RNP National Network Infrastructure and Support for Future Internet Research

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RNP – Rede Nacional de Ensino e Pesquisa

SwitchOn Workshop, São Paulo, Brazil 16/10/2015

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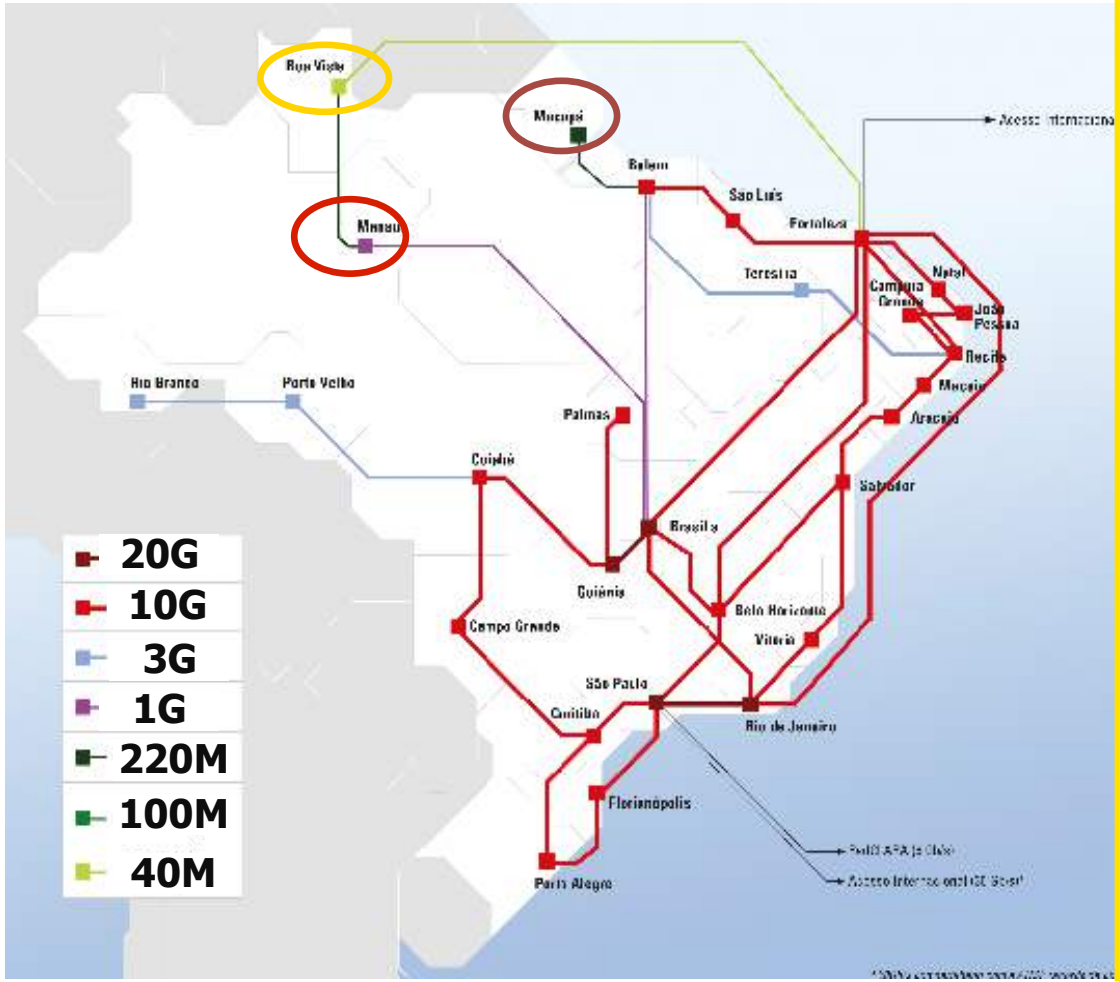
Agenda

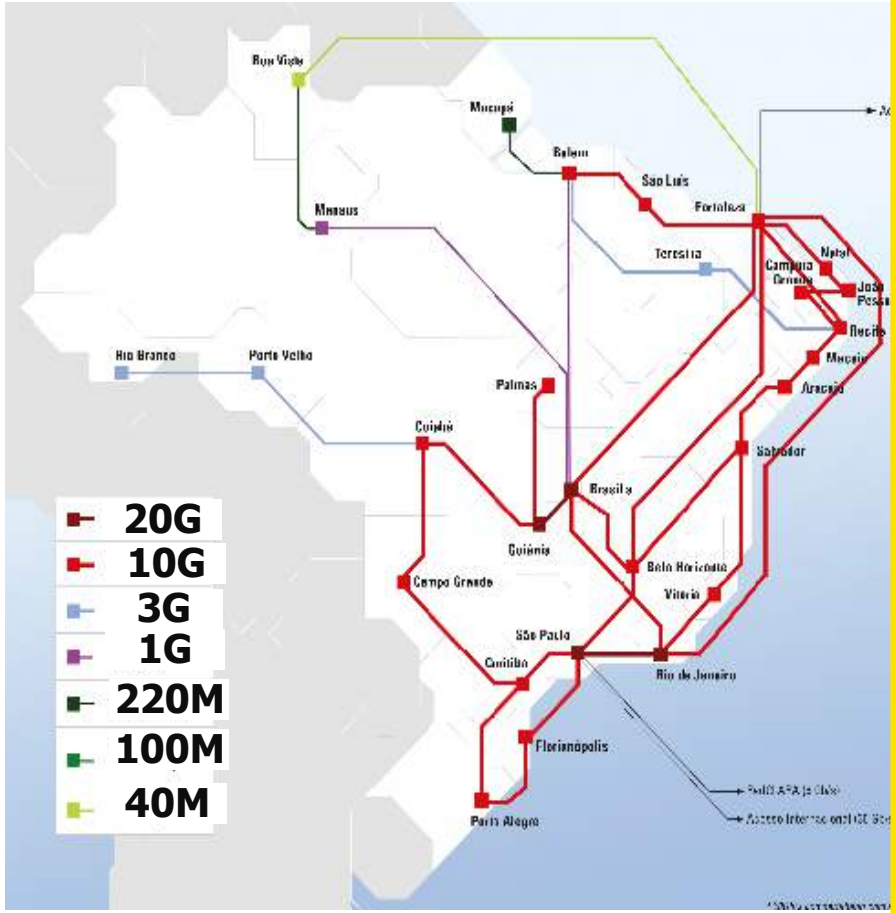
- Backbone network extensions
- New fibre infrastructure in Amazonia
- Planned international submarine cables
- Metro and other access networks
  (now providing access to over 1000 campi)

Brazil in 2014-15: 6th Phase “Ipê” 10G Core Network



- 10G Footprint extended to reach 21 of 26 state capitals
- Brasília – Manaus Link to 1G, via existing terrestrial link
- Completion of the optical fibre footprint: Manaus – Boa Vista (+ redundancy via submarine cable)
- New 2nd fibre across Amazon reaches the northern capitals Macapá and Manaus
  - RNP expects to get multi-Gbps to these cities soon
- Metro R&E dark fibre nets in 26 of 27 state capitals in operation 19 at 2X10G; 2 at 10G +3G;
  only Porto Velho left to be built.
- Completion of long-awaited 10G 300km long metro network in Rio used by 60 campi, including ON and LIneA sites

Brazil "Ipê" Core Network
Major Upgrades in 2014-15



- **3G to 10G Upgrade of circuits from Oi:** from Fortaleza to São Luís and Belém and from Goiânia and Curitiba to Palmas, Cuiabá and Campo Grande
- **New 10 G Telebras link** between Fortaleza and Recife
- New landing points in Rio de Janeiro and Fortaleza of the 10 G submarine link formerly connecting São Paulo to Miami via the Atlantic
- **Incorporation of** São Paulo – Rio de Janeiro and Rio de Janeiro – Fortaleza submarine links into the national backbone
- **Ongoing upgrades to metro R&E networks** Including Phase 2: non-state capital R&E metro networks

Aerial Amazon Crossing at Jurupari (Pará): 2100m span between 300m towers

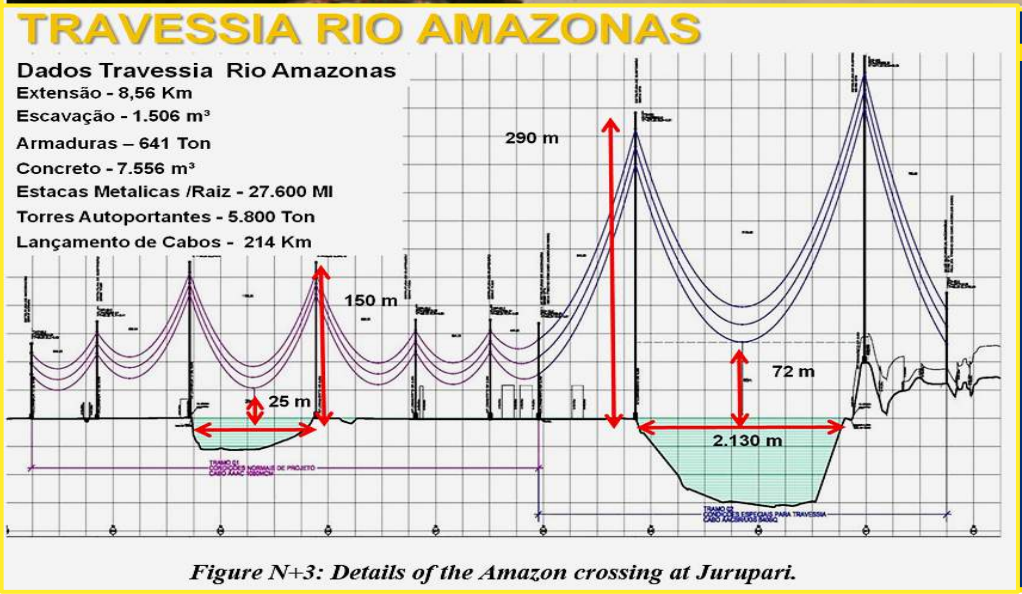


Figure N+3: Details of the Amazon crossing at Jurupari.

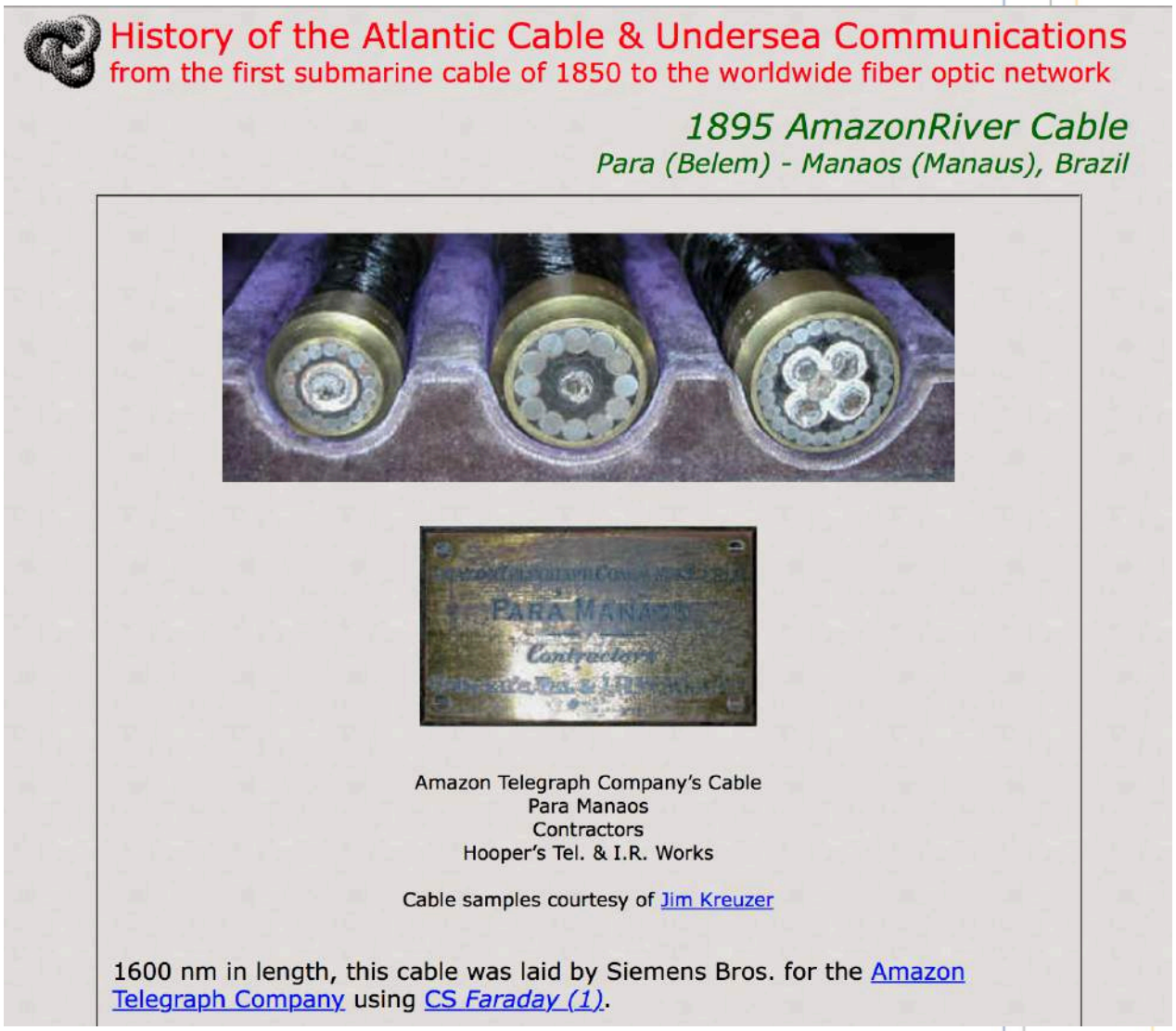
- New 2nd fibre across the Amazon reaches the northern capital cities Macapa and Manaus
  - Brings competition to the 1st terrestrial link to Manaus
  - RNP expects to get multi-Gbps access to these cities soon

Existing infrastructure in Amazonia

- Existing long-distance optical infrastructure in the Brazilian Amazon region
  - Belem-Manaus and Manaus-Boavista 2012
  - Macapá-Manaus 2013
- Does not reach the majority of the riverside population
  - Access to large cities, hydroelectric plants, gas centres, …)
  - Majority lives along the main rivers of the region

Amazon River Cable

- 120 years ago
- In 1895 a subfluvial cable **Belém > Manaus** was installed in the Amazon River



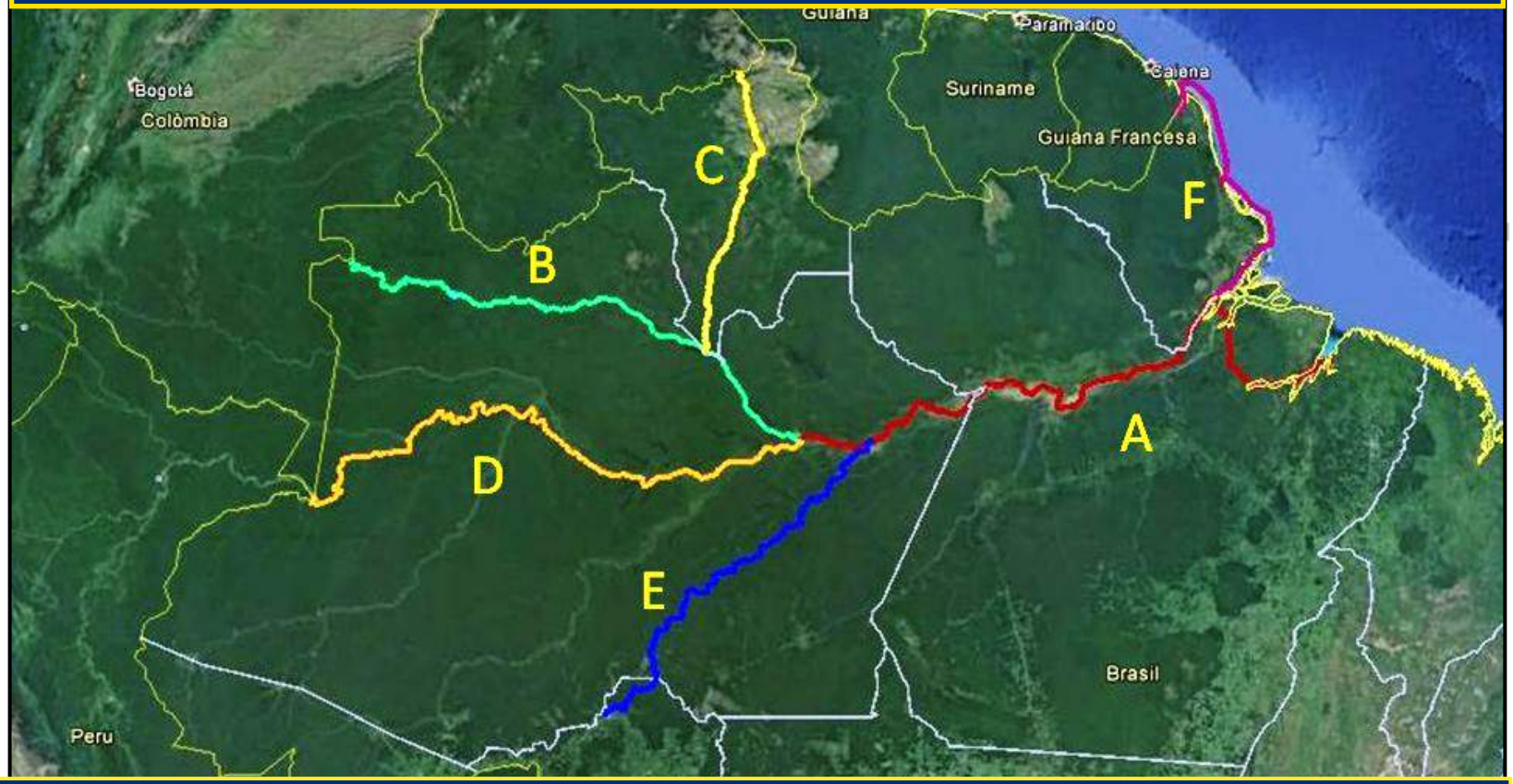
Source: **History of the Atlantic Cable & Undersea Communications**
http://atlantic-cable.com//Cables/1895ParaManaos/

Project “Amazônia Conectada”: 7.000Km of optical cables

- 5 “infovias” following the rivers of the regions:
  - Madeira
  - Purus
  - Juruá
  - Alto Rio Negro and
  - Alto Solimões
- Communities will benefit by way of smaller cables that connect with the main optical fiber.

RNP proposal for subfluvial cables along major rivers in the north

- Complementing existing fibre infrastructure
- 200km pilot along Route D feasible in 2015



Possible major routes for subfluvial fibre optic cables.
Rivers: A: (lower) Amazon; B: Negro; C: Branco; D: Solimões (upper Amazon), E: Madeira; F: maritime route to French Guiana.

Pilot for subfluvial cable project

- First stage
  Coari > Tefe
  (200 km) (Route D)

References:

- Grizendi, E. ; Stanton, M.A. “Use of subfluvial optical cable in a region without land-based infrastructure - a project to deploy optical cable in the Amazon region”. UbuntuNet-Connect 2013, Kigale, Rwanda. http://www.ubuntunet.net/sites/ubuntunet.net/files/grizend.pdf

- Siemens, A., “Cable Laying on the Amazon River”, Nature vol 54, 162-164 (18 June 1896). Also available at http://www.atlantic-cable.com/Cables/1895ParaManaos/

Subfluvial cable

- **Collaboration between:**
  - Brazilian Army (Exército Brasileiro)
  - Rede Nacional de Ensino e Pesquisa (RNP),
  - Companhia de Processamento de Dados do Amazonas S/A (Prodam),
  - Secretaria de Ciência e Tecnologia do Estado do Amazonas
  - Instituto de Pesquisa Ambiental da Amazônia (Ipaam)
- **Joint-venture objective: bring multigigabit capacity for military, R&E institutions, state public agencies and support for people living in the Amazon region.**

New South Atlantic cables
Monet (Miami), SACS (Luanda), eulaLink (Lisbon)

- Monet Cable: 3 Telcos in Brazil, Uruguay, and Angola
  Planned to be operational by 2017
  - LSST to purchase 300 GHz of spectrum on one fibre pair (Currently enough for 6 X 100G) proposed to be funded by NSF
  - 2/3 of this is proposed to be used by RNP and ANSP in exchange for access networks in Brazil and neighbouring countries

South Atlantic Cable System (SACS) (by 2016)

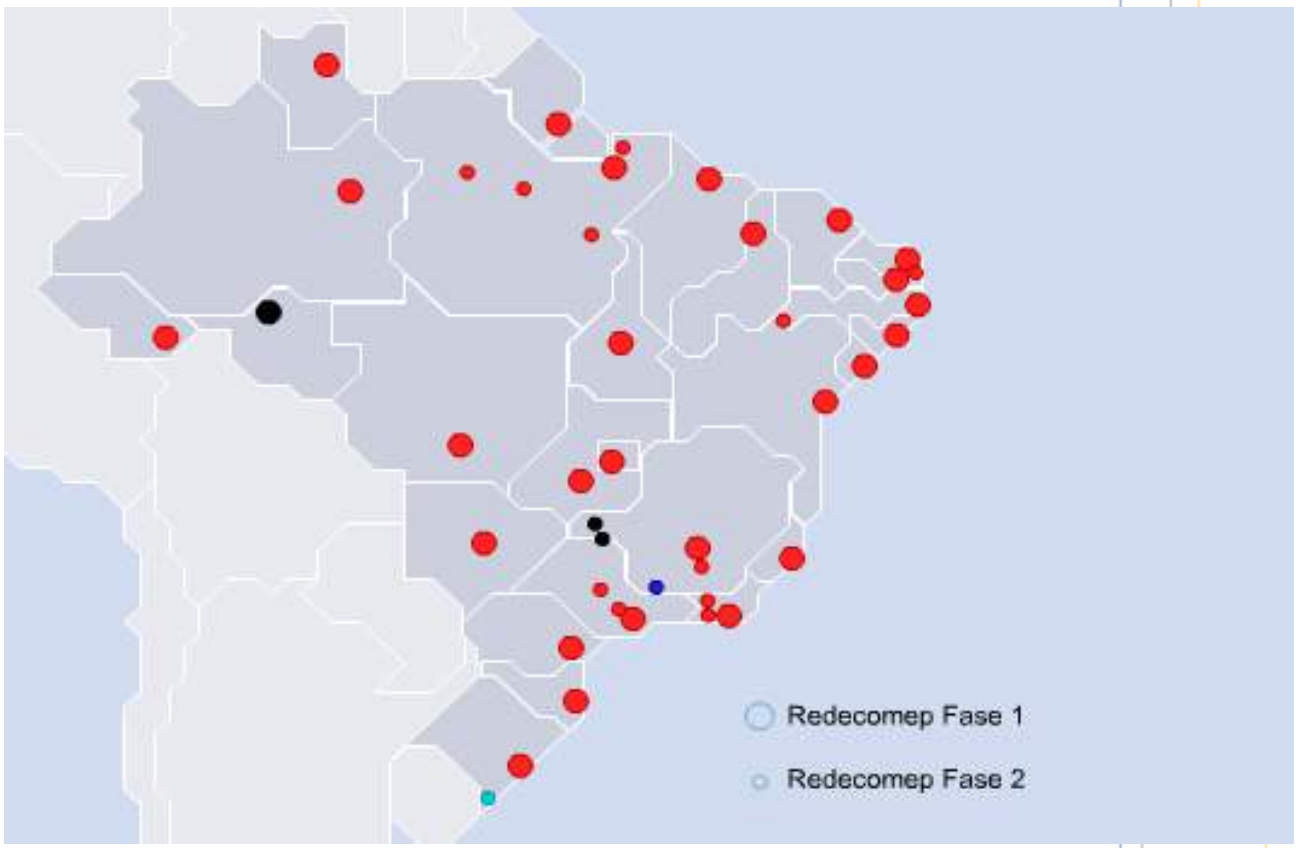
- Owned by Angola Cables
- Shorter route Africa > US
- suited to link SKA to US (?)

eulaLink Cable (by 2017)

- Telebras + IslaLink (Spain)
- Shorter route S.America > EU
- 2 THz Spectrum for LA+EU RENs

Optical Metro Networks

- **Provide high-capacity access to campi**
  - (Usually owned) dark fibre infastructure to connect campi at (currently) 1Gb/s or 10 Gb/s
- **Phase 1:**
  - capital cities
- **Phase2:**
  - non-capital cities



September, 2014: more than 400 campi connected in 40 networks, with the inauguration of the 300km metro network in Rio de Janeiro (Redecomep-RJ)

Integração metropolitana

Última atualização em abr/2012

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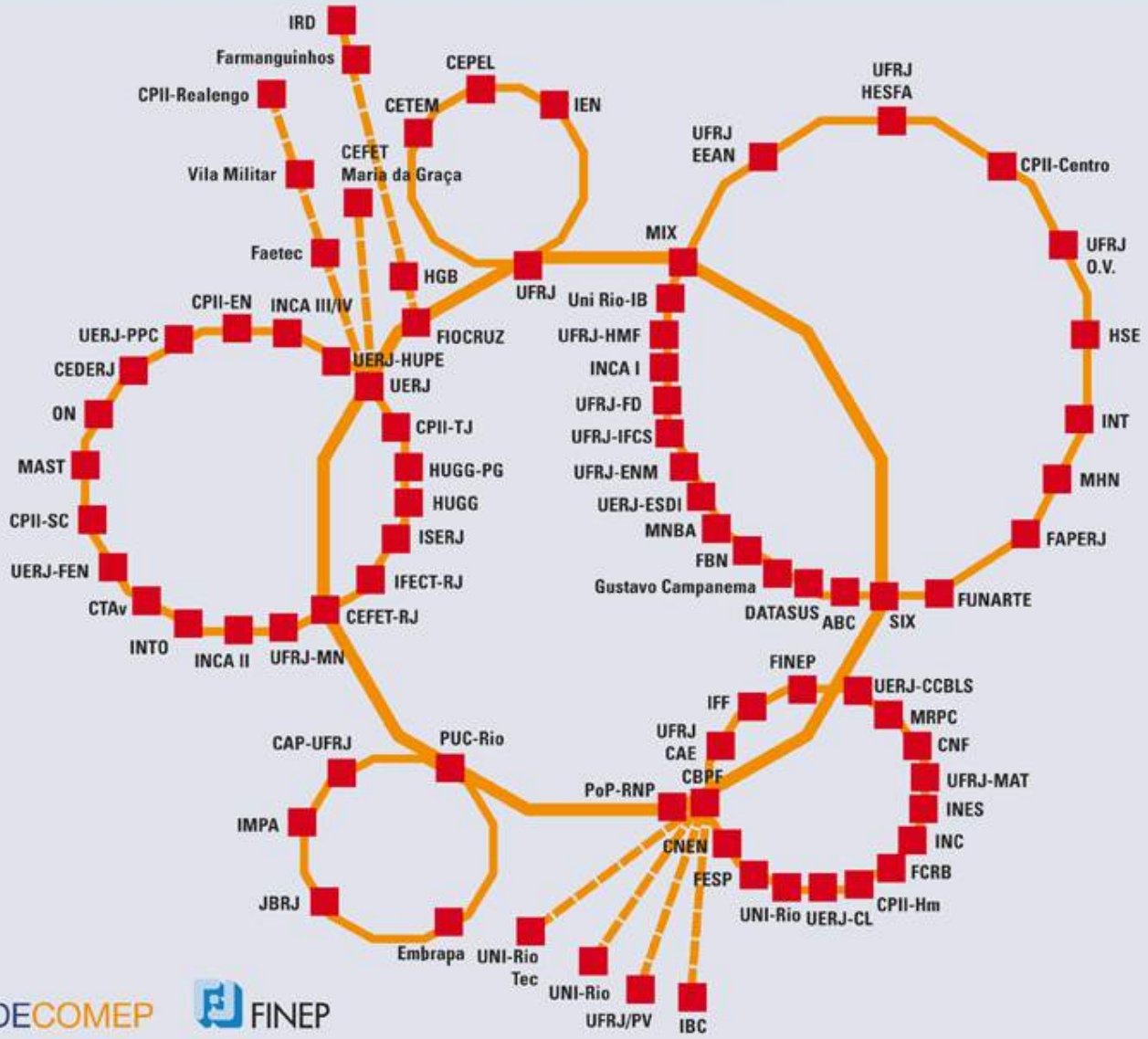
Rio de Janeiro	Extensão de rede	Investimento estimado
Rede Metropolitana do Rio de Janeiro	303 Km	R$ 9.000.000,00



REDECOMEP FINEP

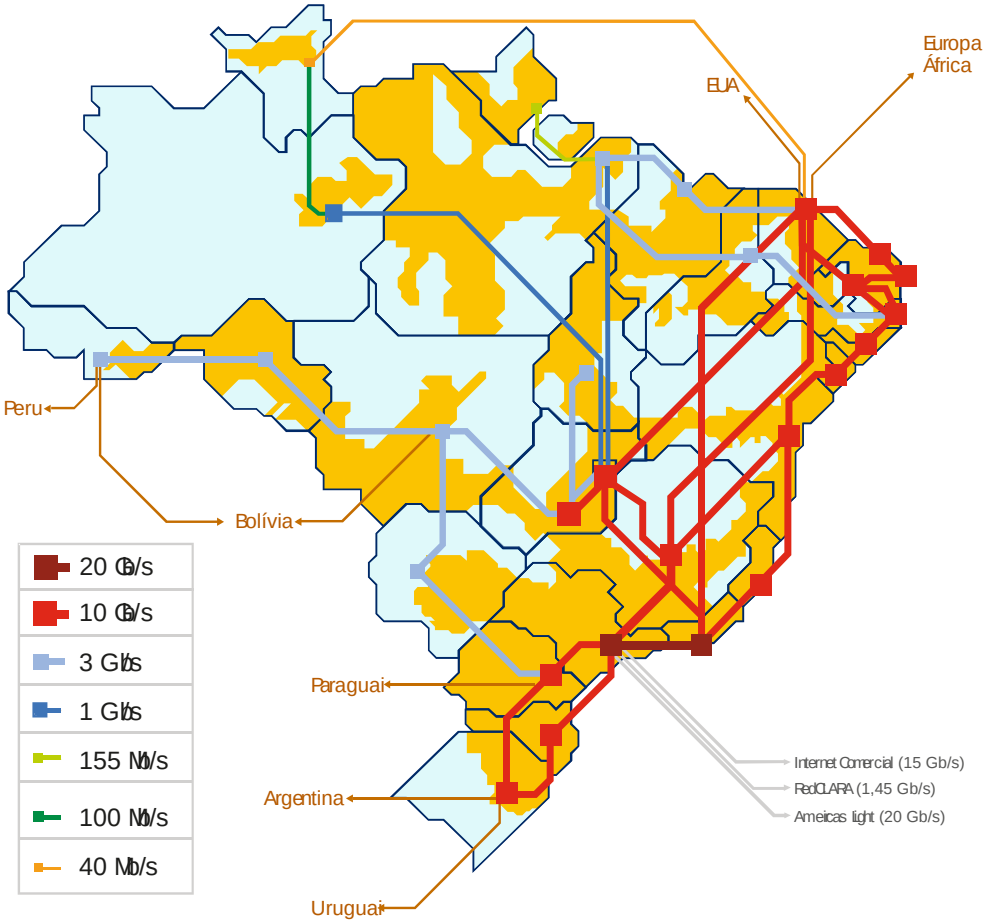
Instituição coordenadora da implantação: RNP

PONTOS DE ATENDIMENTO	128
60 Acadêmicos	
28 Prefeituras	
2 Supervia	
17 Metrô	
8 MS + Rute	
1 MSaúde	
9 MinC	
1 MMA	
1 ABC	
1 MD	

INSTITUIÇÕES PARCEIRAS	6
Faperj	
Governo do Estado do Rio de Janeiro	
LAMSA	
METRÔ	
Prefeitura da Cidade do Rio de Janeiro	
SUPERVIA	

Upstate connections

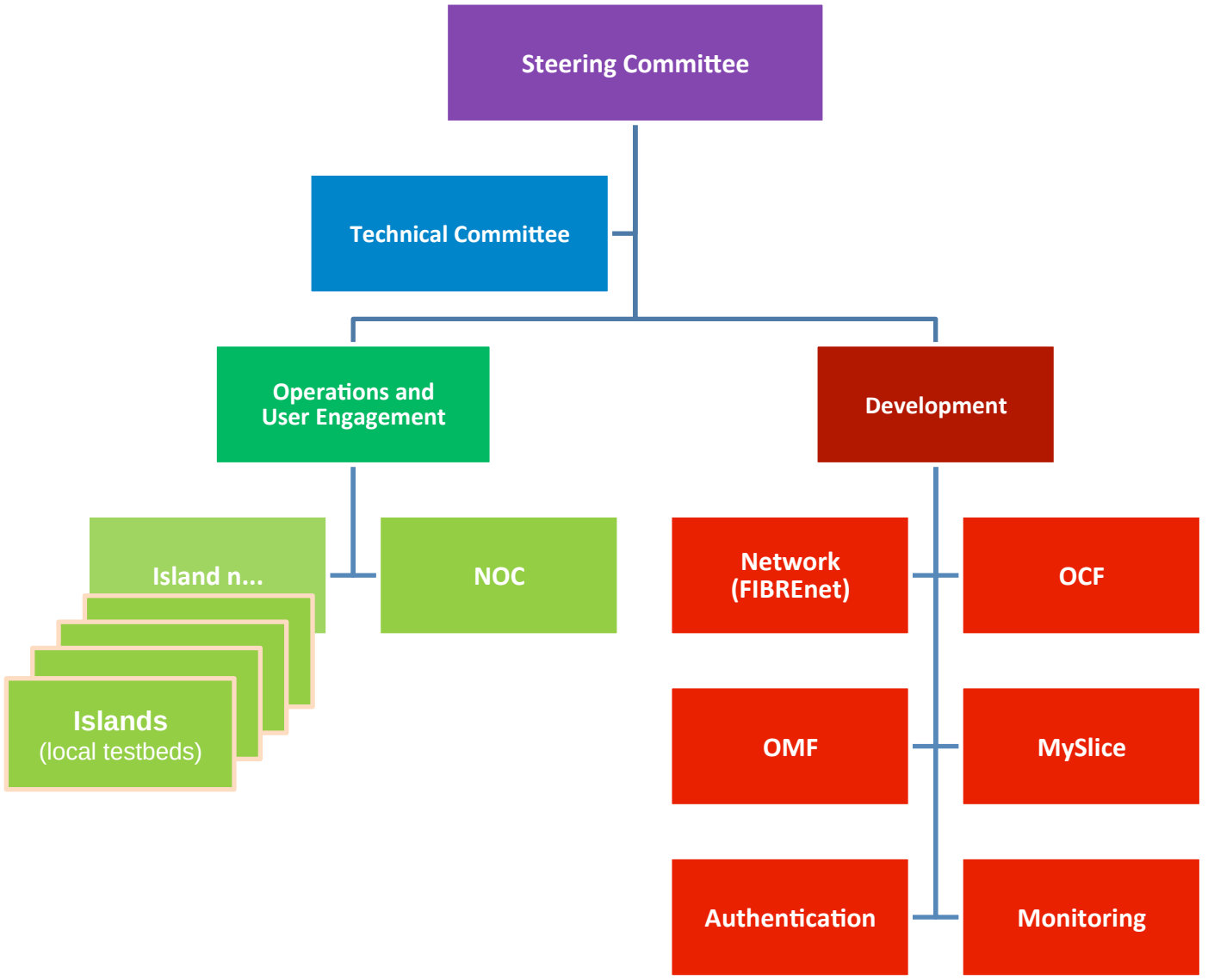
- Apart from the multigigabit backbone that connects Points of Presence in state capitals, RNP connects more than 600 upstate campi of federal universities and institutes at capacities between 100M and 1G.



Evolution of FIBRE: a large-scale Future Internet testbed facility

- Original objective: design, implement and validate a shared large-scale testbed to support experimental research in Future Internet.
- Studies began in 2008, inspired by GENI (USA) and by the FIRE (Future Internet Research and Experimentation) program of the EU
- Funding provided 2011-2014 through the 2010 1st Coordinated Call in ICT between Brazil and the EU, supporting a single FI testbed project, FIBRE (FI testbed/experimentation between Brazil and Europe).
- FIBRE includes 10 nodes in Brazil and 3 in the EU. The follow-on FIBRE2 project is being funded in Brazil to support the operation, maintenance and expansion of the existing testbed, for use by the approved project on "experimental platforms" selected in the 2014 3rd CC.
- On-going conversations were initiated in 2013 to promote the international federation of the FI testbeds, including FIBRE.

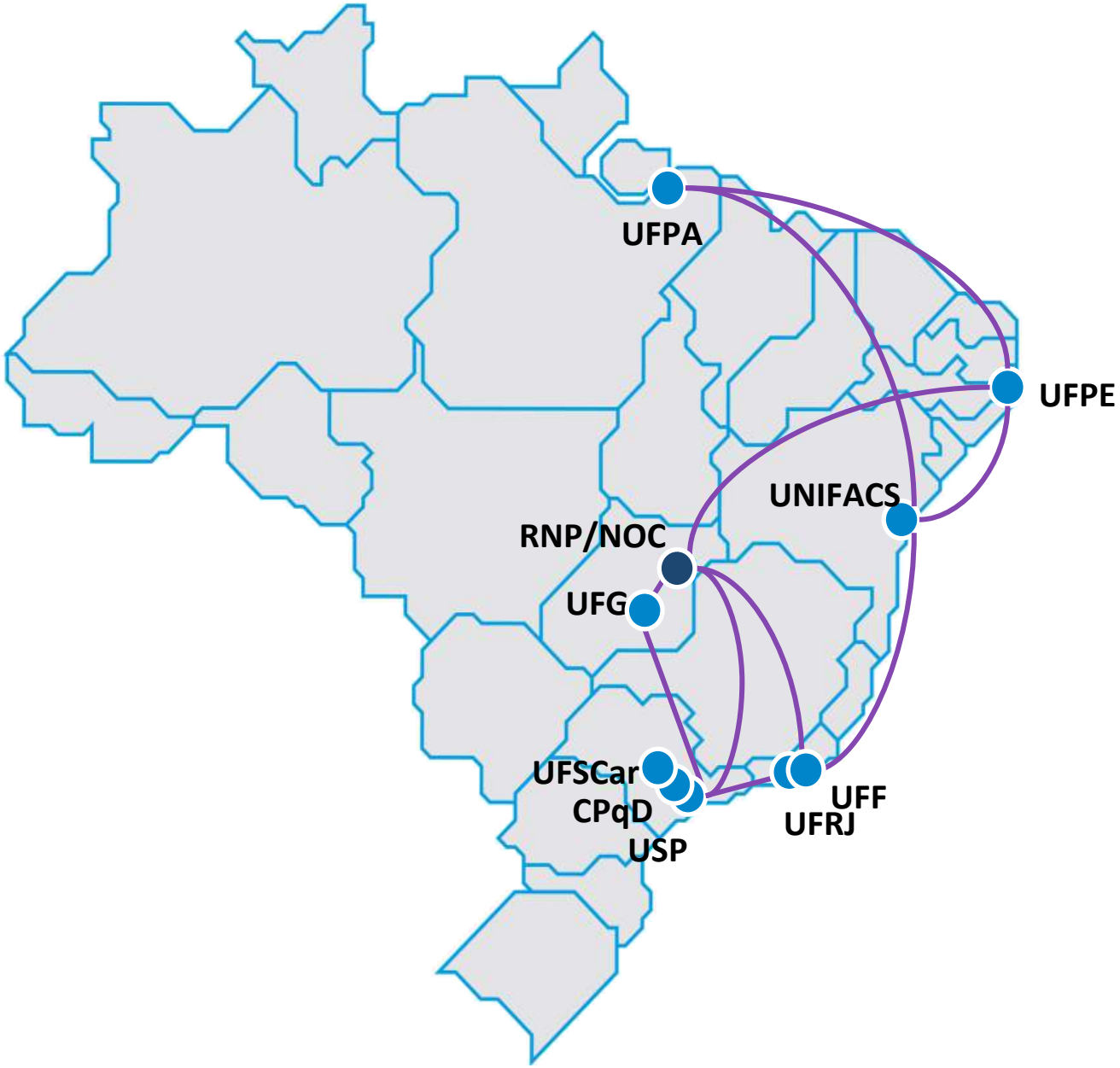
New Governance Model



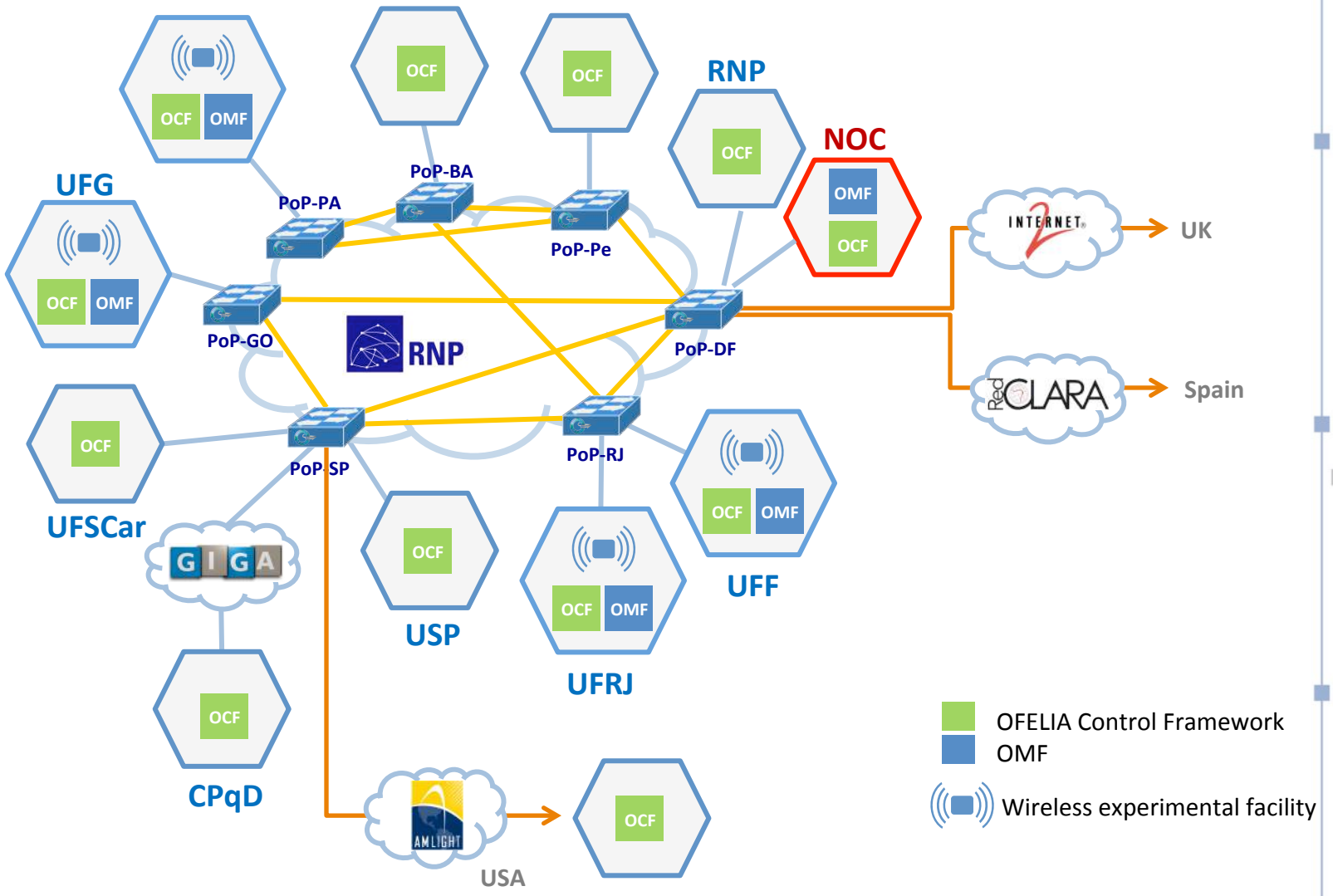
Federation

Red: Native SDN
Yellow: QinQ
Purple: MPLS

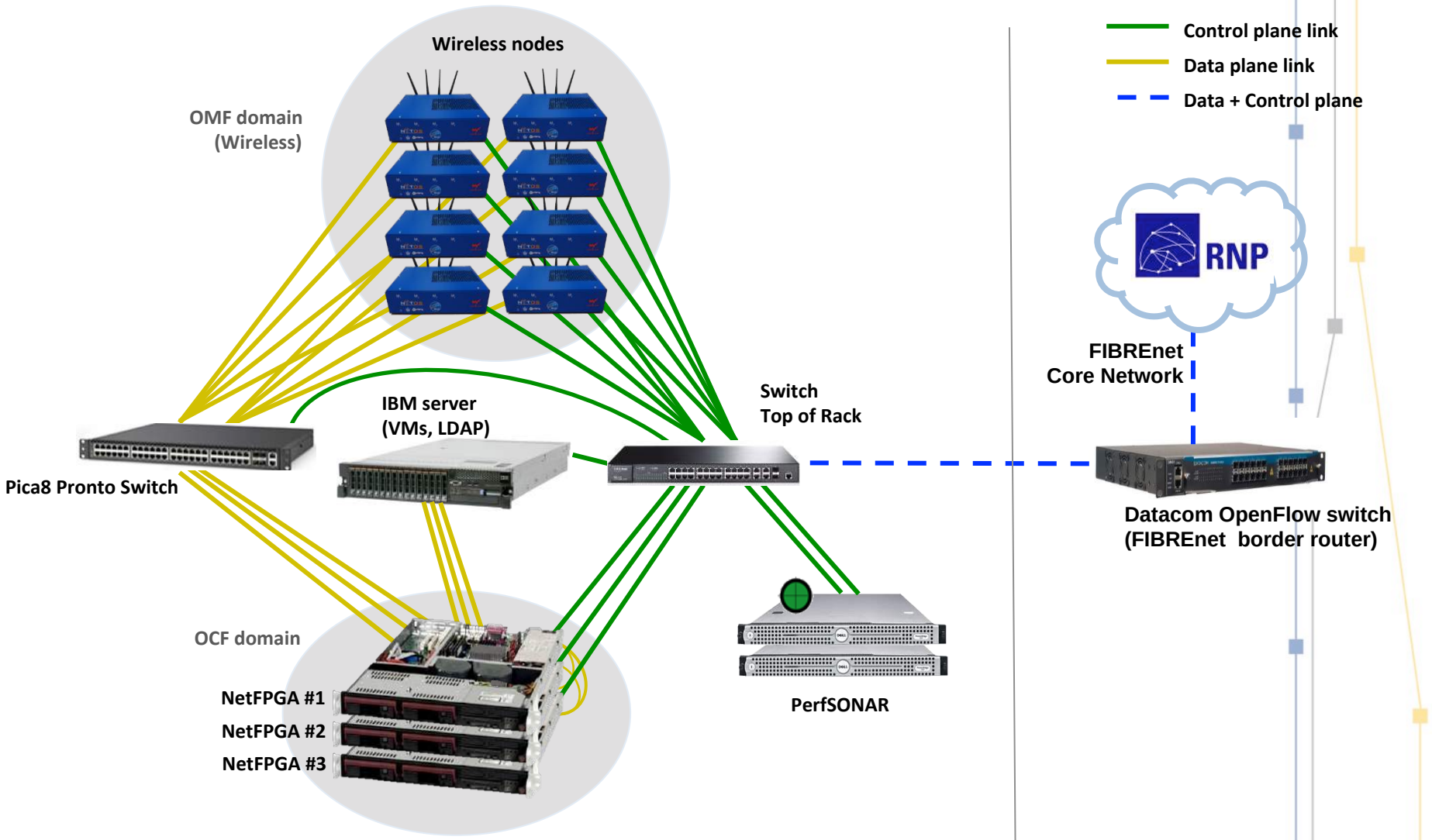
Federation (Brazil)

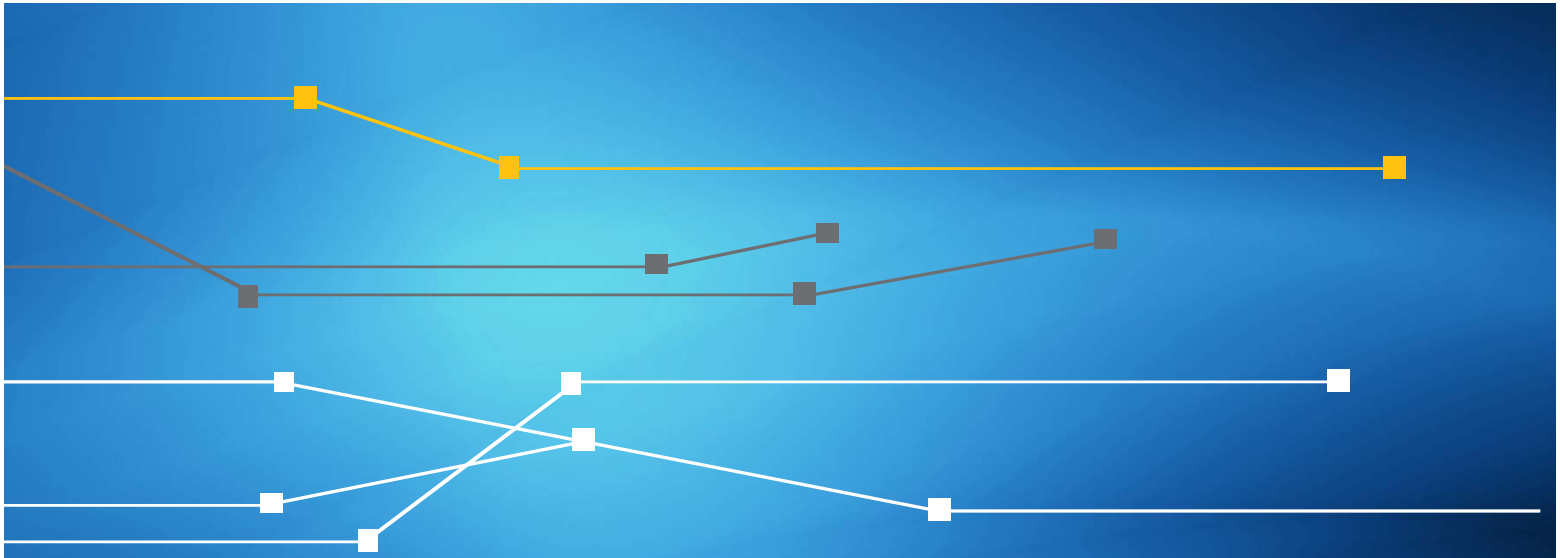


FIBRE Architecture (Feb 2015)



FIBRE Island Architecture (Rack)





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