

e-Infrastructure and Sustainable Development: Advanced Networks and Computing in Brazil

BELIEF

São Paulo, July 2009

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RNP – an advanced network organisation in Brazil

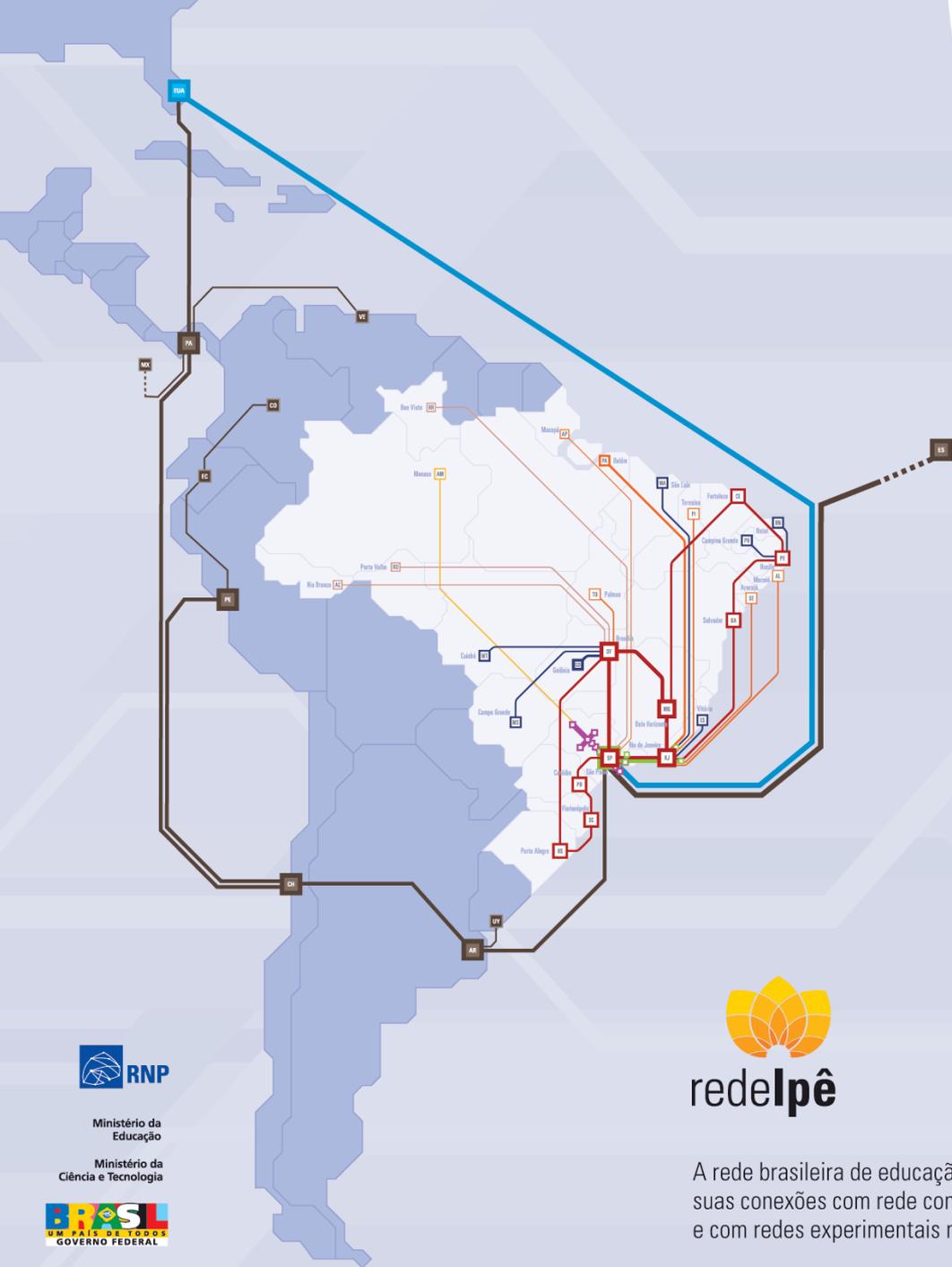


- created in 1989 as a project of MCT (S&T ministry), and continuously supported by MCT since then
- created a national communications infrastructure for the academic and research communities, beginning in 1992
- formally established as a non-profit private company in 1999, with a long-term management contract with MCT
- since 2000 has established financial support by other ministries:
 - MEC (higher) education
 - MS health
 - MinC culture

Advanced networks



- Advanced communications are provided in Brazil through:
 - **networks operated by RNP** and supported by the federal government:
 - **national backbone network** - up to 10 Gbps
 - **metropolitan dark fibre networks** in capital and other cities
 - **international connections** to Europe (through RedClara) and to other countries (in partnership with ANSP) → 20+ Gbps in 2009
 - **networks in some states**, especially São Paulo (ANSP) and Rio de Janeiro (Rede-Rio), with their own international links
- Applications and user communities
 - value-added services: telephony, videoconferencing, support for remote learning, telemedicine, e-science, e-culture, ...
 - organisation of user communities where this is helpful



CONEXÕES INTERNACIONAIS

REDE CLARA (Am. Latina e Europa)

- 622 Mbps
- 155 Mbps
- 45 Mbps

WHREN-LILA (Brasil-EUA)

- 10 Gbps

REDES DE EDUCAÇÃO E PESQUISA NO BRASIL

REDE IPÊ

- 10 Gbps
- 2.5 Gbps
- 662 Mbps
- 155 Mbps
- 102 Mbps
- 34 Mbps
- 20 Mbps
- 6 Mbps
- 4 Mbps

REDE EXPERIMENTAL GIGA

REDE KYATERA



redelpê

A rede brasileira de educação e pesquisa e suas conexões com rede congêneres no exterior e com redes experimentais no Brasil



Ministério da Educação

Ministério da Ciência e Tecnologia



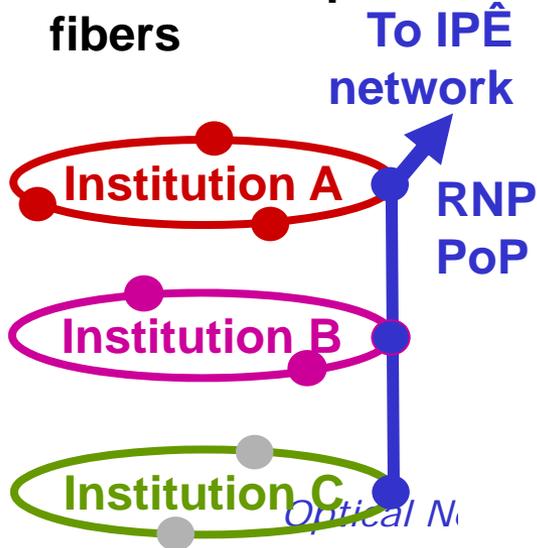
Community-based optical metropolitan networks



- Since 2004, RNP has also concentrated its attention on metropolitan networks, to provide adequate access to the multigigabit IPÊ network
- These metro networks are based on owned dark fiber networks, shared between the R&E institutions served
 - typically operate at 1 Gbps and permit:
 - interconnection of the campi of the participating institutions
 - access to RNP's IPÊ network PoP
 - reduction of current costs
- Pilot project: o projeto MetroBel na cidade de Belém do Pará (inaugurated in May 2007)

MetroBel Topology

- 30 km ring (larger than LHC)
- 10 km extension to Ananindeua
- 12 km access links
- 32 campi
- each institution has its own pair of fibers



Community metro networks nationally



- Investments in this national programme have been supported by MCT.
- In July 2009, RNP inaugurated the 12th out of 27 of these networks. The remaining 15 are planned to operate not later than early 2010 reaching all the metropolitan campi of around 250 R&E institutions countrywide at 1 Gbps
- In most of these the local governments are participating for internal IT and for connecting schools and hospitals
- Many of these projects (e.g. in Amazonas, Pará and Ceará), this initiative has led to state governments installing their own advanced networks connecting other cities, based on access to dark fibre owned by utility companies (usually electricity).

Upgrading of advanced networks



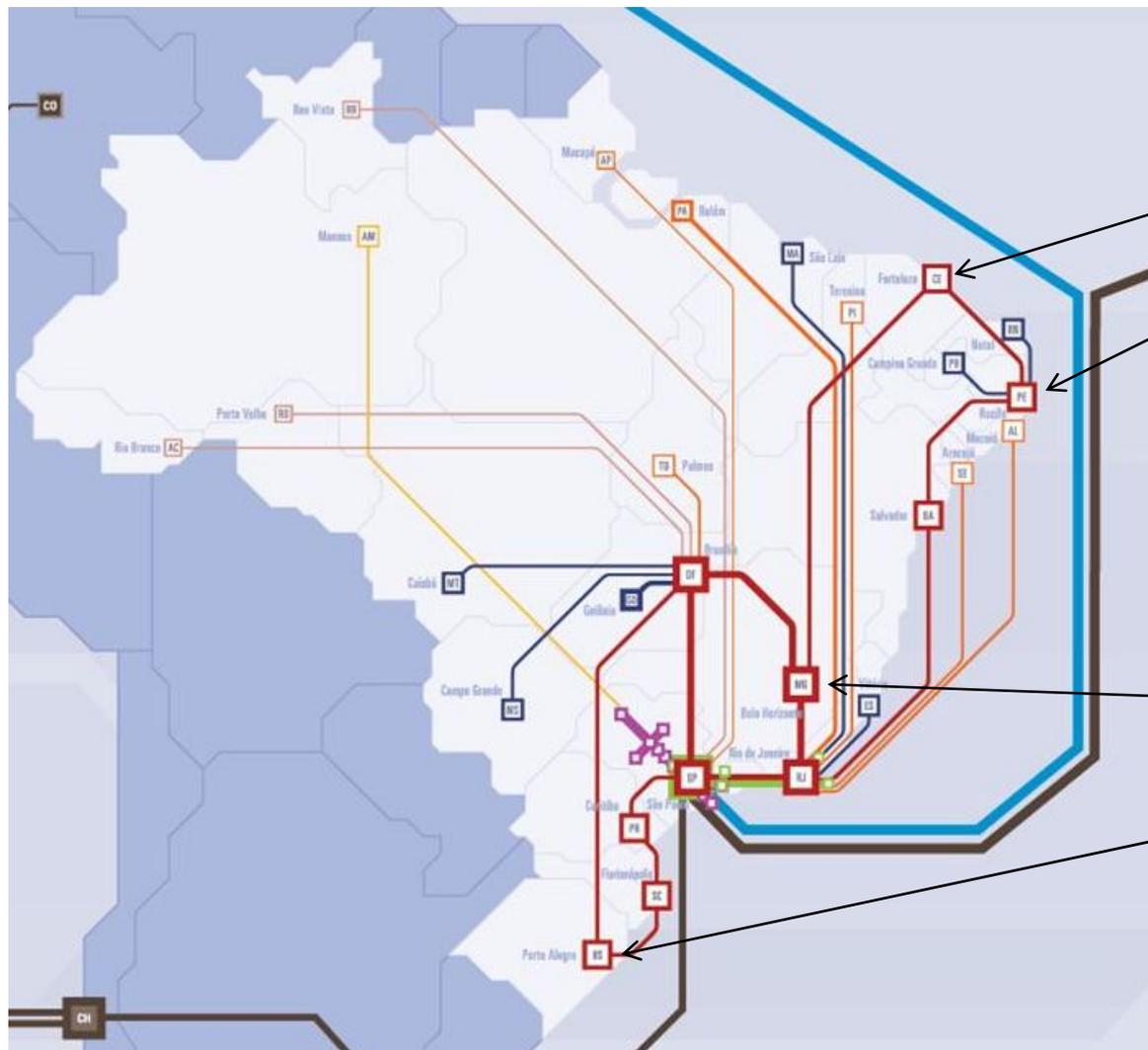
- **New RNP infrastructure** by 2010:
 - layer 2 national backbone
 - adoption of hybrid architecture
 - huge increase in capacity, when possible through multiple lambdas in DWDM systems
- **New RedClara2 network** (EU Alice2 project), augmented by cross-border fibre links to Southern Cone countries (Argentina, Chile, Paraguay, Uruguay) with significant Brazilian investment
- **Large-scale optical network testbeds** provided through:
 - **Project GIGA** - 700+ km (federal support)
 - **Project KyaTera** - 1000 km (SP state support)

High Performance Computing (HPC) centres in Brazil



- Several independent initiatives have led to a number of HPC sites in Universities and research institutions in Brazil. These include:
 - Petrobrás – state oil company
 - CPTEC/INPE – weather and climate forecasting
 - several universities
- In addition, the federal government has promoted the creation of a National HPC System (SINAPAD), to provide several HPC centres (CENAPADs) in different regions, using research networks for remote access
 - coordinated by LNCC (National Lab. for Scientific Computing)

HPC sites in Brazil (except RJ and SP)



* UFC
* UFPE

* UFMG
* UFRS

* = SINAPAD sites

HPC sites in SE Brazil



* Unicamp
USP
UNESP

* INPE/CPTEC

CBPF
UERJ
* UFRJ
Petrobrás

UFF
* LNCC

* = SINAPAD sites

Grid initiatives



- Several of the HPC (and other) centres also participate in large-scale computational and storage grids. Several different middlewares are currently used for these:
 - gLite (EGEE): used in EELA-2 (FP7) and LCG (at CBPF)
 - OSG (US): 2 major universities
 - OurGrid: Brazilian lightweight grid
 - Globus variants
- Discussions held on National Grid Initiative (NGI), but will need to take heterogeneity into account

e-Science and applications



- Several areas are important
 - weather and climate forecasting
 - bioinformatics: genome, protein structures
 - astrophysics and astronomy
 - high-energy physics
 - biological collections (biodiversity)
 -
- Future important applications of HPC and networks will include climate change (IPCC)
 - In particular, CPTEC/INPE is participating in an international collaboration to model the global climate system, involving extensive HPC use for examining different change scenarios

Lessons for sustainability



- Use of new technologies and solutions
 - pushing forward the technology envelope into spaces not so far occupied by commodity providers
 - cost reduction
- Cost sharing
 - shared infrastructure (if appropriate) can be cheaper
 - need to increase the user base
 - government support very desirable