CHAJNANTOR POINT OF PRESENCE FOR RESEARCH AND EDUCATION

REUNA: BRINGING CHILE AND THE WORLD CLOSER TOGETHER

The main mission of the National Research and Education Network of Chile, REUNA, is to be the national leader platform, which articulates, collaborates and communicates with science, culture and educational entities to integrate them in the global scenario.

With over 30 years' experience and currently composed by more than 45 higher education institutions, research centers and international astronomical initiatives, REUNA promotes and boosts the development of national R&E ecosystem. For this purpose, it has a robust, reliable and high-speed network infrastructure and innovative services for its community. Nowadays, REUNA's national digital infrastructure covers 14 regions from the cities of Arica to Coyhaique, and soon it will connect the Magallanes Region, linking the entire continental territory of Chile.

In order to accomplish its mission, REUNA has developed a strong collaboration with different international initiatives to strengthen the connectivity of its R&E community with their partners around the globe. The most outstanding ones are RedCLARA, Vera Rubin Observatory-AURA connectivity project, BELLA and AmLight. As a result, we have become the local digital bridge towards the Global Education and Research Network.

WE CONNECT TO THE MAIN ASTRONOMICAL OBSERVATORIES IN CHILE

For more than 15 years, REUNA has been working with the biggest astronomical centers installed in Chile, with the aim of providing them with personalized connectivity services in accordance with their exact capacity requirements, as well as high standards of network quality, security and network availability.

Currently, we connect and are in charge of the following network operation:

ATACAMA LARGE MILLIMETER / SUB-MILLIMETER ARRAY (ALMA)

This project is located in the Llano de Chajnantor, near San Pedro de Atacama, Antofagasta region, and is an international collaboration radio telescope integrated by ESO/NAOJ/NRAO.

- **National Astronomical Observatory of Japan (NAOJ)**
- **National Radio Astronomy Observatory (NRAO)**

EUROPEAN SOUTHERN OBSERVATORY (ESO)

Its telescopes are installed in Antofagasta and Coquimbo regions. Among them are Paranal (location of the VLT), La Silla, ELT (under construction) and APEX.

ASSOCIATION OF UNIVERSITIES FOR RESEARCH IN ASTRONOMY (AURA)

Located in Coquimbo region. Among its facilities are Cerro Tololo, Gemini Sur and the Vera Rubin telescope. In addition, under the same collaboration, is the Las Campanas Observatory.

ALMA: © ALMA (ESO/NAOJ/NRAO)

Paranal: © ESO/HHHeyer

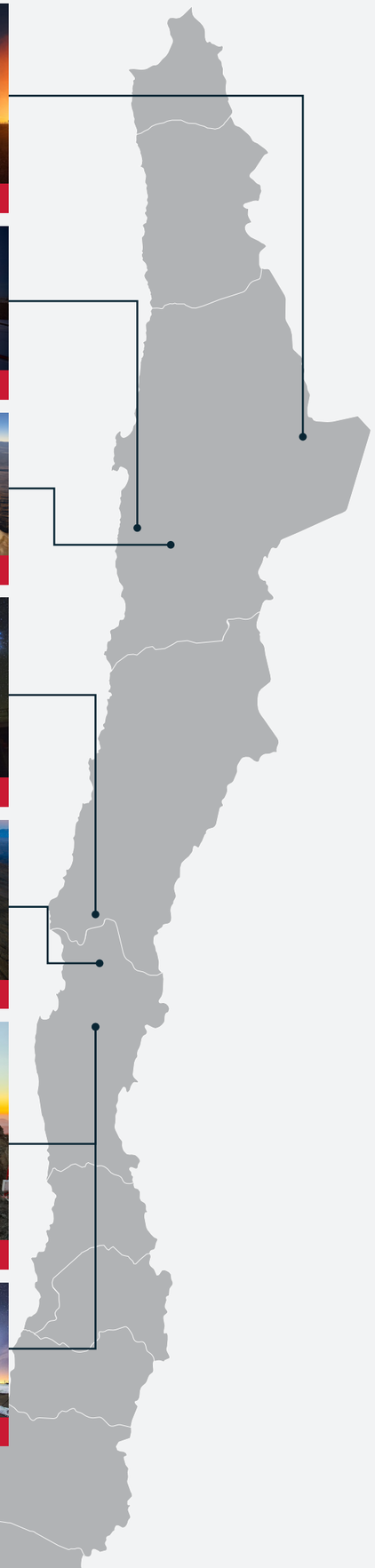
Armazones: © ESO/L. Consorcio Calçada/ACe

Las Campanas: © Las Campanas Observatory

La Silla: © Gerhard Hüdepohl/ESO

Pachón: © Rubin Obs/NSF/AURA

Tololo: © H. Stockebrand



COLLABORATION AGREEMENTS FOR ADVANCED CONNECTIVITY IN LLANO DE CHAJNANTOR

Since 2013, the ALMA Observatory has been connected to REUNA. Within the framework of this alliance, both institutions have established a new agreement to implement and operate a Point of Presence (PoP) of REUNA's network at the ALMA array operations site (AOS) technical building, located at 5,000 meters above sea level in the Atacama Desert in Chile. The aim of the PoP is to connect and transport the data from the different telescopes or astronomical projects, located in the Chajnantor plateau to National and International Research and Education Networks, as well as strengthen the relationship between ALMA and REUNA, in further developing digital infrastructure for research and education, improving ALMA's future connectivity and its connection with REUNA and its stakeholders.

In the same way, there is an agreement between REUNA and the Atacama Astronomical Park (AAP), which is the government entity in charge of managing Chajnantor Park. This agreement aims to establish a long-term collaboration in the implementation and operation of the interconnection of the different astronomical initiatives that are located in the AAP with the REUNA's network, for the transmission of data, both within Chile and towards international institutions. In addition, the parties seek cooperation with each other to facilitate and promote greater collaboration between the initiatives that are located in the Park and universities and research centers of the country, in astronomy and related areas.

EXPANDING THE NETWORK TO MEET THE NEEDS OF THE ASTRONOMICAL COMMUNITY

REUNA's northern backbone extends from Arica to Santiago, with capacities ranging from 10 Gbps to multiple 100 Gbps channels. This infrastructure is fully operated and managed by REUNA, providing the optimal technological conditions to support the scientific and academic development of our partners institutions that are based in the area.

All the links on the map are part of the REUNA's backbone and have a backup. This means that there are multiple routes to interconnect each PoP, which provides 100% accumulated availability of the network during the last three years. The connectivity between the PoPs in Antofagasta / La Serena and the Observatories is under the operation of REUNA and is part of the collaboration and joint work between the parties.

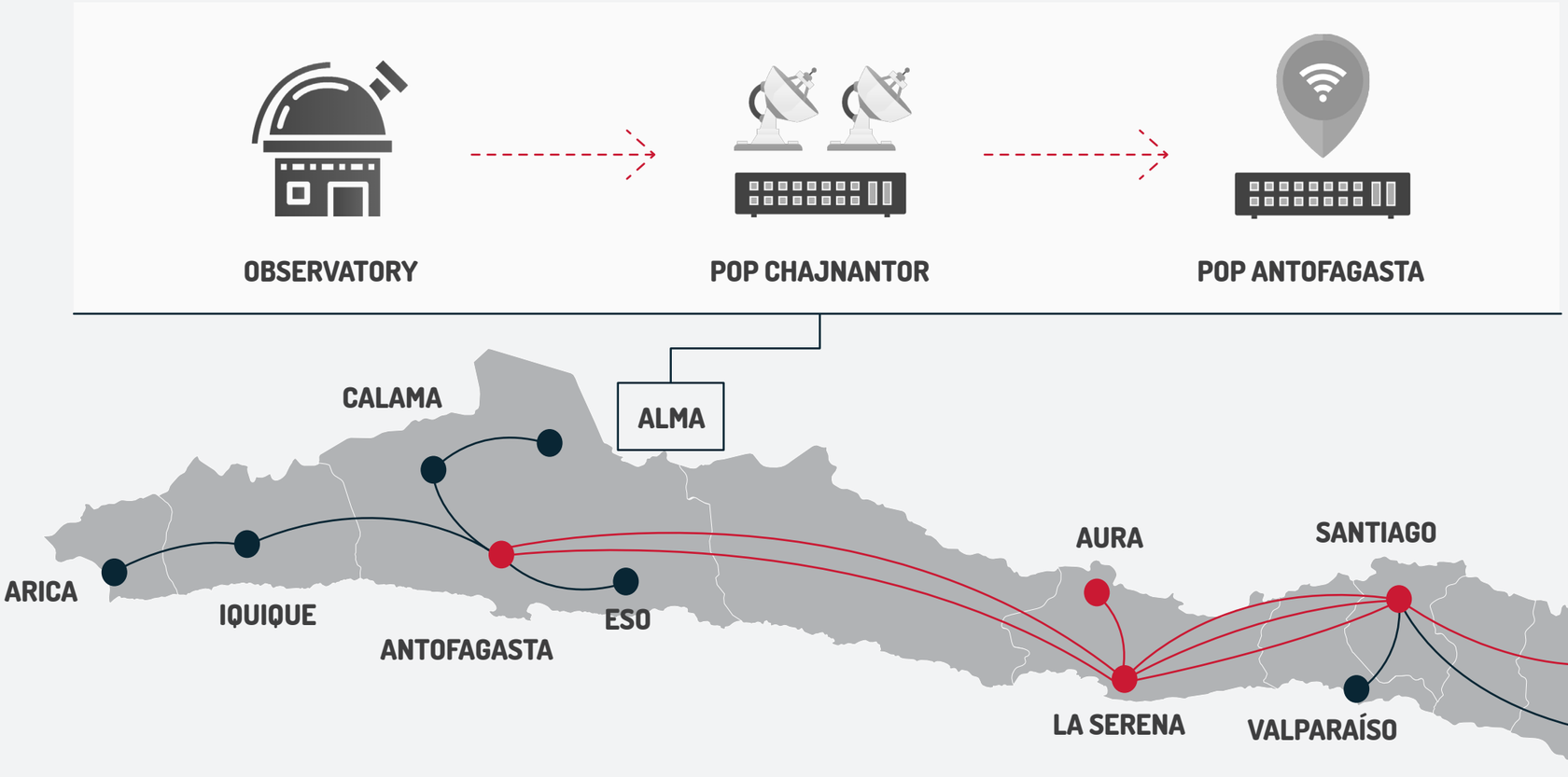
100 Gbps

10 Gbps

CONNECTIVITY FOR THE OBSERVATORIES AT LLANO DE CHAJNANTOR

The following diagram is a representation of physical connectivity for an astronomical project installed near the REUNA PoP in Chajnantor. As shown, the data will be transferred directly from the observatory to REUNA PoP. Physical connectivity is achieved through a synergy of efforts by different actors who, depending on the mountain where the observatory is located, works collaboratively, providing infrastructure to achieve the ultimate goal, which is a last mile in optical fiber. Two mountains, in the surroundings of ALMA, house the main telescopes: Cerro Toco and Cerro Chajnantor. In the first one, ALMA, PAA and the observatories themselves provide infrastructure, while in the second one, ALMA and the observatories have worked together to achieve that said objective.

Once the data is received at the Chajnantor PoP, REUNA will be in charge of transporting it to Antofagasta, and from there to Santiago through the backbone with a capacity of 100 Gbps, to be subsequently transferred abroad, across the International Research and Educational Networks.



INTERNATIONAL CONNECTIVITY DESIGNED TO MEET GLOBAL CHALLENGES

REUNA is part of the main international connectivity initiatives, and through them its members access to a supported platform, with a specific purpose for science and education, which allows to deliver services with expedited traffic and low latency to the main connectivity hubs, which are located in the US, Europe and Asia. This spirit of cooperation is the essence of the global R&D network community.

Currently, REUNA is part of the following projects and initiatives:

AmLight

The Americas Lightpaths Express and Protect (AmLight ExP) project promotes collaboration between research and education communities in the US and Latin America, through a high-speed network of 100 Gbps. REUNA is a partner in the project and a collaborator through its participation in different actions and experiments, in addition to participating in the South American – African Astronomy Coordination Committee (SA3CC).

RedCLARA

The Latin American Regional Academic Network provides regional interconnection and to the world through its links to GÉANT (Pan-European advanced network) and to Internet2 (United States) and, through them, to Africa's advanced networks (UbuntuNet Alliance, WACREN, ASREN), Asia (APAN, TEIN, CAREN) and Oceania (AARNET). RedClara's infrastructure is based on a 100 Gbps main ring that connects Chile and the US through links that run through the Pacific and the Atlantic oceans.

BELLA

The BELLA (Building the Europe Link with Latin America) project installed the first submarine optic fiber cable between Europe and Latin America. Part of the capacity of this new infrastructure is guaranteed by the exclusive use of the scientific and academic community, which will benefit more than 3,000 universities in Latin America and more than 400.000 people, including academics, researchers and students in Chile. The terrestrial infrastructure that completes this project connects, through 100 Gbps links, Chile, Argentina, Brazil, Panama and Ecuador.

REGIONAL VISION: BELLA TODAY AND GAZE TO 2030

- N x 100 Gbps
- 100 Gbps
- 10 Gbps
- L2 VLAN ≥ 10 Gbps
- 6 Gbps
- 5 Gbps
- 3 Gbps
- 2 Gbps
- 500 Mbps
- Estimated networks to 2030
- Countries with connection today
- Countries with estimated connection to 2030