



Characterization of the socioeconomic importance of the Brazilian **NREN**






REAL TIME PREVENTION and control of deforestation in the Amazon, monitoring of vegetation fires, advances in telemedicine and digital inclusion of academic centers in the most remote regions in Brazil. What do all of these achievements have in common?


All of them have had the Rede Nacional de Ensino e Pesquisa (RNP), the Brazilian NREN as the driving force. Pioneer in Internet access in Brazil, RNP supports higher education and scientific and technological development all over the country using a high-capacity nationwide academic network - the Ipê backbone ("Rede Ipê"), of services, applications and training in information and communication technology (ICT).

Despite being invisible to the population and to most of its direct users, RNP ensures support to research and covers over 800 institutions of higher learning and research, benefitting 3.5 million users in the 26 Brazilian states and the Federal District, with several other social and economic impacts all over the country.

Created in 1989 by the Science and Technology Ministry (MCT) to provide basic network communication infrastructure to the academic community through a nationwide backbone, RNP considers that its contribution on the Brazilian academic and scientific scene continues to increase as it offers integrated resources which allow its users to perform functions not possible using services available on commercial networks. Among these is the commitment to cover geographical regions farther away from the large urban centers. This makes it possible for the academic community to better develop and, in particular, retain its talented personnel. The Ipê network, for example, is responsible for internet access to the campus of the Federal University of Amazonas (UFAM) in Benjamin Constant, a city located in the middle of the Amazon Rain Forest, in Northwestern Brazil.

800 
institutions of higher
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3,5 million 
Users

26 
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US\$ 67.4 million

This was the value of RNP's production in 2010.

US\$ 132 million

This is how much was injected into the Brazilian economy as a result of RNP's activities during that year. It is almost twice the value of the organization's production.



US\$ 6.9 million

This was the value of imports in RNP's supply chain in 2010, two-thirds of which directly imported by RNP.



1.476



This is the number of direct jobs generated by the organization in its supply chain during 2010, representing roughly eight jobs in the community for each job at RNP.

Original Value in Reais (R \$) converted to U.S. Dollar (U.S. \$) at the rate of R\$ 1 = U.S. \$ 0.59. Quotation on 10/01/2011. Fountain Central Bank of Brazil

IMPACT ON THE BRAZILIAN ECONOMY

The backbone's high capacity, in turn, makes it possible for the National Institute for Space Research (INPE) to fully perform its weather forecasting activities and, chiefly, monitor climatic conditions, vegetation fires and deforestation. RNP's infrastructure ensures that large volumes of data feed a supercomputer and, after processing, are shared with the community at large quickly and efficiently. Data, which before could only be transported by plane is now transmitted over the very high-capacity academic network.

The resources offered by RNP's structure have also had a fundamental role in the development of telemedicine in Brazil, through the Telemedicine University Network (RUTE), facilitating access to technology by university hospitals throughout Brazil, like the Federal University of São Paulo (UNIFESP). These three examples are just some of the impacts of the activities of the organization responsible for this public infra-

structure network which consumed inputs from 57 different sectors of the economy and contributed US\$46.9 million to Brazil's GDP in 2010. This analysis found that each direct job generated by RNP had a multiplying effect of almost eight in the affected sectors, with an average monthly wage of US\$1,100.

To map this cycle of positive effects, RNP hired the Center for Industrial Economics and Technology (NEIT) of the State University of Campinas (Unicamp) to produce the report titled "Análise dos benefícios econômicos e sociais da RNP" ("Analysis of the RNP's Economic and Social Benefits"). This extensive study, in addition to mapping the organization's economic impacts on the production chain of its suppliers and investigating the social impacts based on user utilization, give RNP the right to be recognized for its essential contribution to research, education and Brazilian culture.



CASE STUDY 1: **TELEMEDICINE AT UNIFESP**

Telemedicine development in Brazil follows a global trend. The forecast is for this market to reach US\$20 billion within the next five years, with a great impact on the efficiency in the use of public funds.

"Brazil's size and this tool work together in favor of the use of telemedicine in Brazil". This declaration by Dr. José Roberto Ferraro, superintendent of UNIFESP's São Paulo Hospital, sums up RNP's importance in this area. Since 2006, RNP has been critical to the development of telemedicine through the Telemedicine University Network (RUTE), created to stimulate distance learning, collaborative research and remote assistance. Telemedicine projects, until then restricted to isolated initiatives, began to receive support from RNP, offering standardized resources to all university hospitals (UHs) in Brazil and disseminating telemedicine activities by broadening access to equipment. In addition to a proper structure, the RUTE Project has also been working toward more training of health care professionals.

The principal highlight of the integration brought about by RUTE are the Special Interest Groups (SIGs), which are collaboration centers among health care professional that promote debates, case discussions, classes and distance diagnostics among institutions all over the country and even internationally. One of the most prominent SIGs is coordinated by UNIFESP together with Hospital São Paulo. This important component of RUTE resulted in the creation of the Telemedicine Sector (SET), inserted in the Health Care Information Technology Department (DIS), which already had a telemedicine project and a network infrastructure before RUTE was created. With the beginning of network operations, the already existing infrastructure was improved and the equipment in the Telemedicine Sector Laboratory (LAT) was replaced. The partnership with RNP allowed for improved network quality and a reduced number of failures.

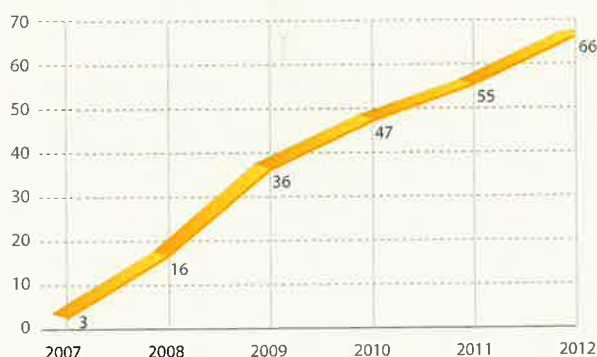
The result of this improvement was a more frequent use of the videoconference room, with a spontaneous increase in its use at the university. Stimuli to the use of RUTE

occurred both due to publicity regarding the network within university departments as well as the initiatives of professors in engaging other teaching professionals in the use of video and web conferencing.

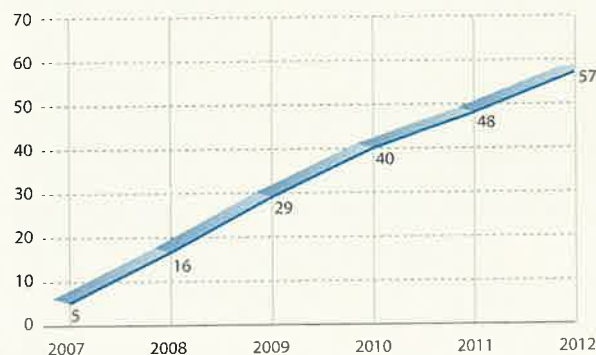
One parameter of the success of RUTE is the growing number of these centers among the participating educational institutions. Already in 2006, 19 telemedicine centers in 19 university hospitals were integrated to the RUTE program. In the following year, 33 additional university hospitals were integrated, in addition to five federal higher educational institution centers and 25 advanced telehealth posts.

In 2008, another 75 institutions became members. There are currently 56 active SIGs, of which UNIFESP participates actively in 29, in several specialties, and coordinates 13 of them. In five of these SIGs, UNIFESP stands out: Ophthalmology, Pediatric Urology, Nursing Services at UHs; Oncology and, chiefly, the UH Management SIG, which arose spontaneously at UNIFESP based on the need to exchange knowledge of management among Brazilian university hospitals.

EVOLUTION IN THE NUMBER OF RUTE CENTERS



EVOLUTION IN THE NUMBER OF SIGs





CASE STUDY 2: INPE

Real-time monitoring of climactic conditions and human activities in every corner of Brazil requires speed and efficiency in transmitting large volumes of data. The strategic importance of the National Institute of Space Research's (INPE) activities for the country is very difficult to measure in economic terms, but there is no question about its worth when international specialists rank the institution among the greatest research centers in the world. On all these fronts- weather and climate forecasting, prevention and control of deforestation in the Amazon region, monitoring of vegetation fires and vigilance of natural and man-made disasters, RNP plays a critical through

the Ipê backbone. INPE's two main facilities – in São José dos Campos and in Cachoeira Paulista (both in the State of São Paulo) – are connected at 10 Gb/sec to the Ipê backbone. Thus, data can be received and transmitted between the INPE facilities and the universe of information processed for specialists, institutions and society at large can be made available.



TUPÃ, INPE's SUPERCOMPUTER CONNECTED TO THE IPÊ BACKBONE

The precision and speed of the data generated by INPE gained a major reinforcement in 2011 with the purchase of the Tupã supercomputer, the 49th most powerful in the world able to perform 258 trillion calculations a second. Installed at INPE's regional facility in Cachoeira Paulista (SP), the computer also assists on analyses of global warming. The supercomputer's large data processing capacity, however, needs the same level of connectivity to properly take advantage of its resources. The important role of providing efficient input and output of information to and from the outside world is performed by RNP's backbone, completely meeting the higher demand for research work and related projects.

The data processed is analyzed by researchers and subsequently disclosed to the press and made available to the general population. On average, 220,000 accesses are received monthly.

The equipment is able to perform **258 trillion** calculations per second.





EARTH OBSERVATION CENTER

What used to be transported by plane, now arrives by Internet. Before the Ipê backbone, that was how the Earth Observation Center (OBT) operated. OBT is an important INPE development and research group which intensively uses RNP's backbone to map and monitor the Brazilian land surface.

The Data Reception and Recording Station in Cuiabá (Mato Grosso) is responsible for capturing images which today are transferred by Internet to INPE's Image Generation Division, in Cachoeira Paulista, São Paulo; which in turn transmits the data to the facility in São José dos Campos, São Paulo.



ALERTS TO IBAMA

Using RNP, INPE provides real time alerts to the Brazilian Institute for Environment and Renewable Natural Resources (IBAMA). Based on this flow of information, IBAMA performs supervisions and enforces the law. Speed and efficiency in detection make all the difference in actions to reduce the levels of deforestation in the Legal Amazon area.

DEFORESTATION, BURNS AND FIRES

Nowadays, this data can be accessed on a real time basis, feeding the Real Time Deforestation Detection System (DETER) and the Monitoring of Vegetation Fires System among others. This data base is also open to 100,000 registered users, serving private and state-owned enterprises, NGOs, public organs, research centers, universities, researchers and students, among others. Close to 300,000 vegetation fires and smoke clouds are detected annually in Brazil. The remote sensing system allowed Petrobras, the Brazil state oil company, to perform a real-time evaluation of the effects of a major oil spill in an exploration field in the Campos Basin off the coast of the State of Rio de Janeiro, in 2011.



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CASE STUDY 3: UFAM, IN BENJAMIM CONSTANT (STATE OF AMAZONAS)

Stimulating advances in telemedicine, preventing natural disasters and watching over Brazilian territory are not the only contributions of the RNP backbone to Brazil's development. Connection of academic communities in the country's most remote regions in the Ipê backbone's coverage also has its strategic and political importance.

A unique example of this commitment has been in the process of development since August/2010 on the campus of the Federal University of Amazonas (UFAM), in Benjamin Constant, 1,118 kilometers in a straight line from the state capital Manaus and 1,621 kilometer by river, the only available access. The campus is located in the strategic Upper Solimões River Mesoregion, which is considered as an area vital to national security given its location in the region bordering Peru and Colombia.

Before RNP, poor connection service meant that the campus had serious interruption problems, leaving the 1,200 students, 64 professors and 30 technicians of the Institute for Nature and Culture, the name of the UFAM facility in Benjamin Constant, for periods of up to 30 days without connectivity. Since 2012, this community has been using a 4 Mbps satellite connection made to RNP's Point of Presence in the State of Minas Gerais. Today, the campus has 500 individual access accounts, 400 of which for students, 74 for professors and 26 for administrative employees.

Based on responses from professors, the study concluded that RNP's network support was directly responsible for improvements in the region's social and economic conditions. Internet access ensures better academic preparation for professionals who will occupy important positions in the region in the future.



NATIONAL AND INTERNATIONAL INTEGRATION

Working toward national integration, through installation of Community Educational and Research Networks (Redecomep) – optical metropolitan networks, 24 of which already in operation, RNP supported the foundation of and participates in RedCLARA, regional backbone operated by the Latin American Advanced Network Cooperation (CLARA), which connects Latin American national academic networks. The Ipê backbone has a 1.45 Gbps connection with this initiative's network, which currently integrates 15 countries in the region. In addition, the Ipê backbone is connected to the U.S. Internet2 network, in addition to the commercial worldwide web. And it is also connected at 2.5 Gb/second to the European Géant network through a partnership with RedCLARA.

On a global scale, RNP is also involved with international initiatives for the development of the Internet. RNP participates in an experimental network to develop new application for the Internet of the Future in partnership with institutions and universities. Known as Fibre, this cutting-edge project is operated through funding from the National Council of Scientific and Technological Development (CNPq) and the European Union's 7th Framework Program (FP7) and is one of the most important projects for studying and testing new Internet architecture.

INTERNATIONAL EXPERIENCES IN IMPACT EVALUATION

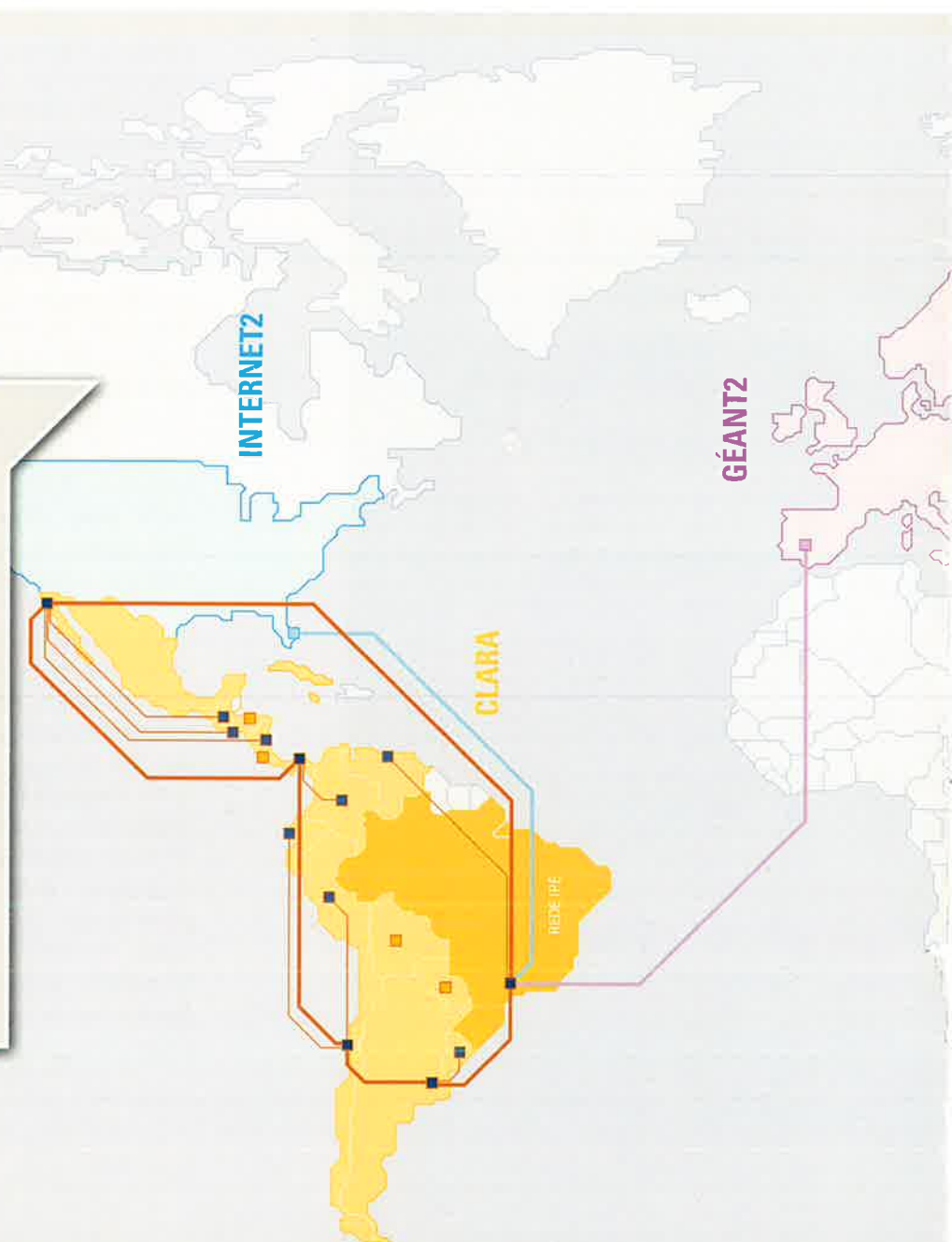
RNP is part of a select group of organizations responsible for national educational networks (or NREN: National Research and Education Networks) which dedicate efforts to measure the impact of their activities on their respective societies.

UNICAMP's Center for Industrial Economics and Technology (NEIT), responsible for the

report titled "Analysis of RNP's economic and social benefits", identified and compiled information on impact of networks such as GÉANT2, the huge European network, CANARIE (Canada), PIONIER2 (Poland) and KAREN (New Zealand). The initiative of identifying and systematizing results of these organizations' activities is innovative and important in providing society with information on their direct and indirect results.

CANARIE (Canada)

The Canadian NREN is a broad band optic fiber infrastructure of over 19,000 kilometers interconnecting close to 1,100 educational and research institutions and 40,000 scientists, researchers and educators. The connections cover 12 regional research networks in Canada and 100 educational and research networks in 80 countries. Analyses of the network's impact on the country show that most Canadian researchers affirm that they could not do their work without the Canarie network, which ensures high-speed transfer of the largest contents of data. Another benefit mentioned is to provide a central backbone for Internet traffic between the Canadian provinces at no additional cost to member institutions.



Despite the differing methodologies, profiles and foci of these networks, studies show that the main property of national educational and research networks is integration of the academic community, both inside and outside the country, offering resources for their users to perform functions that, even if feasible on commercial networks, would be prohibitively expensive. These national networks stand out for the larger capacity they provide, organiza-

tion and technical collaboration and the commitment to cover geographical regions farther away from large urban centers. This allows academic communities to be better able to develop and, especially, retain their talented personnel.

PIONIER6 (POLAND)

Created in 1997 with the name POL-34, Poland's national educational and research network, known as PIONIER6, provides optic fiber broad band connection to 21 educational networks in metropolitan areas, interconnecting educational and research institutions all over the country. The Polish network also interconnects its users to international networks such as GÉANT2 (Europe) and INTERNET2 (U.S.). In addition to the economic and social impacts, the study on the network found that it is largely responsible for the expansion of the high-speed Internet sector itself in the country.

GÉANT2 (EUROPE)

The evaluation of the impacts of the European continent's academic backbone on the different national educational and research networks connected to this infrastructure projected and estimated for a period of five to ten years in the future. The result of the study indicated that, among the principal positive impacts of access to GÉANT2 are ease of access to information and greater interaction between researchers, considered vital to the development and improvement for the advance of research in all connected countries.

KAREN NETWORK (NEW ZEALAND)

Classes given by videoconference represent annual savings of 27,000 New Zealand Dollars (NZD). For the society as a whole, investment in expansion of the network added 0.07% to the country's GDP. Karen is a high-speed network infrastructure connecting 132 research, educational and innovation centers in New Zealand. An analysis of the network's impact, conducted by TEMPLE Capital Investment Specialists in 2008, projected the period between 2009 and 2015. The study concluded that the NZD 51,000 the government invested in the network would generate economic benefits of NZD 200,000.



CHARACTERIZATION OF THE SOCIOECONOMIC IMPORTANCE OF THE RNP – THE BRAZILIAN NREN

A study elaborated by the UNICAMP's Institute of Economics (IE) for RNP.

COORDINATOR

Prof. Dr. Paulo Sérgio Fracalanza (NEIT/IE/Unicamp)

TEAM

Prof. Dr. Rodrigo Lanna Franco da Silveira (NEIT/IE/Unicamp)

Marcelo Pereira da Cunha (CTBE/Unicamp)

Cristiane Vianna Rauen (doctoral student at IE/Unicamp)

Débora Módolo (master's degree student at IE/Unicamp)

Rafael Martins de Oliveira (undergraduate student at IE/Unicamp)

PROJECT MANAGER

Marcus Vinicius Rodrigues Mannarino (RNP)



RNP

Ministério da
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