

Brazilian experience of connecting at 100 Mb/s and 1 Gb/s universities and research institutions in the interior of the country

Eduardo GRIZENDI, Nelson SIMÕES DA SILVA, Michael STANTON†
RNP - Rede Nacional de Ensino e Pesquisa, Rua Lauro Müller, 116, 11th floor,
Botafogo, 22290-906, Rio de Janeiro, RJ, Brazil
Tel: + 55-21-2102.9660, Fax: + 55-21-2279-3731.
† on secondment from Computing Institute, Universidade Federal Fluminense - UFF
Emails: eduardo.grizendi@rnp.br, nelson@rnp.br, michael@rnp.br

Abstract

The paper presents the Veredas Novas (New Paths) initiative of RNP, the Brazilian National Research and Education Network, to provide access to RNP's national backbone network at 100 Mb/s and 1 Gb/s from university and research institutions campi in smaller cities throughout the country. The initiative is supported by the Ministries of Science, Technology and Innovation (MCTI), of Education (MEC) and of Communications (MC), and involves partnerships with public and private companies, taking advantage of the current deployment of the National Broadband Plan of the Brazilian government.

RNP has already interconnected nationally all the universities, university hospitals and research centres, but, in general, it is only in the 27 capital cities (26 state capitals and the national capital, Brasília) and in a handful of major non-capital cities that this is done with high-capacity connections – at 1 or 10 Gb/s. Veredas Novas, which began in February, 2012, aims to extend high-capacity connections – at 100 Mb/s or 1 Gb/s – to hundreds of campi in smaller non-capital cities. This will extend to these campi the use of advanced applications, databases, digital libraries, remote instruments and, most importantly, the opportunity for their researchers to participate in research groups and collaborative research with other institutions across the country and abroad, contributing to creating the same conditions of communication and collaboration that already exist in major centres.

Keywords

100 Mb/s and 1 Gb/s links, high speed access, interconnection of campi, access to smaller cities, NREN

1. An Overview of the RNP

This section provides an update to a more extensive but earlier description of RNP, presented at TNC2010 [Stanton 2010].

RNP, which was created as a project in September 1989 by the Ministry of Science, Technology and Innovation (MCTI), and which became a non-profit company in 1999, operates the Brazilian national research and education network (NREN), the principal research and education (R&E) network provider in the country, serving more than 300 organisations nationwide, including over 130 public universities and 30 public and private research centres. As many of these have multiple campi in different cities, the total number of connected sites is more than 800.

Figure 1 shows the geographical distribution of the campi that are served by RNP in 2012.

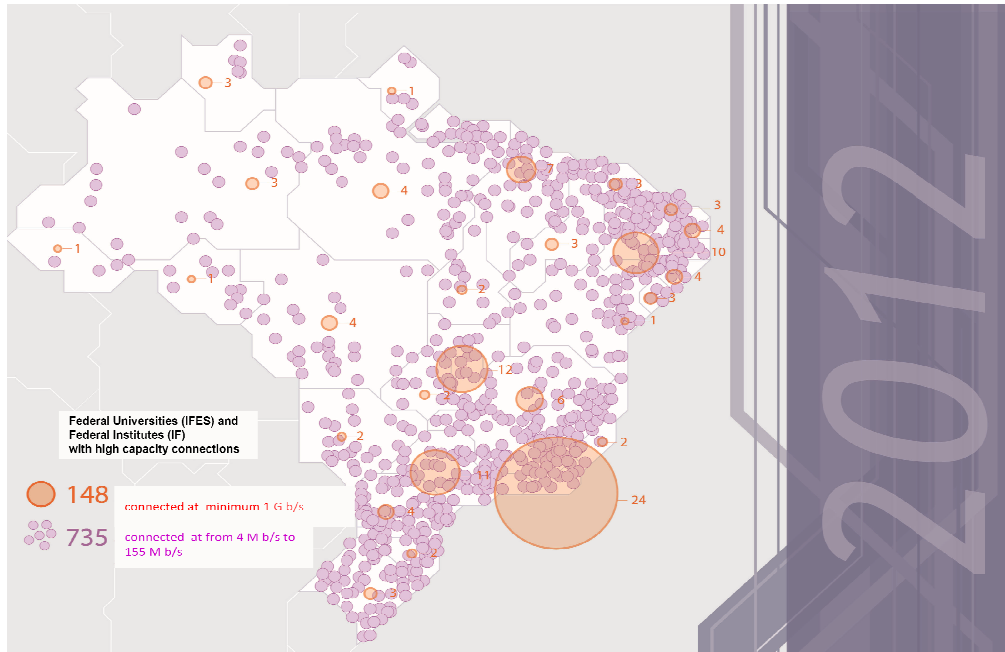


Figure 1 – Campi of universities and research centres served by RNP in 2012

However, not all these 800 campi have high-capacity links to RNP. RNP has already interconnected all universities, university hospitals and research centres at high capacity – 1 or 10 Gb/s – but only in the 27 capitals and a handful of major non-capital cities. In these cities, this is done through RNP’s own metropolitan optical networks. However, in the smaller, non-capital cities, there are still low-capacity connections, typically, at 4, 8 or 12 Mb/s.

Figure 2 shows where RNP has built or is building its own metropolitan optical networks (Redecomep – Community Networks for Education and Research). RNP will be operating such networks in 26 of the 27 capitals by December, 2012, and is currently engaged in deploying them in another 15 major non-capital cities.

To illustrate a typical metropolitan optical network, Figure 3 shows the topology of the MetroBel network in Belém, the capital of Pará state, located in the north of Brazil. MetroBel has a 30 km ring using 48 strand cable, with a further 10 km radial extension with 36 strand cable, and connects 32 campi belong to 12 institutions, each one with a 1 Gb/s connection to the RNP backbone point of presence.

1.1 The RNP national backbone – the Ipê network

In 2005, RNP inaugurated the first academic national optical network in Latin America, called the Ipê network. Currently, RNP has built this national backbone, using optical wavelength links acquired from telco operators, most of them at 10 Gb/s. In each capital, RNP has a Point of Presence (PoP), normally installed in a public (usually federal) university, from which RNP provides access to all the university and research institution campi in that state. Figure 4 presents the current topology of the Ipê backbone, showing the interstate circuits of up to 10 Gb/s, interconnecting the PoPs.

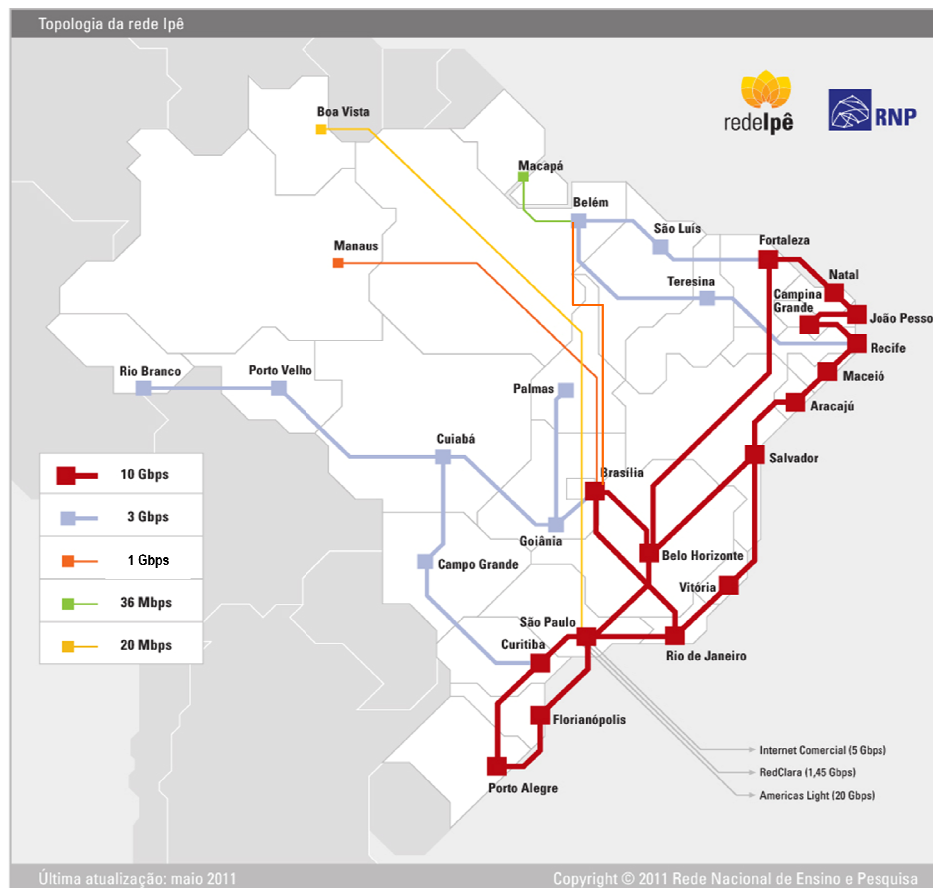


Figure 4 – RNP’s national backbone network in 2012

RNP’s international connections are provided by two separate solutions. In one of these, RNP, currently shares with ANSP, the academic network from São Paulo state, two 10 Gb/s links from the city of São Paulo to Miami in the US, which are managed jointly. These two links carry traffic between Brazilian academic sites and both academic and commodity sites in the US and around the world. Commodity peering and transit is contracted in Miami. The international capacity of this connection is being upgraded in early 2013 to four 10 Gb/s circuits as shown in Figure 5. These links between Brazil and Miami form part of the Americas Lightpaths (Amlight) collaboration funded by institutions in the US and Brazil [Amlight 2012].

The second solution is through RNP’s participation in RedCLARA, the regional R&E network in Latin America, of which RNP is a founder member [RedCLARA 2012]. This network links R&E networks in most mainland countries in Latin America, and has been generously supported by

funding from the European Commission during the period between 2003 and 2012, by means of the ALICE and ALICE2 projects. Figure 6 shows the topology and capacity of RedCLARA at the end of 2012.



Figure 5: Links between Brazil and the US in early 2013 (courtesy of Chip Cox)



Figure 6: RedCLARA topology and capacities at the end of 2012 (courtesy of Florencio Utreras)

1.2 RNP services and R&D activities

RNP offers connectivity to all public universities and research institutions and advanced services, similar to those met in Europe and North America R&E networks [TERENA 2011]. Examples of these services include:

- Identity federation and eduroam;
- Web conference, videoconference and telepresence.
- VoIP – Voice over IP;
- Public key infrastructure for Research and Education
- Internet Data Centre (IDC);
- Service Desk
- Video on demand

RNP is continually developing new services and promoting the innovative use of advanced networks in Brazil. RNP's directorate of R&D uses the Open Innovation Model in its innovation funnel and finances R&D activities in universities and research centres, carried out by research groups under RNP coordination. In this context, two initiatives are worthy of note: the Working Groups programme (WG-RNP) and the projects of advanced networks in which RNP participates or which it supports. Many of these projects are developed in cooperation with other NRENs, integrating international alliances.

A companion paper to this one [Stanton 2012] describes more fully the development of R&D activities at RNP and also at RedCLARA, influenced by RNP experience.

Alternative input for new or improved services uses trend analysis. RNP interacts with its partners (universities, research centres, government, suppliers) to determine technology trends and how to align these with its strategy. Some examples of services that originated from trend analysis are: telepresence, videoconference and web conference [Nunes 2012].

2. The National Broadband Plan

The National Broadband Plan (PNBL) was launched in May 2010 with the aim of providing mass Internet coverage at low prices by 2014. The target is to bring 11.9 million households online over the duration of the plan, while promoting the growth of the telecommunications infrastructure of the country.

According to the Ministry of Communications [IT 2012] [PNBL 2012], the objectives of the plan are:

- to accelerate the entry of the population in the modern information society;
- to promote greater access to e-government services to citizens and to facilitate the use of state services;

- to contribute to the evolution of telecommunications networks in the country, through the adoption of current trends in technology and architecture, based on communications over IP;
- to contribute to the industrial and technological development of the country – particularly the sector of Information and Communication Technologies (ICTs);
- to improve the competitiveness of Brazilian companies, especially those in the ICT sector, as well as micro, small and medium enterprises of other economic sectors;
- to contribute to the increase of employment opportunities in the country;
- to contribute to the growth of the Brazilian economy.

The National Broadband Plan plans to bring broadband Internet access to small towns, currently badly served by the traditional telecommunications companies. The government is looking to enforce end-user link capacity of 1 Mb/s at monthly prices starting at R\$30.00 (US\$15.00).

The telecommunications company responsible for deployment of this plan is the state-owned Telebrás – Telecomunicações Brasileiras, with private sector telecommunications companies acting in a complementary manner. Internet service providers (ISPs) are also important players in this plan, offering access at over 1 Mb/s at reduced prices to their customers.

Telebrás is also responsible for acquiring the resources needed to provide the necessary public infrastructure to deliver the plan. Through agreements with Petrobras, the publicly traded petrol & gas energy company, and with publicly owned electricity companies (belonging to the Eletrobrás holding company), Telebrás is using part of their existing fibre infrastructure to construct a national backbone network, acting mainly as a wholesale provider for ISPs.

Figure 7 shows the Telebrás backbone that is under construction, using fibre from Petrobras and the Eletrobrás companies.

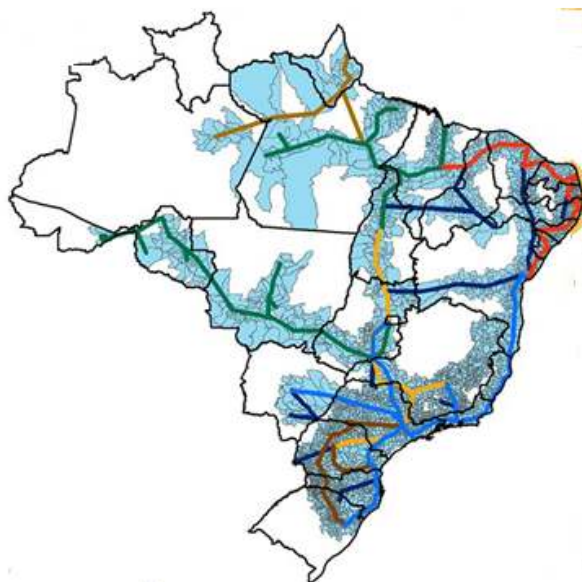


Figure 7 - Telebrás backbone being built out using fibre assets from Petrobras and Eletrobrás companies (by 2014)

3. Veredas Novas (New Paths)

Veredas Novas is a recent RNP initiative that has as principal objective to connect to its national Ipê backbone all institutions in the interior of the country, at minimum capacities of 100 Mb/s (for secondary campi) and 1 Gb/s (the main campus). Today, many of them are still served by low-capacity connections, for example, at 4, 8 or 12 Mb/s.

In addition, Novas Veredas:

- allows access to and use of advanced applications, databases, digital libraries, remote instruments and remote collaboration;
- permits the inclusion in the National System of Science, Technology and Innovation, and in similar systems in other countries, of researchers, teachers and students of federal institutions of higher education and of technology located in the interior of Brazil;
- offers support for the expansion of generation and use of content for telemedicine, telehealth and distance education;
- promotes the provision of higher broadband capacity to those cities that host universities and research centres, contributing to greater digital inclusion in these localities through the National Broadband Plan;

Anchored in partnerships with Telebrás, at national level, and state government IT companies, at state level, Veredas Novas is expanding the infrastructure for network access to the Ipê network, increasing to up to 1 Gb/s the link capacity of the campi of the federal institutions of research and higher education and technology in smaller cities throughout the country. The main expected results are:

- interaction of about 3.5 million users with global research networks;
- insertion of 27,500 research groups in high-performance communication environments and collaborations;
- widespread use of advanced collaborative voice, video, mobility and network security technologies;
- provide adequate professional conditions for the retention of highly qualified staff and of the creation of new postgraduate courses in institutions of education and research in smaller cities;
- provision of telemedicine, telehealth and distance education.

1.3 Veredas Novas and the National Broadband Plan – a partnership between RNP and Telebrás

Veredas Novas capitalises on the National Broadband Plan – PNBL. Telebrás, in partnership with RNP, is providing telecommunications access to cities where there is an R&E campus to be connected to the Ipê backbone. Through a tripartite agreement between Telebrás, RNP and the local

R&E institution, Telebrás equipment is collocated on the campus and, from this site, it provides service in that locality, whilst at the same time providing a clear channel connection between this campus and the Ipê backbone network.

Thus, universities and research institutes act as anchor institutions in the process of massification of broadband access. Through collocation of its equipment on the campus, Telebrás expands telecommunications infrastructure for that locality, providing faster and better Internet access for the city government, local businesses and citizens.

To provide access connection to institutions, both radio link microwave and optical fibre technologies are used for data transmission. In each location, an assessment is carried out to select the appropriate technology to be employed.

Table 1 summarises the goals of the partnership between RNP and Telebrás until 2014, whilst Figure 8 illustrates the localities that are to be connected by this partnership, mapped onto the “Ipe” Network.

Year	Locality	University/Research Institution campus
2012	30	42
2013	100	136
2014	120	157
Total	250	335

Table 1 – RNP– Telebrás partnership goals



Figure 8 - Localities that will be connected through the RNP–Telebrás partnership, relative to the Ipê network.

1.4 Veredas Novas and partnerships with state government IT companies

The RNP–Telebrás partnership is important, but it doesn't resolve all the demands for connections for Veredas Novas.

RNP has established other partnerships, mainly with state government IT companies. These companies have usually carried out digital inclusion and e-government programmes at state level, and some of them have deployed their own regional optical backbone networks. A prime example of this is in Ceará state, in northeast Brazil. The government IT company there, ETICE, has deployed a statewide backbone that reaches practically all cities in that state, called the Cinturão Digital do Ceará (Ceará Digital Beltway). RNP and ETICE have established an agreement to use this state backbone to provide access to all RNP client institutions in the state, connecting them at a minimum of 100 Mb/s to the RNP PoP in Fortaleza, the state capital. RNP is investing around US\$ 3 million in last mile construction to provide access to around 30 institutions in 22 localities in that state.

Figure 9 shows the Ceará Optical Beltway, built and operated by ETICE, illustrating the geographical coverage throughout the state.



Figure 9 - Ceará Optical Beltway

A pilot project, connecting 4 institutions in 3 localities (Redenção (1), Crato (2) and Iguatu (1)), is to be concluded by December, 2012. By June, 2013, all RNP client institutions in this state should be connected at a minimum of 100 Mb/s.

RNP is adopting similar strategies in the Federal District (national capital) in the Midwest, and in the states of Espírito Santo, in the Southeast, and Rio Grande do Sul in the South. Government IT companies in other states are being contacted, and, hopefully, may also participate in this initiative, increasing its impact.

1.5 Veredas Novas and cities not reached by Telebrás and state government IT company backbones

By 2014, the Telebrás backbone should reach only around one third of the total number of cities where RNP has client institutions. On the other hand, few state government IT companies have their own optical backbones. Most of them do not, although some of these are just now deciding to deploy their own backbones. This means that about half of the RNP demand must be met by traditional telecommunications carriers, Internet Service Providers (ISPs) or RNP's own sub-networks of radio-links. In the case of use of traditional telecommunications operators or ISPs, RNP is analysing technological alternatives to clear-channel service, like Metro Ethernet and IP tunneling service.

4. Conclusions

As can be seen, RNP has an ambitious initiative, Veredas Novas, with the objective of connecting all institutions in the interior of the country, with a minimum capacity of 100 Mb/s (secondary campi)

and 1 Gb/s (main campus), raising to these capacities many of the current low-capacity connections, for example, 4, 8 or 12 Mb/s.

The main strategy adopted by RNP has been to “hitch a ride on the National Broadband Plan, by establishing a partnership with Telebrás. In addition, RNP is also “hitching a ride” on state government programmes of digital inclusion and e-government, carried out by the state government IT companies, where they have their own optical backbones.

Even when these partnerships are established and new connections rolled out, in around one third of all relevant cities, it will still be necessary to acquire connectivity from traditional telecommunications carriers or ISPs, and the solutions sought will probably involve, not only clear-channel, but also other connection services, like Metro Ethernet and IP tunneling services.

Nevertheless, to reduce by two thirds the number of connections acquired from traditional telecommunications carriers will certainly be a huge gain. Moreover, it is also very important to bring universities and research institutes to participate in the National Broadband Plan as anchor institutions in the rollout process. By collocating its equipment on and providing external links to the campus, Telebrás expands telecommunications infrastructure for that locality, providing faster and better Internet access for local government, local businesses and citizens, while simultaneously providing a minimum link of 100 Mb/s for RNP to its client institution.

This strategy may be used as a model for other NRENs with similar difficulties to reach institutions in the interior of their countries. National broadband plans and digital inclusion programmes are good to “hitch rides on” and benefit from.

References

Amlight (2012), <http://amlight.net/> [accessed on 3 November 2012]

Jensen, M. (2011), “Broadband in Brazil - A Multipronged Public Sector Approach to Digital Inclusion”, InfoDev publication, 2011. <http://www.infodev.org/en/Publication.1128.html> [accessed on 3 November 2012]

IT (2012), IT’s Brazil: The National Broadband Plan

<http://itdecs.com/2011/07/brazil-tech-the-national-broadband-plan/> [accessed on 2 November 2012]

PNBL (2012), Programa Nacional de Banda Larga (PNBL), Ministério das Comunicações,

<http://www.mc.gov.br/acoes-e-programas/programa-nacional-de-banda-larga-pnbl> [accessed on 2 November 2012]

Nunes, A., Guimarães, L. (2012), “Service Management in Brazilian NREN”, Terena Networking Conference – TNC 2012, Reykjavík, Iceland, 2012. <https://tnc2012.terena.org/core/presentation/18> [accessed on 3 November 2012]

RedCLARA (2012), <http://www.redclara.net/> [accessed on 3 November 2012]

RNP (2012), Service Catalogue (available only in Portuguese). http://www.rnp.br/_arquivo/servicos/catalogo_servicos_novo.pdf [accessed on 2 November 2012]

Stanton, M.A. et al. (2010), “RNP: A brief look at the Brazilian NREN”. In: Selected Papers from TNC 2010 Proceedings, ISBN 978-90-77559-20-8. <http://www.terena.org/publications/tnc2010-proceedings/> [accessed on 3 November 2012].

Stanton, M.A., et al. (2012), “Creating advanced Internet services in collaboration with the research community”, UbuntuNet Connect, Dar es Salaam, November, 2012.

TERENA Compendium (2011). <http://www.terena.org/activities/compendium/index.php?showyear=2011> [accessed on 3 November 2012]

Biographies

Eduardo Grizendi is Director of Engineering and Operations at RNP. Since 1990 he has taught at Instituto Nacional de Telecomunicações (Inatel), in Santa Rita do Sapucaí, Minas Gerais, Brazil. He holds a Master of Science in Telecommunication Systems from Inatel and a MBA in Business from Fundação Getúlio Vargas (FGV). He graduated in Electronic Engineering at Instituto Tecnológico de Aeronáutica (ITA). He has worked in the field of telecommunications since 1978, initially in R&D institutions, and afterwards in telecommunications carriers and consulting services.

Michael Stanton is Director of Research and Development at RNP. After a PhD in mathematics at Cambridge University in 1971, he has taught at several universities in Brazil, since 1994 as professor of computer networking at the Universidade Federal Fluminense (UFF) in Niterói, Rio de Janeiro state. Between 1986 and 2003, he helped to kick-start research and education networking in Brazil, including the setting-up and running of both a regional network in Rio de Janeiro state (Rede-Rio) and RNP. He returned to RNP in 2001, with responsibility for R&D and RNP involvement in new networking and large-scale collaboration projects.

Nelson Simões da Silva has been Director General at RNP since 2001, with overall responsibility for the national high-performance infrastructure for communication and collaboration which serves the more than 300 leading organisations in higher education, research and innovation in Brazil. He was one of the leaders of Latin American networking responsible for the setting up in 2003 of RedCLARA, the international organisation responsible for the regional research and education network in Latin America, and he continues to belong to its governing board.