

Optical infrastructure to support R&E networking in Brazil: recent developments and future plans

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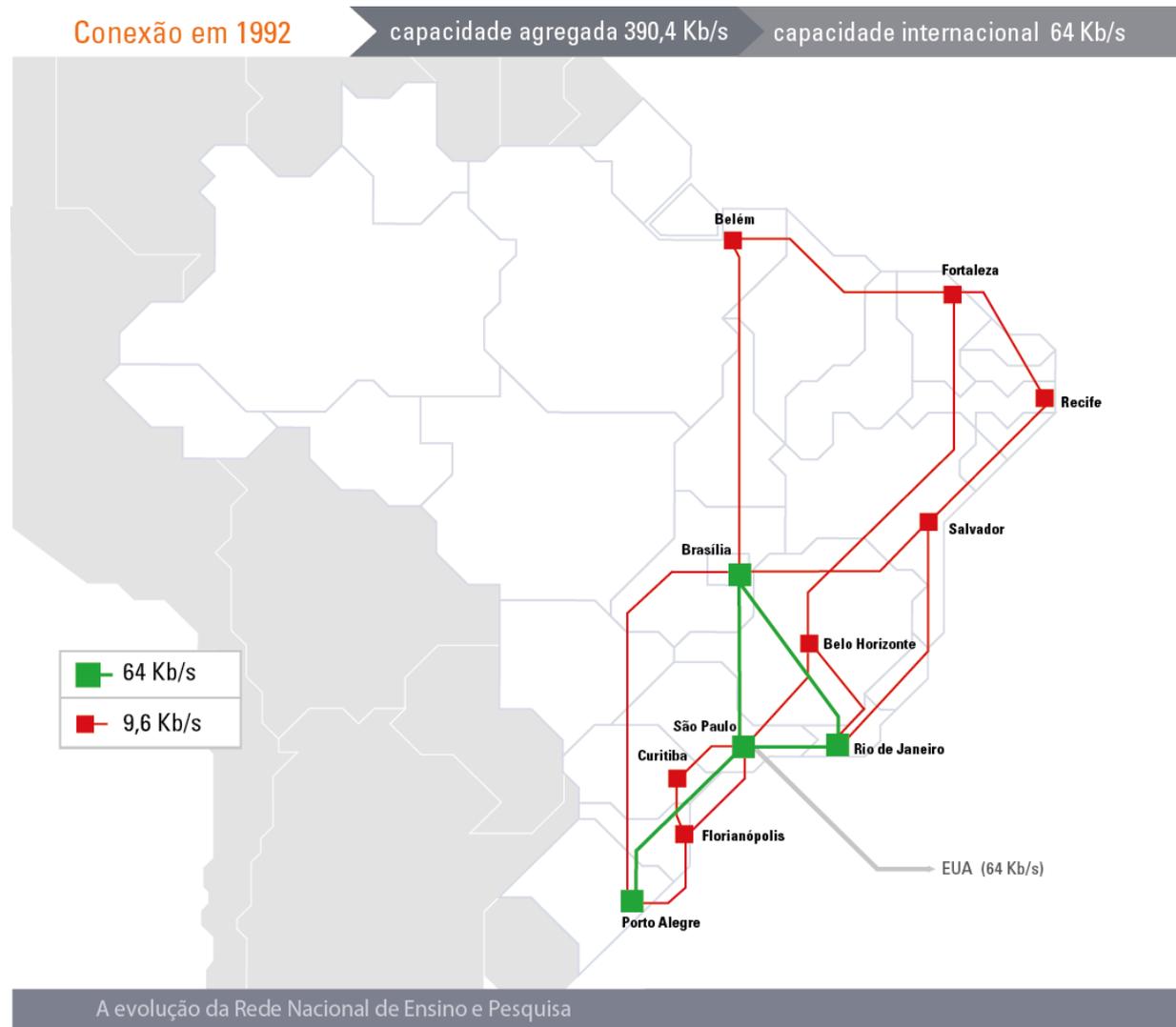
RNP

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- The talk first outlines recent developments in the use of optical infrastructure to provide high-capacity networking services to Brazilian research and education institutions.
- Most medium and long-distance communication infrastructure nowadays depends on use of optical fibre
- International connectivity depends on undersea optical cables
- Future planning implies obtaining long-term access to fibre optic assets (facilities) by construction, swap or IRU (Irrevocable Right of Use) contracts
- The talk describes the current situation and plans for the next generation links.

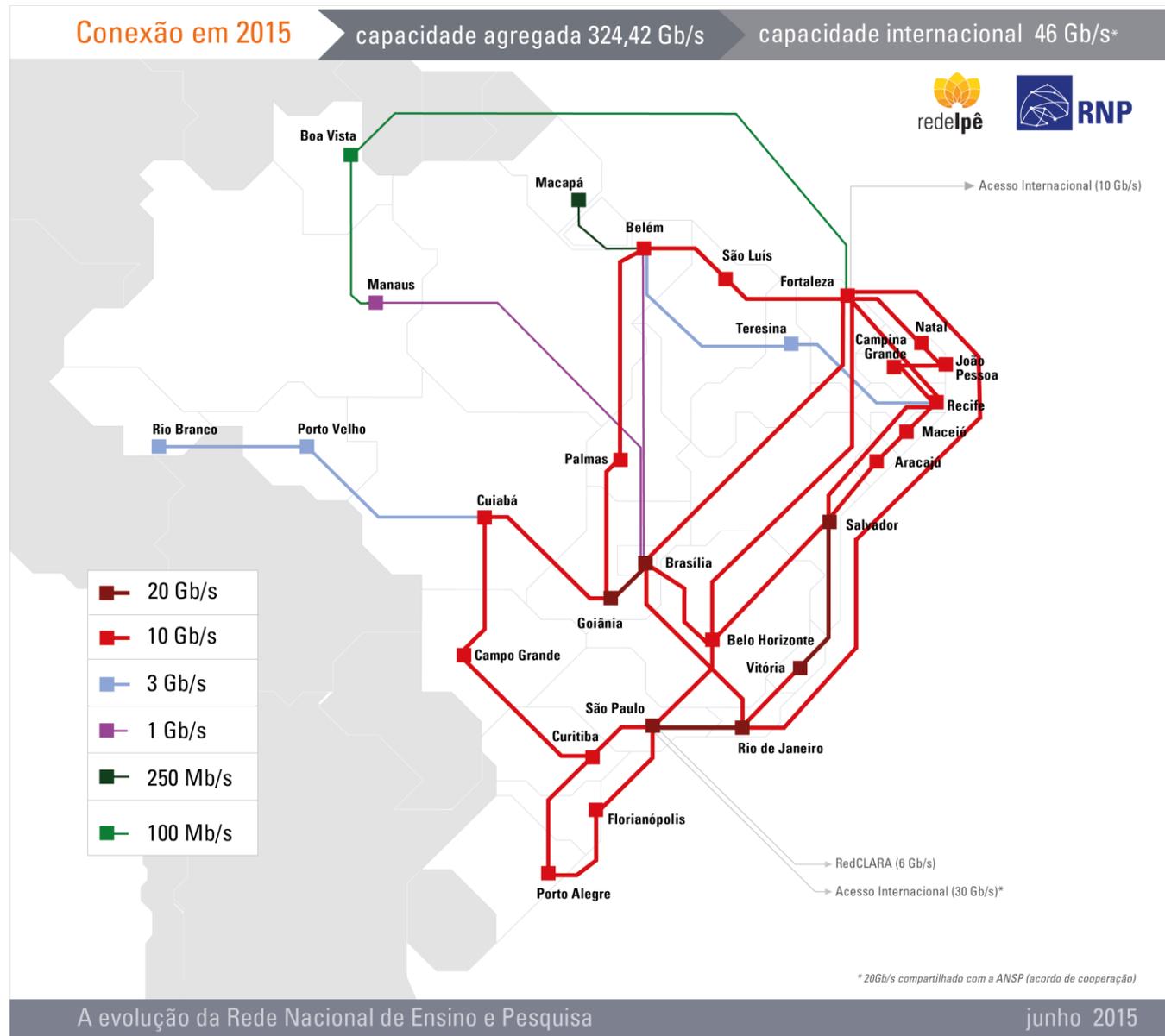
Backbone links were telephone circuits, terminated on IP routers:

Provided L3 services



Backbone links are optical channels terminated on IP routers:

Provides L2 and L3 services



Evolution of connectivity 1992-2014

1992 – 1999 – RNP was a project of the Ministry of S&T (MCTI)

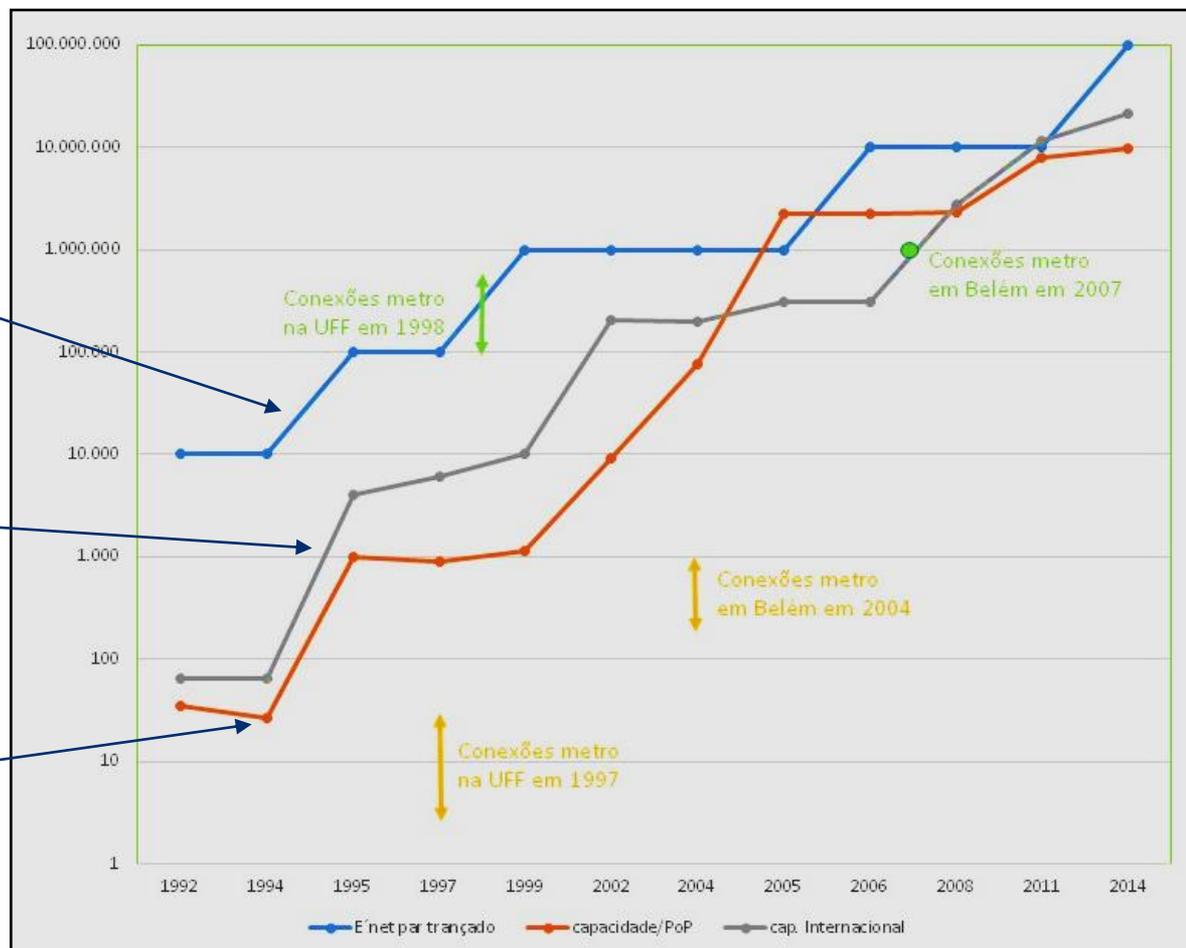
2000 – Interministerial Programme of support for RNP (S&T + Education)

2005 – Beginning of high-quality network

Limit of Ethernet transport in LANs

International Connectivity (capacity of circuits)

(Average) Backbone capacity



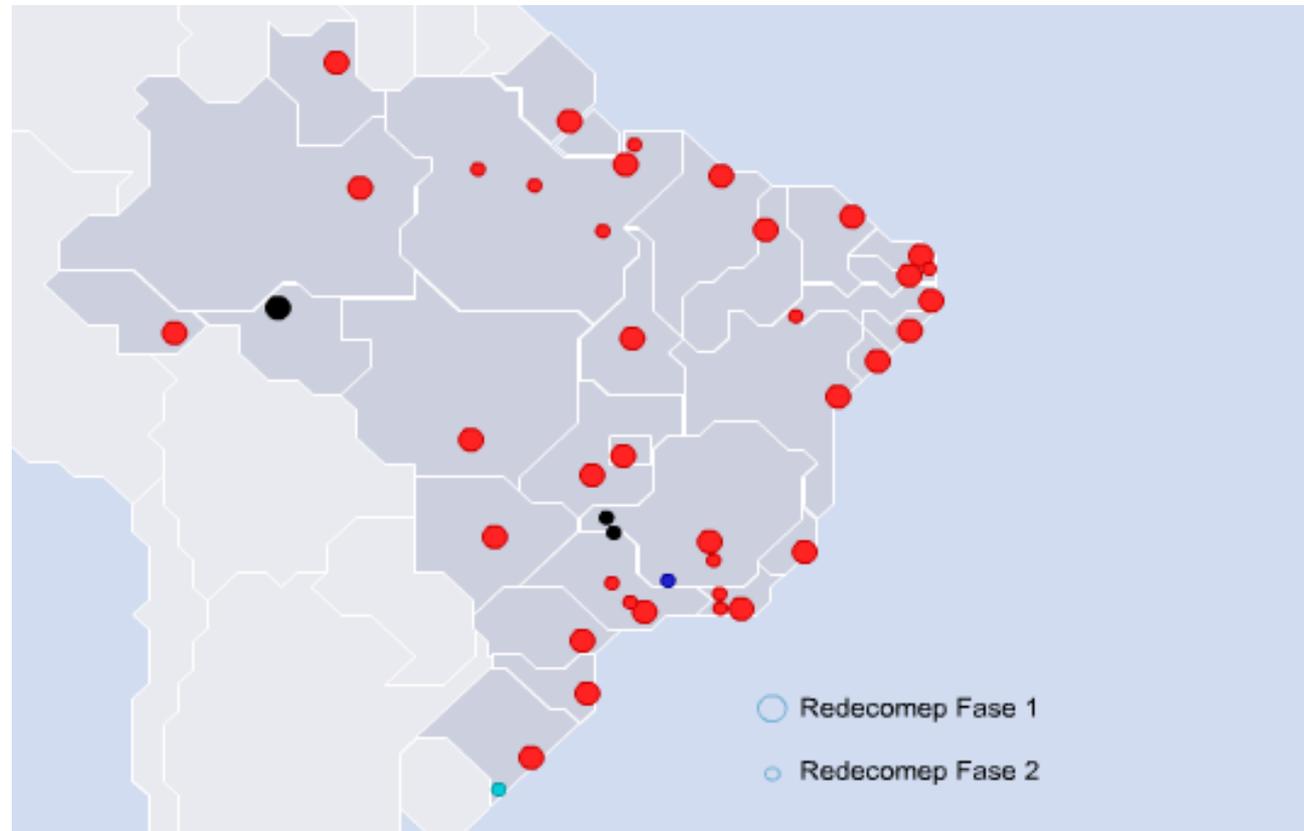
- The main objective of a network operator is to meet the (growing) connectivity needs of its clients
 - More clients, more users, more applications, bigger data objects
- Fortunately, network technology continually advances, and the price/bps falls continually (or there is no increase in cost for increased capacity)
- Increased capacity circuits has brought RNP to use the limit of circuit offerings by telco operators.
- Since 2005, RNP has begun to acquire its own optical infrastructure, firstly in metropolitan networks
- Since 2010, RNP began also to acquire long-distance fibre assets, normally shared with their owners (IRU)
- Actively seeking collaborations to acquire fibre assets both in Brazil and internationally

Optical metro networks

(Usually owned)
dark fiber
infrastructure to
connect campi at
(currently) 1Gb/s
or 10 Gb/s

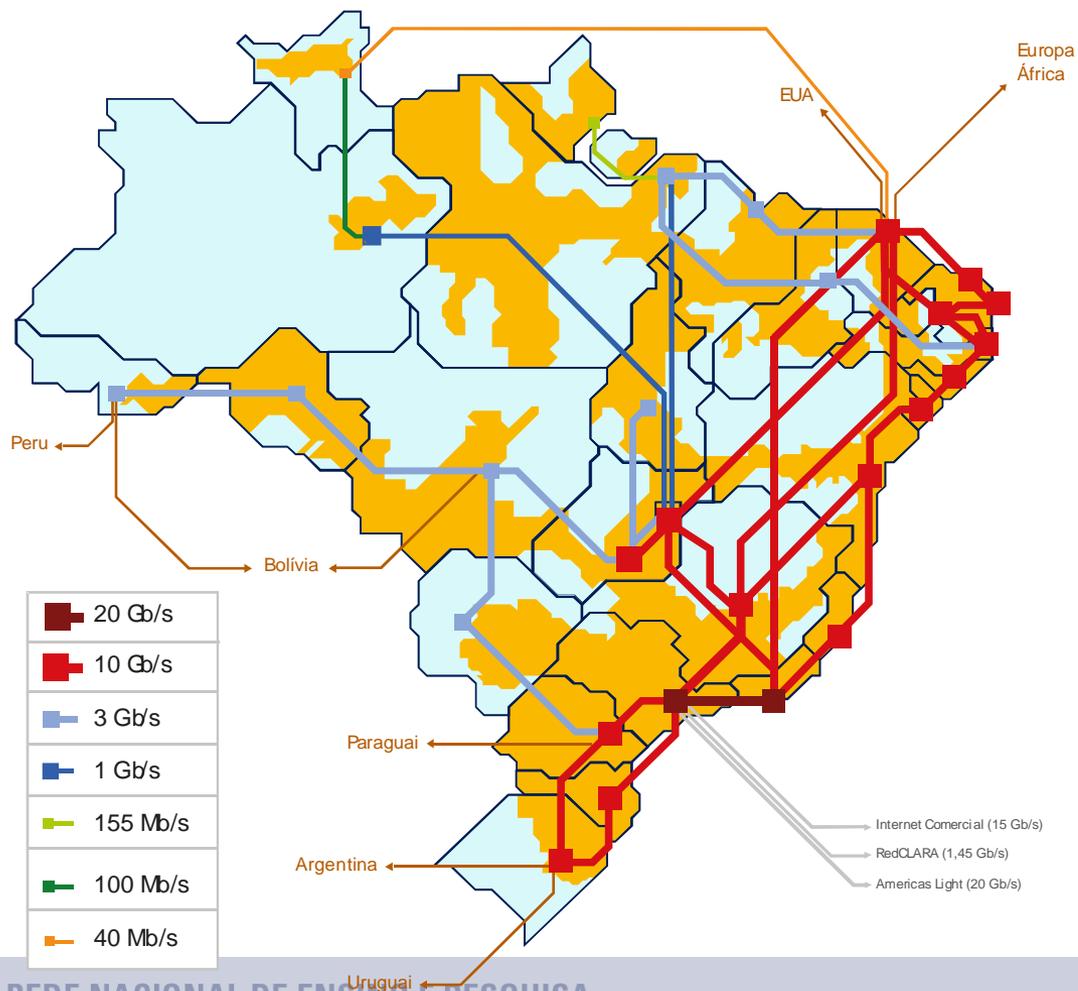
Phase 1:
capital cities

Phase2:
non-capital cities



Upstate connections

Apart from the multigigabit backbone que connects points of presence in state capitals, RNP connects upstate campi, at capacities between 100 Mb/s and 1 Gb/s, of universities and federal institutes.



RNP is served by 2 classes of international link

- RedCLARA is the Latin American backbone network, connecting NRENs of 13 mainland countries from Mexico south, with links to the US and EU. Includes cross-border links to neighbours: Argentina, Paraguay and Uruguay (soon). (The ALICE and ALICE2 projects partially funded by the EU)
- IRNC (submarine cable) links to US through WHREN-LILA and AmLight (IRNC) projects, upgraded in 2013-14 to 4x 10G (shared with ANSP – S. Paulo state network) (partially funded by the NSF)

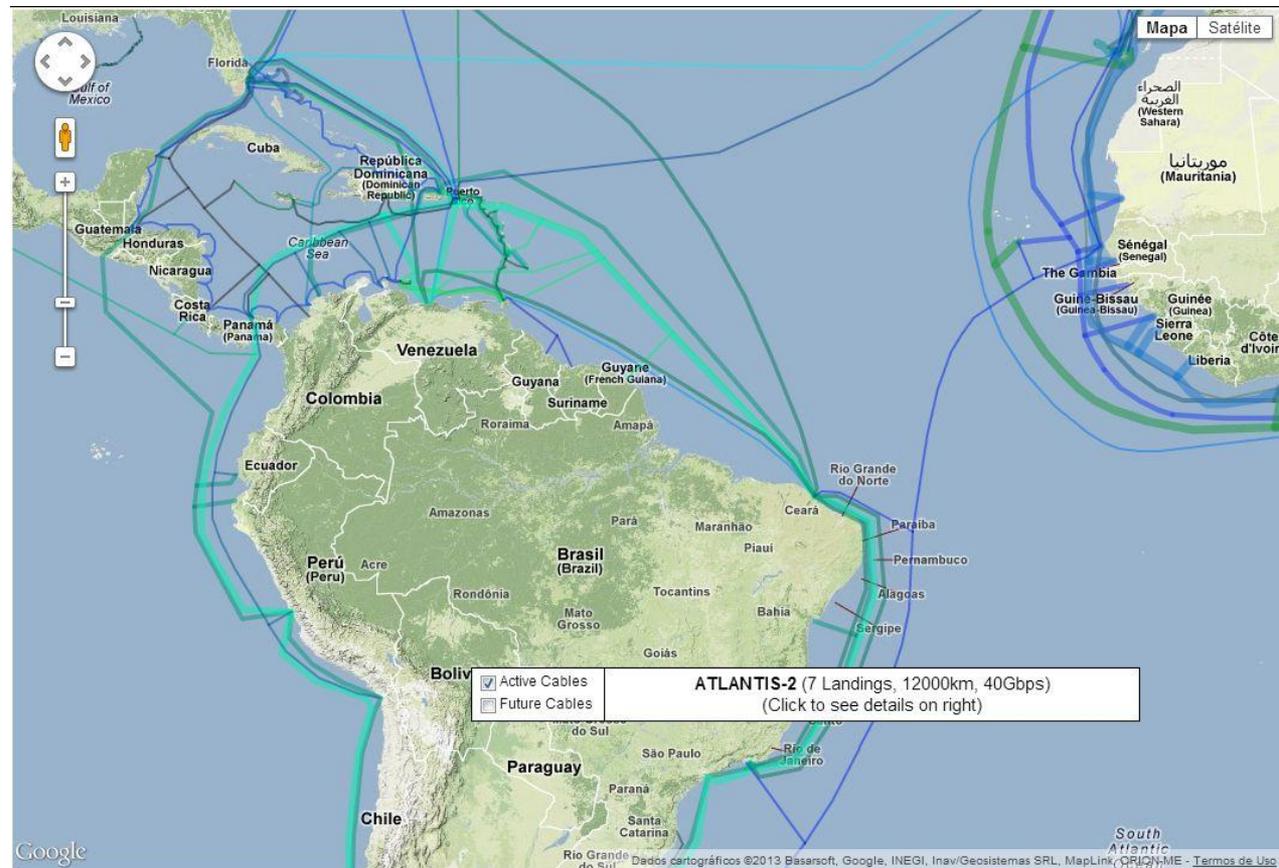
South American submarine cables

(Greg's Cables: <http://www.cablemap.info>)

Currently 3 major cables connect US to Brazil (using mostly 10G):

- SAM-1 (Telefonica)
- SAC (Level3 and LANautilus)
- Globenet (BTG Pactual – BR bank)

Announcements for future cables to Brazil from the US, Europe and Africa.



All cables from US (Florida or Virgin Islands). First stop is Fortaleza in NE Brazil, then on to Rio de Janeiro and S. Paulo

RedCLARA 2014

RNP is the largest network belonging to RedCLARA, and provides one of 3 backbone nodes, with other links to Argentina, US (Miami) and EU (London), just upgraded to 5G.

- Link to EU physically routed through US

RedCLARA is migrating to a facilities-based network with long-term IRUs on terrestrial fibre routes within both South America and Central America.

RedCLARA Network Topology
November, 2013 - Future Plan



Collaboration BR-US - AmLight

- Collaboration ANSP – RNP – AMPATH (AmLight East)
 - IRNC 2009 award by NSF
 - ANSP – S. Paulo state network
 - AMPATH – academic IXP in Miami
- 2013: 4 spatially diverse 10G links (SAC and SAM-1 cables) between São Paulo and Miami, shared between ANSP and RNP.
- Hybrid use of connections for IP and L2 circuits, including GLIF link to global partners



New submarine cables by 2017-18

100 Gbps circuits; opportunities for long-term IRUs

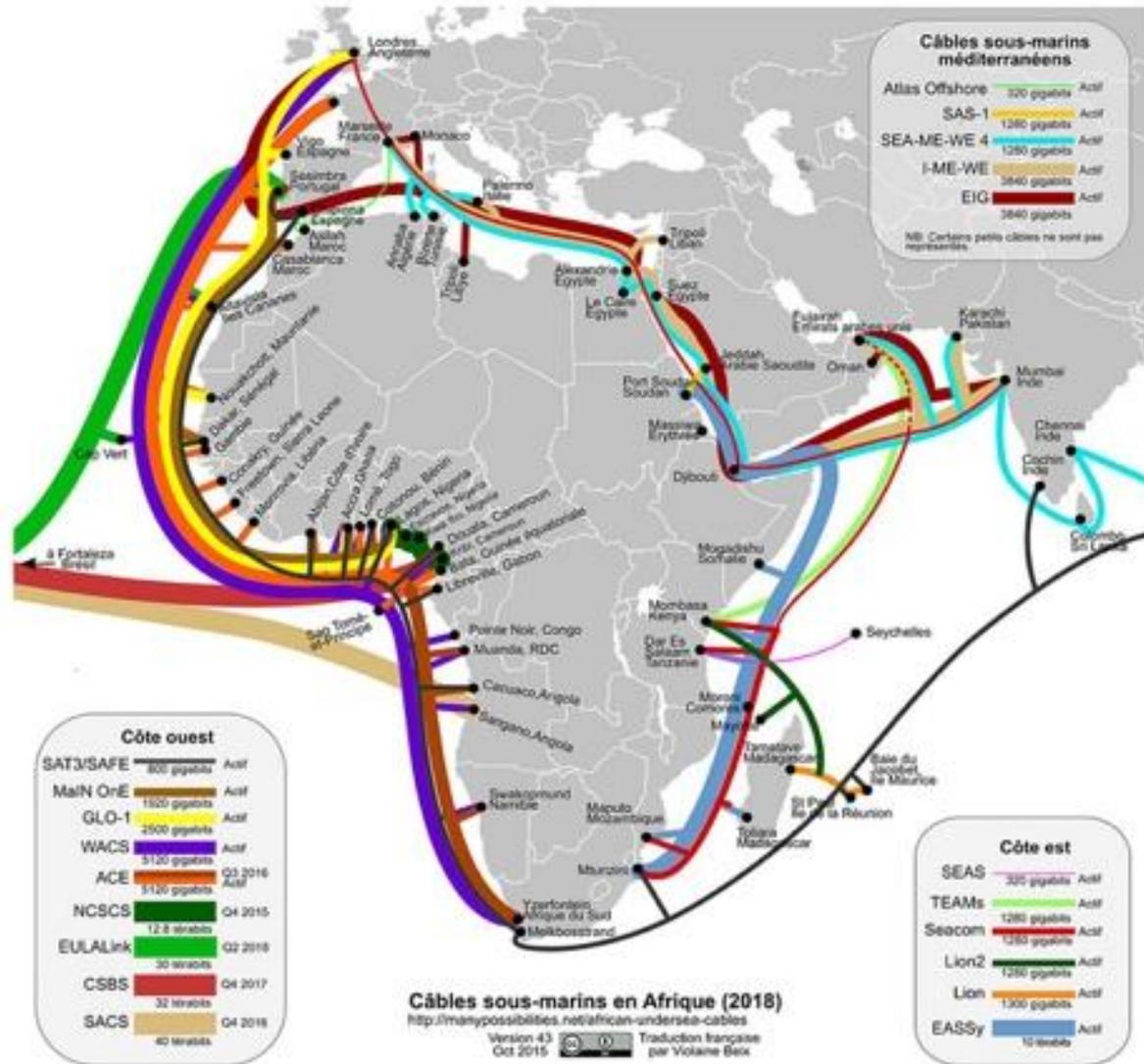


African cables in 2018

<http://manypossibilities.net/african-undersea-cables/>

Shows the proposed transatlantic cables from Fortaleza to Portugal, Cameroun and Angola

The latter two routes will enable a shorter path between the Americas and Africa, especially the SKA project in South Africa.



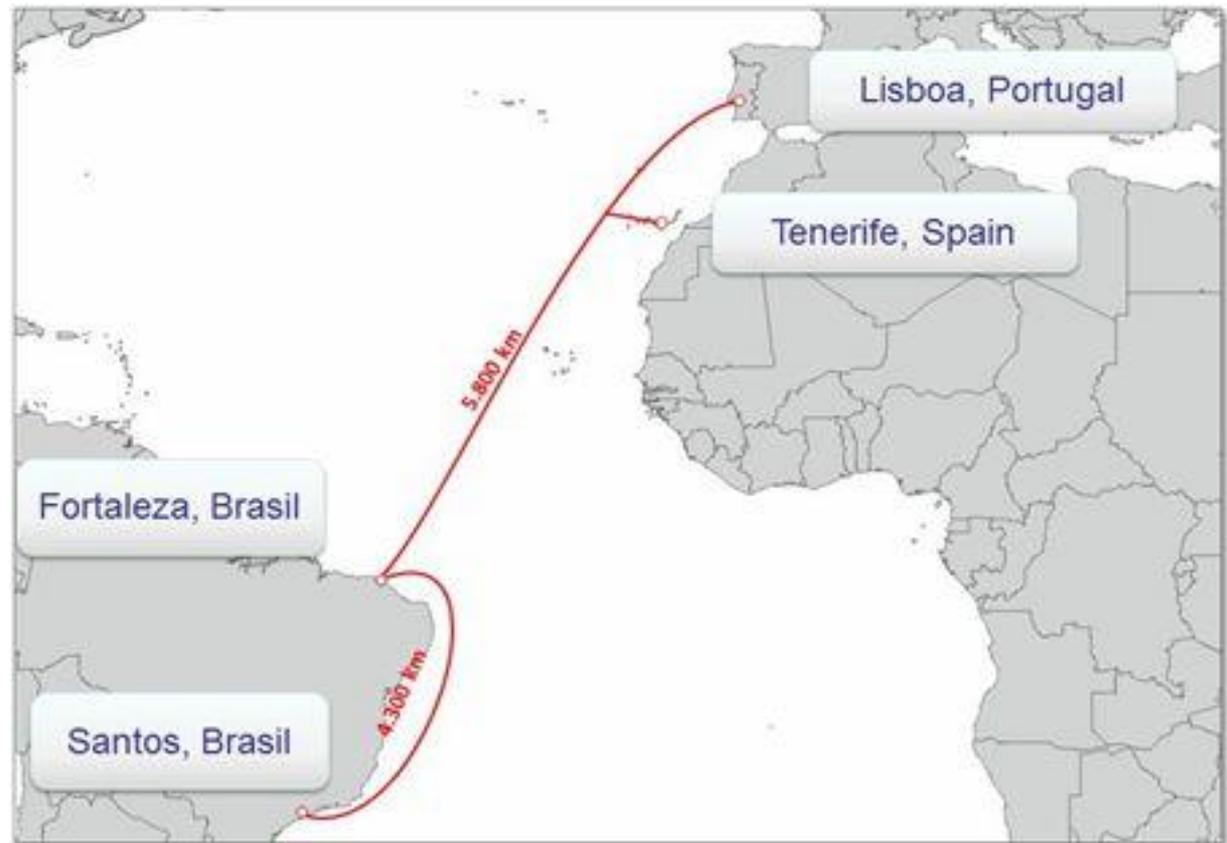
Ellalink cable

ELLA was EC/FP7 project for feasibility study of new direct EU-Brazil cable (2011-12).

- Aimed to “provoke” cable build.

Proposed EU-LA cable:

- Telebras, IslaLink (ES), investors (including academic networks)
- Initial link: Fortaleza-Lisbon by 2018
- Extension to Santos



Note that access in Tenerife (Canary Isles) permits links to West African North-South cables, providing redundancy to other links to Africa.

EU-LA cable: BELLA access network

EU-LA cable Brazil-Portugal

- Several RedClara partners (Brazil, Colombia, Ecuador) interested in paying for IRU for a substantial fraction of the capacity of new cable

BELLA terrestrial network from Fortaleza to Colombia

- Financed by RedClara partners through access to fibre assets
- Requirement to provide redundancy (by segment)
- Possible alternative route Fortaleza-Venezuela (within Brazil)



Elements:

- New Monet cable (Boca Raton -Santos)
- Amlight Protect (40 to 100G Atlantic & Pacific)
- Terrestrial links FOR-SP-Santiago
- Ellalink cable (FOR-Lisbon)

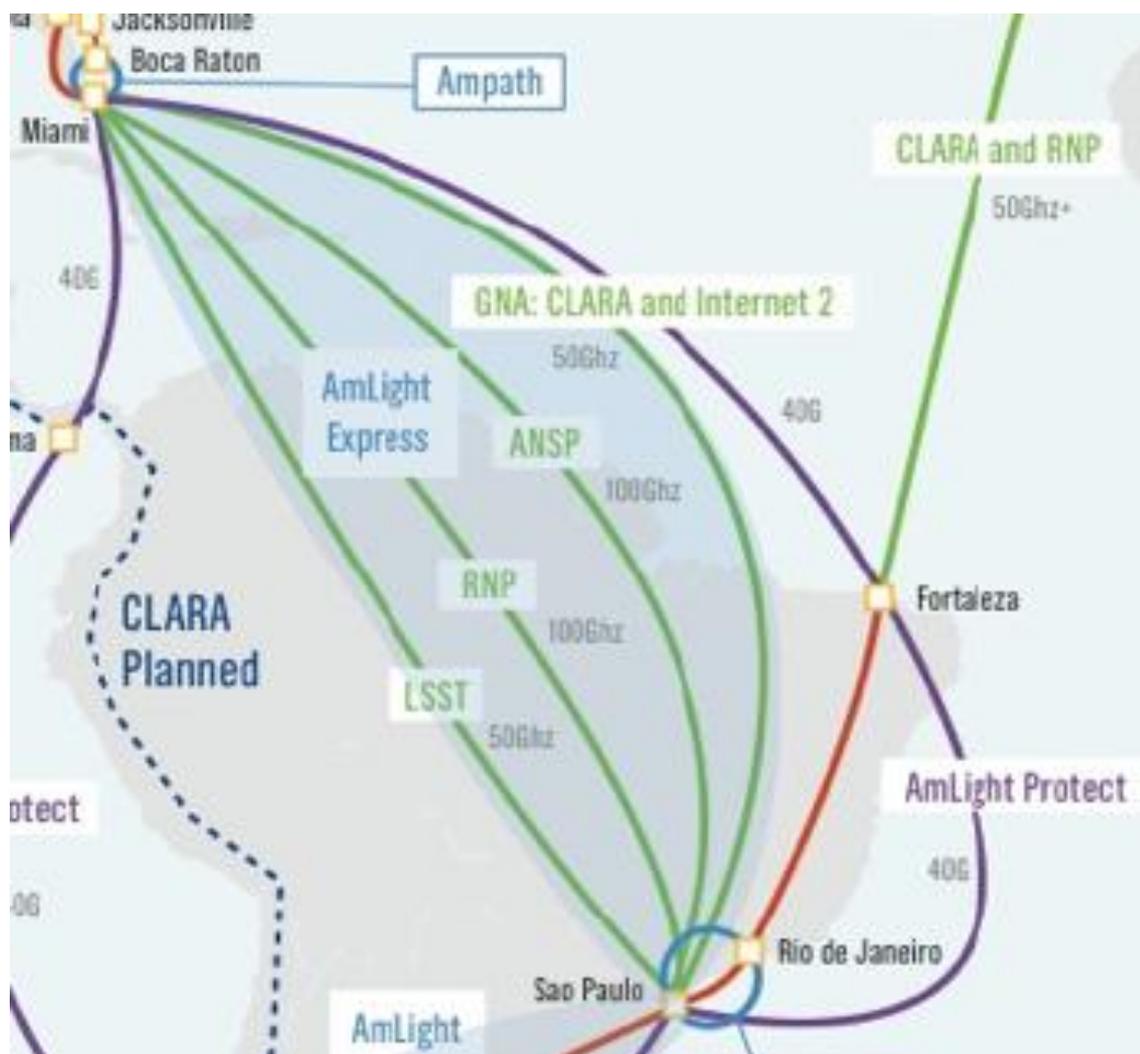
Observations

- Central America via Panama
- Possible cable from Colombia to Panama or US



New Monet cable US-Brazil

- Large Scale Synoptic Survey (LSST) telescope invested (via NSF) US\$15M for IRU for 6x 100G waves (300 GHz of spectrum)
- Beneficiaries:
 - LSST (1x λ = 50 GHz)
 - RedCLARA + I2 (1x λ)
 - ANSP (2x λ = 100GHz)
 - RNP (2x λ = 100GHz)
- RNP part:
 - Capex US\$1,2M (est.)
 - Opex US\$ 120-180K /ano)
 - Provide transit LSST to CL
- Landing in Fortaleza for access to other new cables to Africa & EU



- R&E networks are extending their coverage and upgrading their capacity, in order to meet the needs of a fast growing user community and the data demands of media, collaboration and the use of large-scale research infrastructures deployed around the globe.
- This is only possible due to close interaction between the principal R&E networks and long-range planning to ensure that this planned expansion is suitably and rationally financed.

Thank you!

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