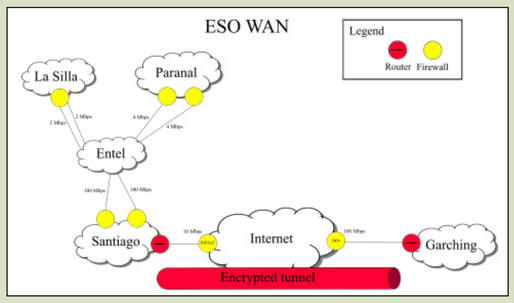
- OAT - INAF - Osservatorio Astronomico di Trieste
- UniTs - Università degli studi di Trieste
- ESO - European Southern Observatory
- GARR - Consortium GARR
- AIRUB - Astronomisches Institut Ruhr-Universität Bochum
- NOVA - Nederlandse Onderzoekschool voor Astronomie
- CLARA - Cooperation Latino Americana de Redes Avanzadas
- QMUL - Queen Mary University of London
- REUNA - Red Universitaria Nacional

Link upgrade

Since currently there is no available network infrastructure in the neighbourhood of the Observatories of interest to this project, EVALSO aims at providing a solid and long-term-lasting physical infrastructure allowing for a basically unlimited increase in capacity according to today's and future needs. The network elements currently involved are the ESO, OCA, REUNA ans RedCLARA networks.

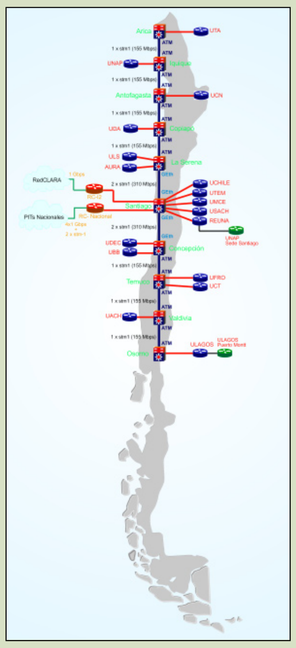
The ESO network

The ESO Paranal Observatory is part of the ESO Wide Area Network, which provides connectivity between all ESO sites.



The OCA network

The Observatorio Cerro Armazones is currently connected to the outside world through a microwave antenna from ENTEL. There is a fibre link between the ENTEL antenna and the 40/80 cm (educational) telescopes. The research telescopes are connected to the microwave knot by a Wireless Local Area Network (WLAN) system. The bandwidth, insufficient for a real-time data transfer, is 512 kbps.



The REUNA network

Chile's National Research and Education Network, one of the founding members of CLARA and hence the Chilean link into the RedCLARA network, has a backbone network connecting Chile's major cities.

The RedCLARAnetwork

The network connects Tijuana (Mexico) to Panama, Santiago (Chile), Buenos Aires (Argentina) and Sao Paulo in Brazil at 155 Mbps. An intercontinental link connects Sao Paulo to Madrid at 622 Mbps and an additional link connects Santiago to Sao Paulo.

The EVALSO project will install an optic fibre facility running from the Observatories at Cerro Paranal and Cerro Armazones to Antofagasta and from there will use REUNA's network and its long term agreements with local operators to jointly upgrade that network. The project will provide ESO and OCA observatories with a private path at Gbps capacity between their sites and Santiago across the new fibre and REUNA's network.

Fast data access

The data streams at the telescopes at the ESO observatory at Paranal and at the nearby OCA are currently handled by a part of their data flow systems that populates a local data archive as science, calibration, and technical data are produced by the instruments at the telescopes.
In the case of ESO, periodic incremental backups of the data archive contents are then produced on physical media, which are then sent by commercial post services providers to the ESO Headquarters in Garching. Once in Garching, the contents of these media are ingested in the central copy of the ESO Science Archive, from where it can become accessible to the scientific community. OCA data is handled similarly. This process can result in a delay of days between observation and data arriving in the archive in Europe. Part of this paradigm will change with the implementation of the fibre link.
The new ESO infrared survey telescope VISTA (Visible and Infrared Survey Telescope for Astronomy) uses the Observatory Data Flow System, and will dominate the data stream from Paranal once it enters regular operations with a data rate far exceeding that of all the VLT instruments combined. Therefore the EVALSO project will use VISTA as a test bed for the developments, together with the forthcoming survey telescope VST (VLT Survey Telescope), which also will have a fairly high data rate.

Virtual presence

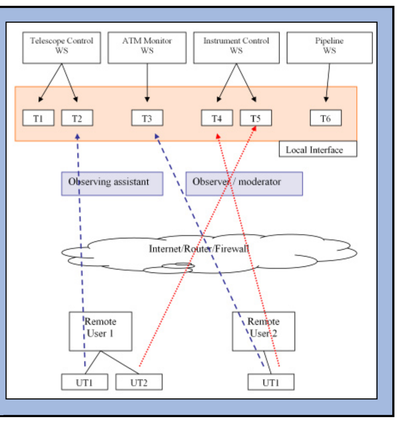
The main role of INAF–OAT within the project is to build a set of tools to implement a "virtual presence system" (VP system) for the scientists and for any other kind of experts, obviously embedded in a "virtual environment", that reproduces the local user interface at its better. This will be obtained 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 observer to interact with the local staff,.

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. Remote astronomical observing sites are natural candidates, but every situation where the remote presence of an expert is needed, are equally beneficiaries of such a system.

Virtual presence architecture

A survey of the already available GPL software has been performed in order to choose the tools and the software packages that satisfy the requirements at best. The future work will concentrate on making the chosen components work together and tuning them in order to achieve the desired functionality.

- **Session management**.The task is to make audio-video communication subsystem, interface sharing and secure tunnel work together as if they are a single solution. The SIP protocol may be used in this case to give support to this functionality, due to his extensibility and not being specific to VoIP only.
- **Interface sharing**. Currently the best suited software for this task is VNC and its derivatives. Some integration with custom written software or scripts will be needed to manage the required selective access and integration with the session management. The proposal is to perform a remote sharing of the local interface and it is not foreseen to run applications that access the data structures of the observing site.
- **Audio and video connection**. The preference will be given to software that relies on well known protocols and with good diffusion. Current open-source projects support SIP protocol for session initiation and RTP/RTCP for data transport; some of them support also the H.323 family of protocols. Such examples are Ekiga, Linphone, Minisip and others.
- **Security**. A possible solution is represented by VPN technology implementations like Openswan based on IPsec or openVPN based on SSL/TLS.



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