



# ALMA AOS/OSF-SCO Communication Infrastructure

Update for the 6<sup>th</sup> SAACC meeting  
2015-04-20

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*The Atacama Large Millimeter/submillimeter Array (ALMA), an international astronomy facility, is a partnership among Europe, North America and East Asia in cooperation with the Republic of Chile.*



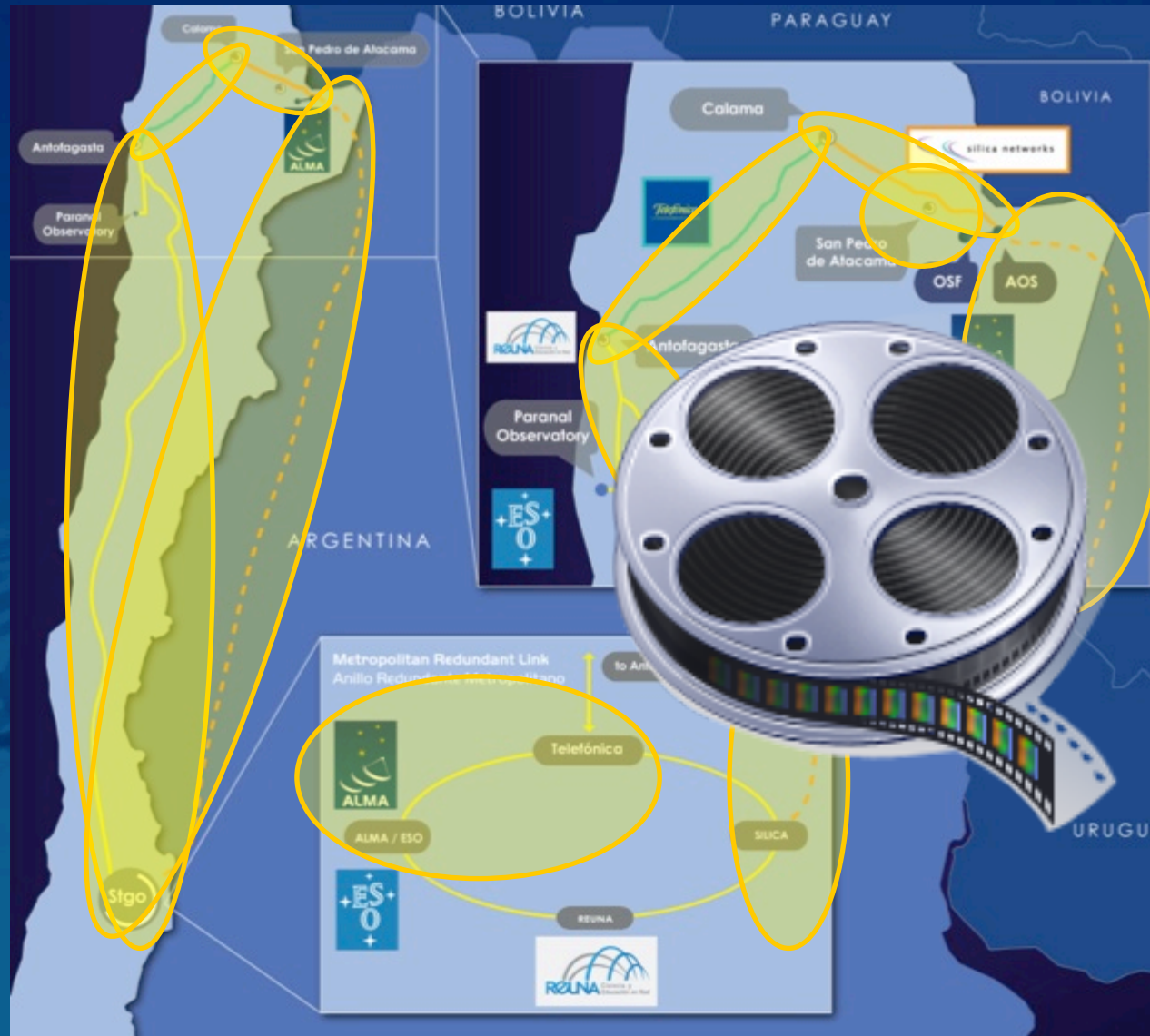
# PROJECT GOALS

ALMA OSF-SCO currently uses a 100Mbps Microwave (MW) link. The projected needs for full array operations is 300Mbps. Some recent developments may even move upward such value.

Need for a communication infrastructure between the ALMA Observatory site near San Pedro de Atacama and the JAO offices in Santiago capable of:

- Providing a long term (>15 years) solution infrastructure
- Coping with projected operations needs (>1Gbps) and scale further
- Minimize latency between the end sites
- Being available as soon as the array is completed (end 2013)
- Having reasonable upfront CAPEX and very low future OPEX
- If cost effective, taking advantage of the existing EVALSO capacity

# Architecture of the communication system



1. A dark fiber pair between AOS and CALAMA (about 150km): this comes from a newly built fiber cable.
2. A dedicated LAMBDA between CALAMA and the REUNA Point of Presence (PoP) in ANTOFAGASTA (about 200 km).
3. A dedicated sub-LAMBDA between the REUNA PoP in ANTOFAGASTA and the SCO at the Vitacura Campus in Santiago: this is indeed configured on the existing EVALSO backbone.
4. A dark fiber pair between AOS and the town of SAN PEDRO (2016).
5. A dedicated LAMBDA between AOS and Santiago via Argentina (2016-2018).



# PROJECT TIMELINE



2011		Feasibility study completed
2012	Mar	Project Plan completed
	Apr	ALMA Board approves the recommendation
	May-Oct	Procurement for AOS/OSF-Antofagasta optical path
	Nov	Contract with Silica and Telefónica signed
2013	Jun	Contract updated with new path and future redundant link
	Aug	Contract with REUNA for equipping & operating AOS-SCO link
	Dec	Fiber AOS-CALAMA: Construction start
	Dec	Lambda CALAMA-ANTOFAGASTA: provisionally accepted
2014	Feb	DWDM equipment selected (PADTEC)
	Sep	DWDM equipment installed
	Nov	Fiber AOS-CALAMA: Construction end (150km of fiber cable)
	Dec 18th	first end-to-end test





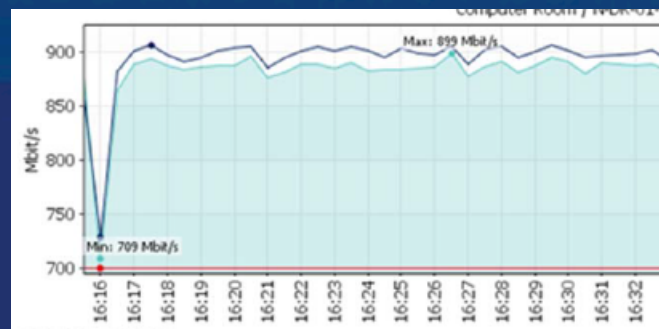
# FIRST END TO END TESTS OF THE LINK

## ALMA-AOS $\leftrightarrow$ ALMA-SANTIAGO



3-way  
video-  
conference

FTP on each of  
the two 1Gbps  
channels





# LINK ALMA-AOS ↔ ANTOFAGASTA COMPLETED AND INTEGRATED WITH THE EXISTING NETWORK UP TO ALMA-SCO (SANTIAGO)

See

ALMA  
announcement

for more

## ALMA Gains Broadband Connection with Global Science Community

Tuesday, 20 January 2015

ALMA's remote location is a boon to astronomy but a telecommunication challenge for the astronomers who work there. Thanks to a newly installed broadband fiber-optic line between the ALMA Operations Site (AOS) and the city of Calama in northern Chile, astronomers from around the world now have high-speed access, 25 times faster than before, to this world-class telescope.



The new system uses 150 kilometers of fiber optic cable to cover the distance from the astronomical observatory to the city of Calama, where it is then linked, through an existing high-speed communication line, to the research and academic network operated by REUNA (Red Universitaria Nacional) in Antofagasta that, thanks to the infrastructure that was developed as part of the EVALSO project, connects to the ALMA offices in Santiago, where the data are processed and shared with astronomers around the world.



Credit: ALMA (ESO/NAOJ/NRAO) - E. Diaz | [Download](#)



# (new) fiber cables AOS – CALAMA





# some snapshots from the construction



The special machines used to cut a trench, about 20cm wide and 80 to 120 cm deep, depending on the soil nature. The trench is ready to receive the cable.

The cable is suitable for direct installation (no ducts). A caterpillar is used to pull a special device (ripper) that insert the cable into the loose soil left at the bottom of the trench.



After the cable is in the ground, a warning tape is laid on top and the trench is filled with the material left by the original excavation.

As the cable is delivered in 4km reels, manholes are needed to host the splice box that is needed to connect two segments. Last but not least, the area is cleared from traces.



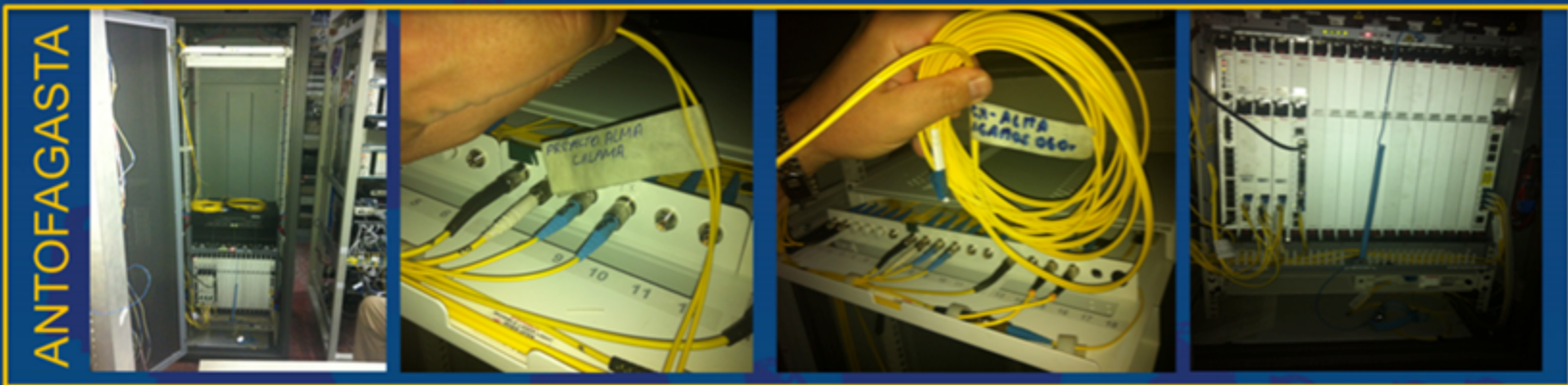




# “LAMBDA” between Calama and Antofagasta

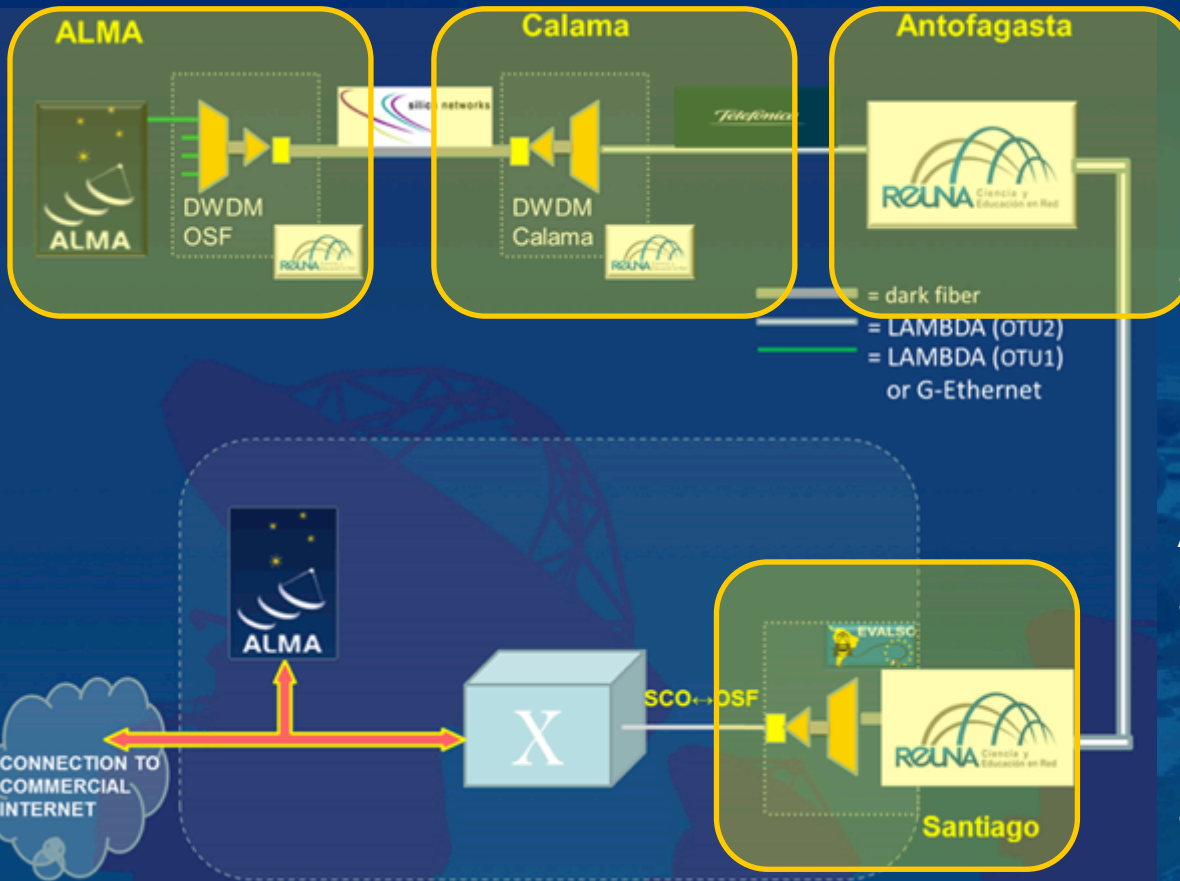


As this is part of the provider backbone, the solution include automatic backup at optical level (1+1).





# DWDM EQUIPMENT



As NEW installations:

- At the ALMA AOS border. This unit manages the traffic that ALMA generates and sends it, using an OTU2 channel, to the Antofagasta node.
- At the Telefónica PoP in Calama. This unit receives the traffic from the Observatory and feeds the OTU2 to the Telefónica Lambda to Antofagasta.

As upgrade of the existing EVALSO:

- In Antofagasta, the lambda coming from AOS via Calama has to be remapped into the EVALSO backbone.
- in Vitacura, the upgrade is minimal and consists in enabling the two 1Gbps ports where the communication is interfaced with the SCO LAN.

## The link will be operated by REUNA



## Relevance to ALMA strategic priorities



Efficient communication is a strong pre-requisite for all type of scientific and operational processes involving remote observing facilities.

With the availability of high bandwidth:

- data transfer processes can be made more efficient in both time and quality,
- data analysis, archiving, and other computational analysis can be located where more convenient, reducing operational costs,
- people interaction opportunities are increased by the enhanced quality of the audio and video;
- other organizational processes and activities may be moved from OSF to SCO with substantial savings in travel and accommodation costs.

Scientific Competitiveness: better communication can boost also scientific results because of:

- Data quantity and quality are not bottlenecked by the remoteness of the site,
- Reducing operational costs frees resources for other tasks, improving long term sustainability,
- Improved cooperation among people on the different sites maximizes the exploitation of the technical and human capital of the ALMA installation.

The new system will replace the existing one without major changes at technical level for the end user. Operation is at the same level as now, but with a higher stability.



# OSF-ANTOFAGASTA Optical Path: future redundancy

