

Enabling Virtual Access to Latin-American Southern Observatories

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EVALSO (Enabling Virtual Access to Latin-American Southern Observatories) is an international consortium of nine astronomical organisations and research network operators, part-funded under the European Commission FP7, to create and exploit high-speed bandwidth connections to South American observatories. A brief description of the project is presented. The EVALSO Consortium inaugurated a fibre link between the Paranal Observatory and international networks on 4 November 2010 capable of 10 Gigabit per second.

It should come as no surprise that the remoteness which makes a site excellent for optical–near-infrared astronomy also conflicts with the need for good connections to a fast communications infrastructure. With the constant increase in data rates and, more generally, in communications needs, limits in bandwidth may impede the efficiency of operations, and hinder future expansion. For the ESO Paranal Observatory and the Ruhr-Universität Bochum Observatorio de Cerro Armazones (OCA), this conflict will soon cease to exist. On 4 November 2010, at the ESO Vitacura offices in Santiago, the EVALSO Consortium formally inaugurated a fibre-based system capable of 10 Gigabit per second (Gbps) to connect the two observatories to the international academic networks.

The partners of EVALSO are the Università degli Studi di Trieste, Italy; the European Southern Observatory; Ruhr-Universität Bochum (RUB), Germany; Consortium Gestione Ampliamento Rete Ricerca (GARR), Italy; Universiteit Leiden, the Netherlands; Istituto Nazionale di Astrofisica (INAF), Italy; Queen Mary, University of London, United Kingdom; Cooperación Latino-Americana de Redes Avanzadas (CLARA), Uruguay; and Red Universitaria Nacional (REUNA), Chile. More details of the overall project and its members are available at the EVALSO website¹.

The project focuses on two aspects:
 – building an infrastructure to connect observatory sites efficiently to the European astronomical community by linking to the network infrastructures created in recent years with EC support (in particular ALICE² and GEANT³);
 – promoting research activities to enable and validate new ways to interact with the remote facilities made available by high-bandwidth communications. More details can be found in Filippi et al. (2010).

The present article focuses on the communications infrastructure, which is broken down into two major components: the optical paths and the communications equipment. The locations served by the new high capacity infrastructure are: the ESO Paranal Observatory and OCA, about 1200 km north of Santiago; the REUNA offices in Antofagasta (about 120 km from Paranal); and the ESO and REUNA offices in Santiago de Chile.

The communications technology

To guarantee current needs while making provision for future performance demands, the EVALSO project has opted for optical fibre network paths that could be procured from commercial installations or, where none existed, created new ones. The use of dark fibres (i.e. physical fibres whose full capacity is available) and, where this is not economically possible, use of reserved wavelengths, provides an optimal and flexible infrastructure for the traffic management needs of today, with a clear potential for future growth. In order to exploit these optical communications most effectively, DWDM (dense wavelength division multiplexing) technology was selected for the communications equipment.

The optical path infrastructure (numbers refer to Figure 1) consists of:

- new fibre cables (1 and 4) that serve the Paranal Observatory and OCA sites up to Ruta 5 at La Varilla;
- a pair of fibres from the existing installation along Ruta 5 to relay from La Varilla to Antofagasta;
- fixed wavelength communication (2) between the telecommunications provider Point of Presence (TELCO PoP) in Antofagasta and Santiago;
- dark fibres (5) between the TELCO PoP and the end points in Santiago, namely ESO's Vitacura offices and the REUNA office in Providencia;
- and housing space for EVALSO equipment at the TELCO PoP in Antofagasta (6) and Santiago (3).

In order to connect the two observatories to the Chilean TELCO infrastructure, new cables had to be installed in the Atacama Desert for a total of about 100 km. The cables were of the type used for direct underground installation and the first cable, approximately 80 km long, was laid down between Paranal and the point of connection to the telecommunications provider's backbone, situated along the Panamericana (Ruta 5, the Pan-American Highway) at La Varilla. The second, approximately 20 km long, is between OCA and an intermediate point on the first cable. These installations established an optical fibre path between the two observatories and, together with the portion of fibre procured from the commercial network, to Antofagasta.

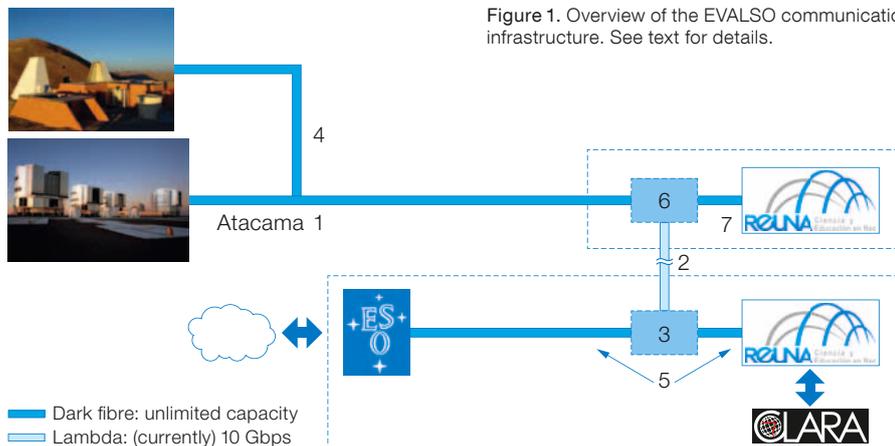


Figure 1. Overview of the EVALSO communications infrastructure. See text for details.

Underground installation is not only more secure, but limits the visual impact on the pristine desert environment. A special machine cuts a trench about 20 cm wide and 80 to 120 cm deep, depending on the nature of the soil (see Figure 2). The cable is suitable for direct installation without ducts (Figure 2). As reels of 4 km length are used, splicing boxes have to be placed in chambers at the same distance. The construction also crosses existing roads and a gas pipeline. A movie of the cable-laying process is included in the ESO podcast⁴. The distance from the end of the new cable, at the La Varilla crossroads, to the nearest installation of the telecommunications provider in Antofagasta is about 50 km. This distance has been covered by procuring a fibre pair from the existing facility. A fixed wavelength channel (LAMBDA), capable of carrying 10 Gbps, links Antofagasta and Santiago.

EVALSO equipment is installed at five nodes. At Paranal this node receives the traffic to and from both observatories. For each user community separate sub-channels are used to transport the traffic to its final destination. The aggregation point for the traffic handled by REUNA and from the observatories is sited at Antofagasta. Here the bundled (but not mixed!)



Figure 2. Two views of the work involved in laying the EVALSO optical cable from Paranal to link with the existing network infrastructure; upper image: cutting the trench; lower: laying the cable in the trench.

traffic is passed to the provider equipment for the approximately 1200 km section over the LAMBDA cable to Santiago. The LAMBDA termination in Santiago is the distribution point for the traffic coming from the northern region of Chile. Using local dark fibres, the Paranal traffic is delivered to the ESO Vitacura offices and the REUNA traffic to the REUNA offices in Santiago, and from there to the commercial and academic networks.

Project history and inauguration

The EVALSO project team (SA1 work package) began work in 2008 by taking over an initial market survey, which gave enough confidence in terms of technical and economic feasibility to continue with the project. Based on this input, the SA1 team detailed the specification of the final system and entered the procurement phase, assigning the optical paths to ESO (in coordination with OCA for their part of the connectivity) and the DWDM equipment to REUNA. The complex procurement phase took nearly the whole of 2009, leading to the final decision and the start of engineering in the last quarter. The installation of the new cables as well as the configuration and integration of the existing commercial parts, both paths and DWDM equipment, kept the team busy until October 2010, when the first transmission test could be made.

The EVALSO formal inauguration took place in a ceremony at the ESO Offices in Santiago (see the picture on the *Astronomical News* section page 40). The event was attended by a number of ambassadors and diplomats from EU countries, a very large delegation from the EC, high level officials from ESO, ALMA and other organisations. The event was opened by a short speech by the ESO Director General, Tim de Zeeuw, and there were speeches from Josè Palacios (REUNA president), Rolf Chini (RUB-OCA), Massimo Tarengi (ESO representative in Chile), Mario Campolargo (EC) and Ambassador Fernando Schmidt Ariztía (vice-minister of Foreign Affairs of Chile). Fernando Liello, Università degli Studi di Trieste, EVALSO Project Coordinator, explained the EVALSO framework and its relations with the overall academic research networks. The technical aspects of the EVALSO infrastructure were

illustrated by Giorgio Filippi, ESO, for the optical paths, and Sandra Jaque, REUNA, for the DWDM equipment.

The overall system is now available for the research activities of the EVALSO Consortium. There are three key areas that the project will develop:

- Fast and efficient access to data: at present, data collected at the Paranal Observatory can take anywhere from hours to weeks before it becomes available for use in Europe. EVALSO will allow data to be transferred in near real time.
- Virtual presence at the observatories: the bandwidth offered by EVALSO makes a “virtual presence” at the observatories possible.
- New possibilities in observing: EVALSO can serve several of the needs of its partner members, for example, by operating robotic telescopes on Cerro Armazones, supporting their use for educational purposes and improving the scientific exploitation of the capabilities of both observatories through innovative operations schemes, which will act as pathfinders for the operation of future facilities like the European Extremely Large Telescope.

As a member of the Consortium, ESO is planning to integrate the system into its communications infrastructure in the coming months, leading to its use in regular operation of the telescopes on Paranal.

Results of these developments will be reported in a future article.

References

Filippi, G. et al. 2010, *Proc. SPIE*, 7740, 77401G

Links

- ¹ EVALSO web page: <http://www.evalso.eu>
- ² ALICE network: <http://www.redclara.net>
- ³ GEANT pan-European network: http://www.geant.net/About_GEANT/pages/home.aspx
- ⁴ ESO Podcast: <http://www.eso.org/public/videos/eso1043a/>

