Definitional Mission to Evaluate ICT Projects in Brazil

Volume 5: Paraíba

(Volumes 1, 2, 3, 4 & 6 Issued Separately)

Final Report

Submitted by
Hellerstein & Associates

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The U.S. Trade and Development Agency

The U.S. Trade and Development Agency (USTDA) advances economic development and U.S. commercial interests in developing and middle income countries. The agency funds various forms of technical assistance, feasibility studies, training, orientation visits and business workshops that support the development of a modern infrastructure and a fair and open trading environment.

USTDA's strategic use of foreign assistance funds to support sound investment policy and decision-making in host countries creates an enabling environment for trade, investment and sustainable economic development. Operating at the nexus of foreign policy and commerce, USTDA is uniquely positioned to work with U.S. firms and host countries in achieving the agency's trade and development goals. In carrying out its mission, USTDA gives emphasis to economic sectors that may benefit from U.S. exports of goods and services

TABLE OF CONTENTS

Paraíba Data Center and Hybrid Broadband Network Project

Definitional Mission Report

Section 1: INTRODUCTION

The U.S. Trade and Development Agency (USTDA) has provided a grant in the amount of US$733,830 to the Paraíba State Data Processing Company (the "Grantee", or *Companhia de Processamento de Dados do Estado da Paraíba - "CODATA*") in accordance with a grant agreement dated **May 25, 2018** (the "Grant Agreement") to fund a Technical Assistance ("Technical Assistance") for a Paraíba State ICT Modernization Project ("Project") in Brazil ("Host Country"). This Technical Assistance will help expand the broadband network and upgrade the data center in the Brazilian State of Paraíba.

Grantee: The Paraíba State Data Processing Company (CODATA)
Activity Budget: $733,830 USD.
U.S. Export Potential: Fiber optic cables; optical electronics; wireless equipment such as antennas, transmitters, and receivers; systems and application software, Servers, Switches, Storage, virtualization software, other data center equipment, and cloud storage services; total approximately US$63.6 million.

Section 2: BACKGROUND SUMMARY

The Paraíba State Data Processing Company (*Companhia de Processamento de Dados da Paraíba – CODATA*) CODATA, is a mixed capital company, belonging to the indirect administration of the State of Paraíba. It is a company with government participation in its capital and administration for carrying out economic activities. It is governed by the rules of commercial companies, Law No. 6404/1976. CODATA has the following characteristics: legal personality according to private law; (*Pessoa Jurídica de Direito Privado*): the capital is public and private; it conducts economic activities; the coating of a corporation; the detention by the Government of at least a majority of the shares entitled to vote; the exceptions of private law by public law; and the creation by specific legislative authorization.

There may be private capital, but we the control is public, and the state has the absolute majority of the shares entitled to vote. Private law does not apply in its entirety to CODATA. . CODATA is linked to the Secretariat of Administration of GEPB.

CODATA was and created in 2003 by Complementary Law 049/2003 to provide information and communications technology services (ICT) to centralized and decentralized organs of the State Public Administration. The company's mission is to provide solutions using information technology, thereby contributing to the modernization of public administration, with transparency, sustainability and standardization for excellence in service to citizens. Accordingly, CODATA aims to propose and provide integrated solutions of means, methods and skills, making intensive and appropriate use of information technology; channeling efforts to improve the services provided by the state public administration; and preserving the management, control and the integrity of strategic state information.

CODATA seeks technical assistance for an international consultancy financed by USTDA to:

- Estimate state government demand for data center services over the next five years;

- Assess the current capacity of CODATA's data center, the other principal state data centers and smaller server rooms (particularly for the Secretariat of Revenue (*Secretária de Receita*) regarding equipment, software and physical facilities.
- Design a plan for the integration and consolidation of the state's data centers, including full active-active backup of all the data centers, to ensure they operate securely under a cloud computing architecture, significantly reduce costs and improve quality of service as compared to the present system and satisfy the projected demand for data center services and
- Determine the requirements for new hardware and software for the integrated and consolidated system of data centers, including the possible use of a private or public cloud computing architecture;
- Propose a design and business model for the expanded broadband network; and
- Support implementation of the upgraded data center and backup data center.

The scope of work of the Definitional Mission (DM) for USTDA requires development of detailed terms of reference (TOR) for activities recommended by the consultants, detailed consultant qualifications, and a detailed Project budget, with final approval of the activities by USTDA. This Final Report contains a summary of the DM process and findings.

II. PROJECT DESCRIPTION

A. Introduction

Brazil

Brazil is a recognized leader in ICT and in e-government in Latin America and among major emerging market economies worldwide. In keeping with Brazil's strong federal system, not only the national government but all state governments and a growing number of municipal governments have expanding e-government and ICT programs, of increasing sophistication. Ever more powerful, flexible and economical, ICT presents formidable new opportunities to accelerate economic, social and political development. But realizing this potential requires an enabling environment: appropriate incentives, policies and programs structured by governments that can also catalyze private investment. Brazil's national, state, and municipal governments recognize that a strong effort to bridge the digital divide is necessary in a country known for its high degree of income inequality.

In July 2016 Brazil was estimated to have 139 million Internet users, fourth largest in the world after China, India, and the United States. According to the annual survey conducted by the Brazilian Internet Steering Committee (*Comitê Gestor da Internet no Brasil* - CGI.br), in 2014 50% of Brazilian private homes, that is 32.3 million, had an Internet connection in 2014, up from 15% in 2006. Over the same period the percentage of individuals above 10 years of age who accessed the Internet (in the three months prior to the annual survey conducted by CGI.br) rose from 28 to 55. So despite the undeniable progress, there is still a long way to go to achieve true digital inclusion. As of May 2016 the number of fixed broadband subscribers had reached only 26 million, or 12.7 per 100 inhabitants. Of these connections, 69% were over 2 Mbps and only 31% greater than 12 Mbps. But mobile broadband subscriptions had exploded to 173 million, of which 21.2% were 4G (LTE). While 3G and 4G mobile connections are useful, smart phones are less than ideal for many applications, especially e-learning, e-health, and e-government.

Brazil is the largest country in Latin America, with an estimated population of 206,3 million in August 2016, it is also the most populous. According to the World Bank, in 2014 Brazil's economy was the seventh largest in the world. Per capital income was US$11,790 in 2014. The five largest cities are São Paulo, Rio de Janeiro, Salvador, Fortaleza, and Belo Horizonte. There are 29 cities of over 500,000

people, and 5,570 *municípios*.[1] With almost 30 million people in the rural areas, provision of affordable broadband to this group, which has the lowest average income levels, presents a particularly severe problem.

In 1999 the federal government launched an "information society program". The program focused on universal access, business competitiveness & e-government. After an initial push during the second government of President Fernando Henrique Cardoso (1999-2002), this effort stalled. Under the governments of President Luis Inácio Lula da Silva (2003-2010) and Dilma Rousseff (2003-May, 2016 when she was replaced by the Vice President, Michel Temer while she undergoes an impeachment trial in the Senate), the emphasis has been more on digital inclusion than e-government. As of May, 2016 the new government is in the early stages of evaluating its ICT policies.

To help improve broadband coverage and reduce the cost of broadband access, the government launched a major broadband infrastructure development initiative in 2010, setting ambitious targets to triple broadband uptake by 2014. The National Broadband Plan (*Plano Nacional de Banda Larga* – PNBL) aimed to ensure that broadband access is available to low-income households, especially in areas that have so far been poorly served. Many States created strategic plans and are implementing the projects in these plans. Most state Governors understand that they need to modernize their government secretariats and agencies, and support them with a modern information infrastructure so they can become transparent and nimble, focused on producing excellent public services in essential areas, such as public safety, education, health, and welfare. These states are creating public and private partnerships to help achieve these goals. For example, the Rio de Janeiro Government states that Government's role should be as an articulator, motivator and facilitator by creating conversations with public and private entities in their effort to modernize the Government and create a 21st century public administration.

At one end of the spectrum there is a high density of access in the industrialized urban areas, mostly in the southeast and south of the country. In these areas, and in the richer strata of the population, Brazil has achieved high levels of Internet use. But at the other end there are the vast hinterlands of unconnected rural and remote areas, particularly in the north, northeast, and west of the country. For example in the Northeast region, rural fixed broadband penetration is only 1.5%, while it is over 11% in the more industrialized Sao Paulo state. The pattern of uneven access also repeats itself at the local level. Most cities have wealthy areas with high levels of domestic broadband access, while close by, in the informal settlements (called *favelas*) that house most of the country's urban poor, there is little fixed broadband and residents mostly depend on lanhouses (small businesses offering Internet access and related services), telecenters (free public Internet access providers) or relatively slow and more expensive 3G wireless connections.

Despite receiving considerably less investment resources than announced on various occasions by government official (that can be considered a sign of less than urgent priority for the PNBL), Telebras has gradually created a national network of fiber optic cables, in large part through public-public and public-private partnerships that involve leasing or exchanging existing dark fiber. As of 2016, the Telebras network includes 28,000 km of fiber. In 2011 Telebras established long-term rental contracts for use of fiber pairs some 16,000 km in the optical ground wire (OPGW) cables of electric power companies that are run by Eletronet, a company that is owned by Eletrobras and AES, an American company. Telebras also leased some 2,200 km of fiber from Petrobras. Another 2,200 km were obtained in an exchange of use of fiber with a private operator, TIM, in 2013. These arrangements allowed expansion of Telebras trunk lines in rings that provide redundant links in case of failure at any point in the system. Telebras has also invested in its own fiber optic links to provide high capacity redundant

[1] A *município* is the lowest level of government in the Brazilian federal system, after the federal and state governments. It includes the municipal seat and surrounding territory. The closest US equivalent is a county.

links to the six cities where the Confederations Cup soccer matches were played in 2013 & to the 12 cities that hosted the World Cup matches in 2014.

Traditional private telecommunications providers complement Telebras in implementation of the PNBL. ISPs that offer access of at least 1 Megabit per second (Mbps) to their customers at PNB prices – R$35 (US$15) or R$29 (US$12) in states that have eliminated the ICMS on PNBL subscriptions – qualify for wholesale bandwidth from Telebras at below-market prices. Small and medium ISPs and the large operators – like Oi, Telefônica, Embratel, TIM, and Algar Telecom – offer the PNBL packages, in some cases benefiting from state tax exemptions. The operators are discovering that many PNBL customers soon want faster and more expensive connections. In this way, the PNBL is opening new markets for the private operators.

The growth of the Telebras network has increased competition and thereby led to lower prices offered by private providers. Telebras says it has not cut the wholesale prices it charges as far as it could and still cover costs so as not to drive the private operators, needed for meeting Internet penetration goals, out of the market. The federal government encourages private operators to expand digital inclusion of populations in underserved markets. Telebras is also investing in a Brazilian geostationary satellite providing military X band and civilian KA band communications covering all of Brazil's territory. The satellite is scheduled to be launched in late 2016 and enter service in the first quarter of 2017. Telebras also has plans for submarine fiber optic cables to Africa, Europe, and the United States to reduce costs for Internet connectivity. It is unclear whether the necessary resources will be forthcoming to undertake these investments.

Expansion of high-speed connections has been spurred by growth in demand for Internet access by the emerging lower middle class. This group provides voting support for the government, but also is courted by opposition parties. These new consumers are buying smart phones, tablets, and laptops (encouraged by exemptions from taxes on production of these products as discussed below) and want broadband connections.

Another strategy to support the PNBL is requiring coverage of rural areas when auctions are held for mobile spectrum allocation. Operators bidding on 450 MHz frequencies were required to provide voice and data services in rural areas and remote regions as well as free access to rural public schools. Winning bidders were required to offer these services on a commercial basis within a radius of 30 km from the municipal seat (capital) in all *municípios* by the end of 2015, thus covering 91% of the rural population. They also had to provide free broadband connections to all the public schools in these areas, thus serving 96% of public schools. Winners were determined according to the lowest price on commercial connections. In 2012 federal law 12,715 provided a full exemptions from federal taxation for telecommunications services offered on this frequency and for small satellite antennas as well as for network equipment, terminals, and transceivers for these services.

For primary and secondary education, beginning in 2008 telecommunications operators were required to provide broadband connections at increasing speeds to all urban public schools. This was obtained at virtually no budgetary cost by the so-called "exchange of obligations" agreed in April 2008 whereby the operators were relieved of the requirement to provide thousands of outmoded Telecommunication Services Posts with public phone booths, fax machines and Internet-connected computers. By 2014 all 62, 925 urban public schools had free broadband connections, though the quality and speed of the connections still left much to be desired.

Prior to the establishment of the PNBL, a large number of municipal and state-supported efforts to improve access to the Internet were already underway, including the use of tax incentives and provision of low-cost, or even free broadband services in public access facilities (telecenters) and schools. These efforts are now accelerating as implementation of the PNBL proceeds. For example, the state of Sao

Paulo has exempted broadband from the state value-added, and developed a network of 850 telecenters with more than 3 million registered users supported by 1,211 supervisors in 600 *municípios*.

A growing number of states and *municípios* are participating in the PNBL and others, such as Ceará, Pará and Rio Grande do Sul, have built their own terrestrial networks making use of various kinds of partnerships, usually with the National Education and Research Network (*Rede Nacional de Educação e Pesquisa* – RNP), electric power distributors, and companies such as Petrobras and Vale that own fiber networks of their own. There objectives have been to reduce costs of connectivity and reach previously underserved or unserved residents.

In 2005 RNP began a program to build fast metropolitan fiber optic networks in Brazil's major cities in association with a variety of partners. This program is called Redecomep, and as of December 2015 had 36 metropolitan networks in operation with some 3,650 km of fiber optic cables. Redecomep achieved this by partnering with electric power companies, state and municipal governments and other entities that provided rights or way, ducts or poles in return for access to fibers in these cables.

The Ministry of Science, Technology and Innovation (MCTI) finances fiber optic cables and equipment for operation of the fibers in these cables that serve academic and research institutions. But the number of pairs of fiber in these cables is much larger than needed for the academic and research institutions, allowing allocation to other partners that provide services in kind or for direct leasing payments. For example, metros, light rail lines, urban toll roads, and state and municipal governments can offer rights of way and ducts. Electric power companies can provide poles on which the cables can be hung. And Telebras can offer fibers in its backbone network.

RNP's newest program is called *Veredas Novas* (New Paths). It is a joint program with MCTI, the Ministry of Communications, the Ministry of Education, and Telebras. Its objective is to provide fiber connections to research and educational institutions in the interior of the states, and also digital inclusion of the as yet unserved population in the vicinity of these institutions. In each city RNP is establishing a local access point, with radio and eventually fiber connections to ISPs that agree to offer Internet service of at least 1 Mbps at PNBL prices. These ISPs can also offer faster connections at market prices. To obtain cheaper broadband service, several states are building their own fiber optic networks outside the capitals. The leaders are Pará and Ceará.

In Ceará the state ICT Company, ETICE, has built a 3,000-kilometer ring of fiber optic cables around the state that, with its wireless extensions, reaches 88 percent of the state's population. Called the Digital Beltway (*Cinturão Digital do Ceará - CDC*), its nucleus is Gigafor, co-financed by RNP's Redecomep program in the state capital, Fortaleza. At various points along the fiber trunk lines there are towers from which *municípios*, not on the CDC, can connect through wireless links, allowing them to communicate with the state government and other *municípios*. In 2015 ETICE held a public auction of dark fibers in the CDC using a RFP designed with USTDA-funded technical assistance. A consortium of Ceará-based ISPs won the right to a lot of fibers. The income from the lease of these fibers covers all of ETICE's operating costs, making the company independent of the state budget and contributing to the expansion of private sector ISPs in Ceará. There are plans to expand the CDC to reach more interior points in the state as part of contracts to be signed with future private sector partners to be selected in new auctions using the improved RFP design and through the RNP's *Veredas Novas* program.

In Paraná the state government has used another route to building a state network, namely purchasing bandwidth from Copel Telecom, a subsidiary of the state electric power company. Copel Telecom has an extensive fiber optic network launched in 2010 that by the end of 2012 reached all *399 municípios* in the state.

Among the characteristics of the best state and municipal networks are:

- The state or *município* takes advantage of dark fiber allocated to it in the state capital's Redecomep;
- Partnerships are established with RNP; *municípios*, state and federal public enterprises, private telecoms, and Telebras to extend the network's reach and share costs of operation and maintenance;
- Complementary fiber and wireless networks are built to fill in gaps and provide capillarity (urban as well as rural);
- Maintenance and operation are outsourced to private firms; and
- States or *municípios* lease dark fiber in their networks to private operators to generate additional revenue, helping to cover operating and maintenance costs.

Rapid technological change and increased competition among providers of telecommunications services promoted by Brazil's successful privatization and liberalization of this sector help reduce the cost of connectivity, as many of the PNBL's and various state and municipal initiatives aim to provide free or low-cost wireless Internet service to low-income populations. Continued technological progress, the availability of free and open source software, and increasingly favorable financing terms have reduced the cost of computer equipment and software. Brazil's commitment to macroeconomic stability and already high tax burden have made it difficult to increase public financial resources for ICT and e-government-related investments, including telecommunications and IT infrastructure, public digital inclusion programs, connectivity, distance education programs, and the like.

The state of Paraíba

Paraíba is located in Brazil's Northeast Region, bordering the Atlantic Ocean on the East; Rio Grande do Norte on the North, Pernambuco to the South, and Ceará to the West (Figures 1 - 2).

Figure 1: Political Map of Brazil and location of Paraíba

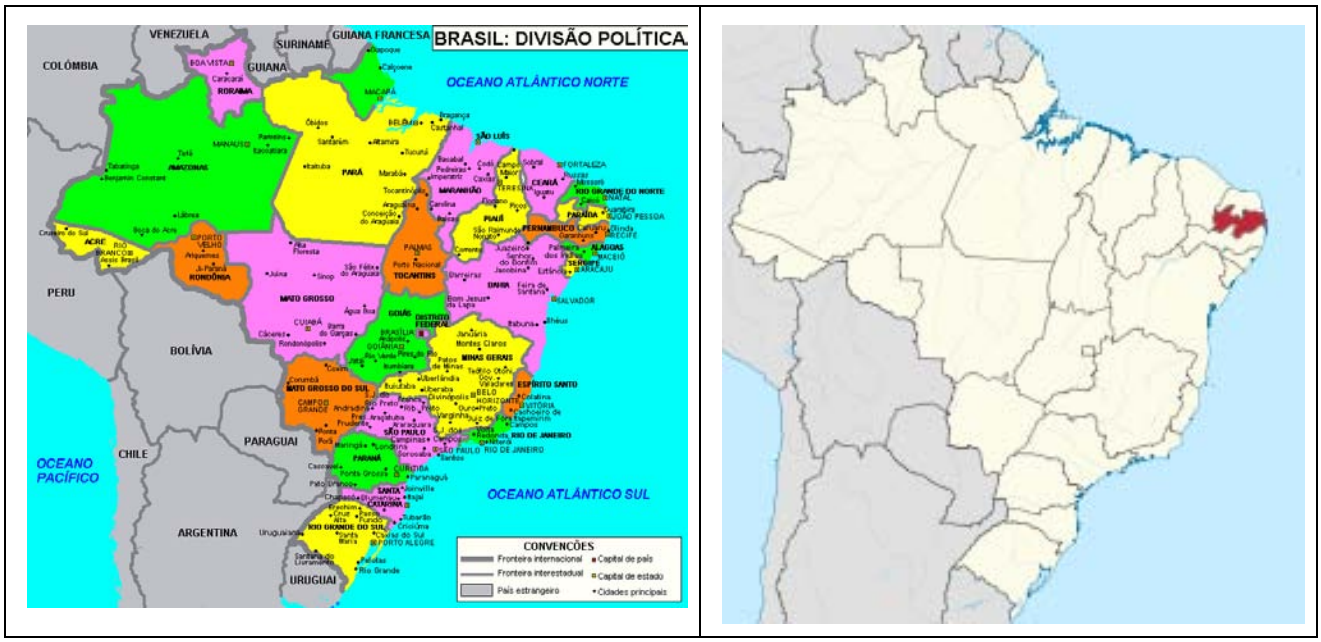

Figure 2: Map of Paraíba

Paraíba occupies an area of 56,470 square kilometers, about the size of Iowa in the United States. The state's estimated population in June 2016 is about 4.0 million living in 222 *municípios.*

Paraíba's GDP in 2013 was only 0.9% of Brazil's, and its per capita GDP US$4,836, about 46% of the national average. The state's geographical regions include a narrow well-watered coastal zone (*zona da mata*) with extensive sugar cane plantations, a high semi-arid inland plateau (*sertão*) subject to periodic droughts and used mainly for extensive grazing of livestock, and an intermediate zone formed by the terraces and slopes between the two with moderate rainfall (*agreste*) where smaller farms predominate.

Paraíba's economy is mainly based on the trade and services sector, but its industrial sector is the fourth largest in the Northeast behind Bahia, Pernambuco and Ceará, and includes the second largest cement production in Brazil. Its agriculture is based on sugarcane, livestock, tobacco, fruits, black pepper, cassava, rice, and beans.

But the most important sector is services – largely composed of commerce, tourism, and government services – that was responsible for 73% of the state's GDP in 3013.

Paraíba's capital, João Pessoa, is at the center of a metropolitan area including 12 *municípios* with a population of 1.2 million in 2015, 31% of the state's population. The João Pessoa metropolitan area is the dynamic center of the state's economy, having important medical, education poles and the principal port of the state. The second largest *município* is Campina Grande, with a population of about 405 thousand.

CODATA

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The Multi-Year Plan (*Plano Plurianual* – PPA) for the period 2016-2019, approved by the state legislature on December 17, 2015, assigns to the Secretariat of Administration responsibility to expand the state data center and modernize the state broadband network, with an allocation of R$1.5 million (about US$ 430 thousand).[2]

B. THE PROJECT

CODATA seeks technical assistance for an international consultancy financed by USTDA to develop detailed plans to:

1. Review the current organization and management model of the CODATA data center and its proposed containerized backup data center;
2. Help define the technology to be used to upgrade CODATA's data center, including the possible use of a private or public cloud computing architecture;
3. Support implementation of the upgraded data center and backup data center;
4. Review the current plans to expand the Paraíba High Performance Network (*Rede Parabaino de Alto Desempenho* – REPAD) to interlink all units of the GEPB – both in the João Pessoa metropolitan region and in the interior of the state in order to meet the demand for ICT throughout the state.
5. Propose a design and business model for the expanded REPAD

Design and implementation of an integrated and consolidated data center system

The US consulting firm would conduct an evaluation of CODATA's existing data center and its planned organization and management model designed to integrate and consolidate existing state data centers. This evaluation would:

- Review the technology, organization, and management model of the existing CODATA data center and its planned containerized backup data center;
- Estimate GEPB demand for data center services over the coming five years; and
- Assess the current capacity of CODATA's own data center, the other principal state data centers and smaller server rooms (with special attention to the Secretariat of Revenue (*Secretária de Receita*) as regards their equipment, software and physical facilities.

[2] Governo do Estado da Pernambuco Paraíba (2015). *Paraíba 2040: PPA 2016-2019: Anexo I – Programas Temáticos ao Estado*. João Pessoa, p 27 and 31. Available at http://www.al.pb.gov.br/wp-content/uploads/2015/10/PPA-2016-2019.pdf. Accessed June 12, 2016.

In the second stage of the study the principal tasks would be to:

- Design a plan for the integration and consolidation of the state's data centers, including full active-active backup of all the data centers, so that they can operate securely under a cloud computing architecture, significantly reduce costs and improve quality of service as compared to the present system and satisfy the projected demand for data center services and
- Determine the requirements for new hardware and software for the integrated and consolidated system of data centers

<u>The principal existing state data centers</u>

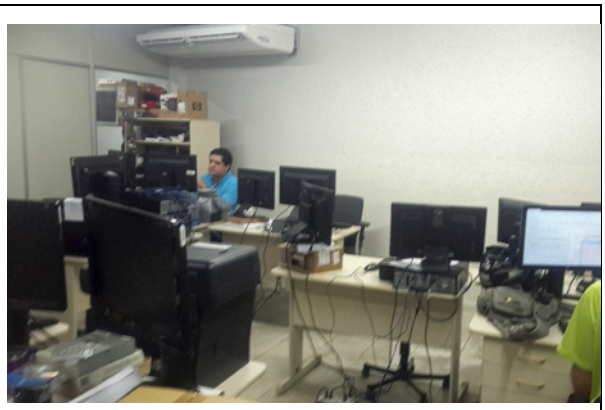
H&A visited the two state data centers the main data center CODATA (and the site for a planned containerized backup data center) and that of the Secretariat of Revenue and held discussions with their managers.

The CODATA data center. This data center serves most state secretariats and agencies except the Secretariat of Revenue.

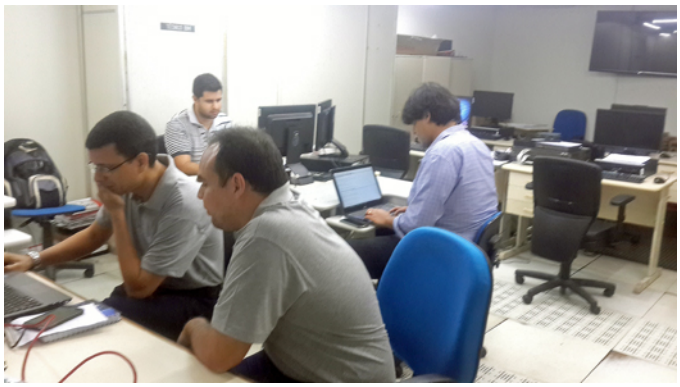
Figure 3 includes photographs of major elements of the CODATA data center.

Figure 3: Existing CODATA Data Center and its new building

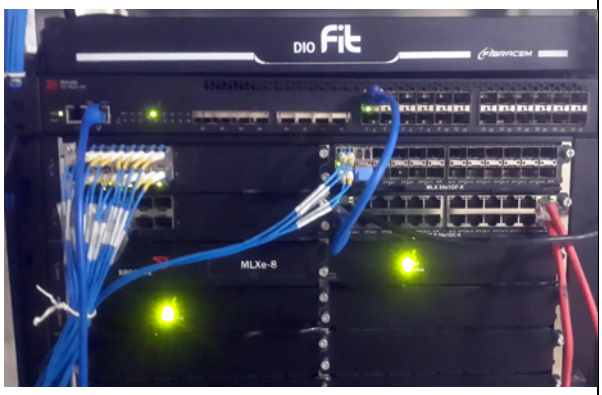
Entrance to existing data center



CODATA Data center control



REPAD broadband network control room



Optical connections

HP blades and storage

Mainframe drives

Backup tape storage racks

IBM Mainframe, HP storage

Cabling

Cabling

Co-located server

Generator

New building for data center

Walkway between existing data center & new building

CODATA has two computing environments, High Platform and Low Platform. The High Platform environment (mainframe) uses the newest equipment from IBM, where multiple systems in the financial sector and state government payroll are processed. The Low Platform uses BLADE server architecture, configured in CLUSTERS unites the processing power of multiple servers.

- **High platform:**
  - Server IBM 2818-z114 M10;
  - Tape virtualizer CGx LUMINEX with approximately 4TB useful área;
  - Machine with a central processor at 80 MIPS;
  - Capacity Setting H01 (80 Mips - 10 MSU´s);
  - Three Integrated Facilities processors IFL de 3,8 GHz for Linux;
  - Two Cryptos (Criptographic processors for secure transactions ad Access operating at 3.8 GHz;
  - Memory96GB;
  - Storage IBM DS6800 2.3TB gross. Configured in raid-5;
  - Operating System z/VM e z/VSE e z/Linux.

- **Low platform**:
  - 2 Chassi Blade c7000;
  - 9 Blade servers BL 460c com 2 CPU Intel Xeon E5440, 16GB RAM and 2 146GB drives;
  - 3 Blade servers BL 460c G7 with 2 CPU Intel Xeon 5650, 96GB RAM e 2 146GB drives;
  - 3 Blade servers BL 460c Gen8 with 2 CPU Intel Xeon E5-2670, 128GB RAM and 2 300GB drives;
  - 4 Blade servers BL 460c G7 with 2 CPU Intel Xeon 5650, 32GB RAM e 2 146GB drives;
  - 4 Proliant servers DL 380 Gen9 with 2 CPU Intel Xeon E5-2630v3, 128GB RAM e 2 900GB drives;

- Storage EVA 4400 with 2 Array controllers with 28 300GB drives, 27 600 GB drives, 14 discos de 1TB e 14 discos de 2TB, totaling 66.6TB of storage space;
- Storage EVA 4400 with 2 Array controllers with 12 600GB drives and 16 2TB drives, making a total of 46.4TB storage space;
- Storage 3par with 2 controllers NODEs with 48 900GB FC drives and 44 3TB drives, making a total of 175.2TB storage space;
- Backup library with 2 LTO-5 internal units and 2 LTO-4 internal units, together with 100 LTO-5 data media units and 200 LTO-4 data media units.

In addition, CODATA hosts a HP Blade and Storage solution for the State Secretariat of Education (SEE/PB) in the CODATA data center with the following components:

- Chassis Blade c7000;
- 4 Blade BL 460c G7 servers with 2 CPU Intel Xeon 5650, 96GB of RAM e 2 146GB drives, with a total processing power of 128GHz and 384GB of RAM.
- Virtualization: VmWare vSphere 4.0 licenses for 8 CPU and VmWare vCenter Standard license;
- Storage EVA 4400 with 2 Array controllers with 12 600GB FC 10k RPM drives, giving a total of 7.2TB storage space;
- Backup Library with 2 LTO-5 internal units, together with 100 data media.

Annex 1 provides more details on the CODATA and co-located SEE/PB equipment and software.

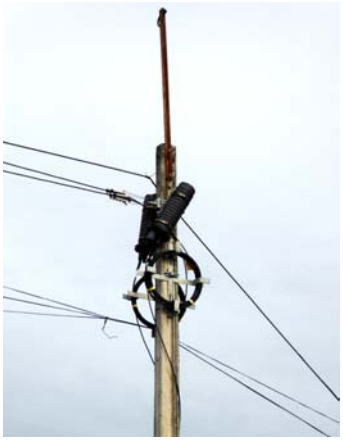
CODATA is planning to install a full containerized backup data center in a secure location, the Military Police training school (Figure 4), with a fiber connection to REPAD. A very detailed RFP (*Edital*) with a full list of equipment and services needed was approved on January 8, 2016 and should be reviewed by the US consulting firm.

Figure 4: Location of CODATA's planned containerized backup data center

Site for CODATA backup data center

Existing generator building at site

Connection to REPAD fiber optic network



Detail of connection to REPAD network

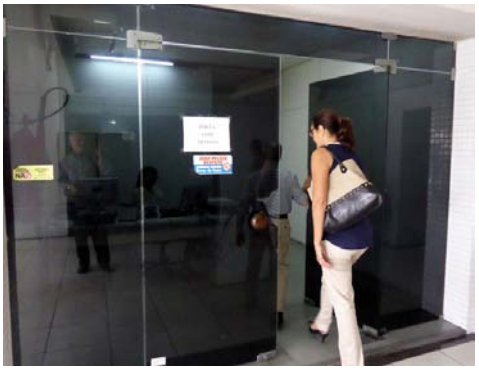
CODATA believes migration to a cloud model, using SasS (software as a service), PaaS (Platform as a Service), IaaS (Infrastructure as a Service) and integration with the legacy environment, will make possible a new standard of interoperability and media convergence, offering an array of benefits:

- Agility;
- Elasticity;
- Automation;
- Sharing;
- Scalability;
- Economic viability;
- Monitoring;
- Accounting by use;
- Standardization;
- Capacity Planning;
- Management;
- Direct Processing Power for users;

- Innovation;
- Development of Open Data solutions;
- Transparency;
- Self Service;
- Backup;
- Multimedia;
- Integration and
- Control, among others.

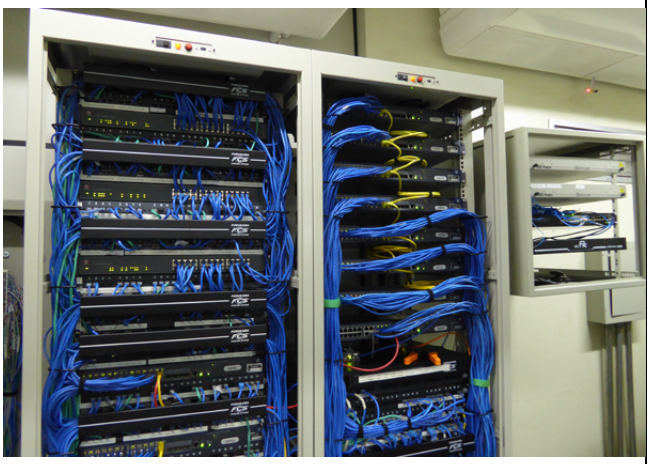
The Secretariat of Revenue (SER/PB) has a modern data center but lacks its own backup data center, and its level of security seems less than desirable (Figure 5). This data center is scheduled to be transferred to a new building currently in the final stages of construction, but again one can question the level of security (Figure 6). A backup data center could be co-located in the new building of the CODATA data center, or in CODATA's planned containerized backup data center. Which of these options should be chosen, and what kind of equipment and software should be installed are issues for which CODATA seeks USTDA-funded technical assistance in addressing. Another possibility that should be considered is cloud backup for one or both of the CODATA and SER/PB data centers using one of the commercial services like Microsoft's Azure, Amazon Web Services or Google Cloud Platform.

Figure 7: The existing SER/PE data center and its new building



Entrance to existing data center

Storage, fiber links in background

Blades and storage	*Back side blades*
 *HP storage*	 *Back side IBM blades*
 *Fiber connections*	 *Map of fiscal posts to connect to REPAD*
 *UPS Room*	 *UPS controls*

Batteries for UPS

Generator buildong

A summary of the equipment and software of the existing SER/PB data center follows.

1) Servers:
- IBM Pure System (two)
- HP Bladesystem C3000
- Oracle Exadata (1/8)

2) Security:
- Fortinet Fortigate 1000C (dois)

3) Backup:
- EMC Data Domain (two)

4) Connectivity:
- LAN: HP
- WLAN: Cisco

5) Storage:
- IBM V7000 (dois)
- HP EVA 4100

Among the principal services are::

- ATF;
- VMware Vcenter;
- IBM VIOS server;
- Mail;
- Database (Informix);

- Webservers Apache;
- Jboss EAP;
- Active Directory;
- Centreon (Monitoring);
- DNS;
- Files;
- GLPI (System for monitoring requests for service);
- Intranet / Internet;
- CVS;
- EMC Networker;
- BI;

Figure 8: New building under construction for SER/PB data center

Construction financed by BNDES

Entrance to new building

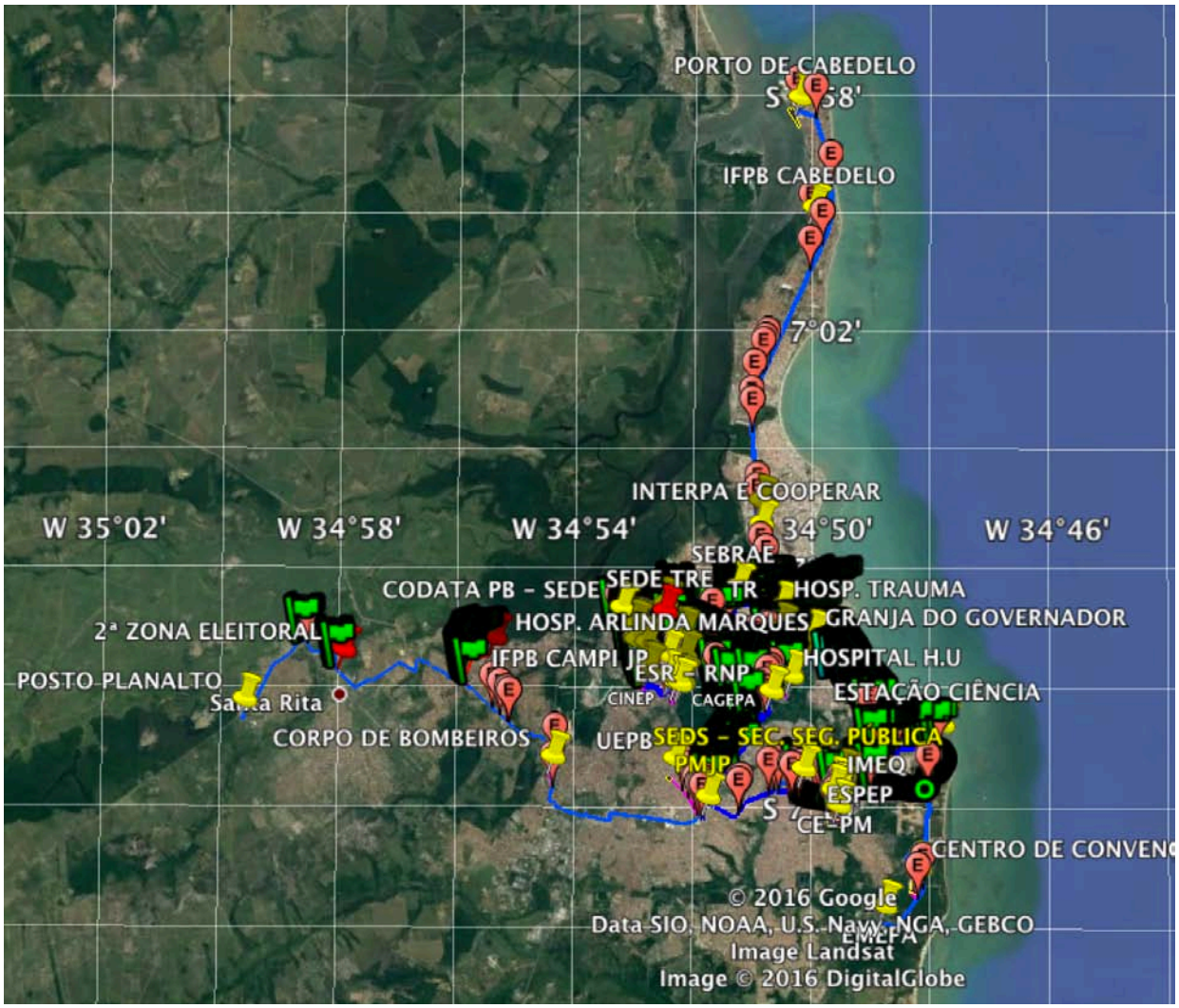
Construction still underway

New equipment room – note windows

The State Corporate Network Project (Rede Paraibana de Alto Desempenho - REPAD)

The REPAD expansion project would provide high performance broadband connectivity to interconnect all units of the state government throughout the state and offer similar connectivity to the 222 municipal governments in the state of Paraíba. The project would build on the existing REPAD network located in the João Pessoa Metropolitan Region built by the state government in partnership with RNP, Energisa (the electric power company operating in Paraíba) and possibly one or more telecommunications operators. The João Pessoa metropolitan network began with a partnership between the Paraíba State Research Foundation (*Fundação de Apoio à Pesquisas do Estado da Paraíba* – FAPESQ), a dependency of the State Secretariat of Science, Technology and the Environment, and RNP via the Ministry of Science and Technology's funding organization, FINEP and signed in 2006. The initial joint network served state government offices and institutions of higher education and research. It was later expanded to include another additional state government offices. The João Pessoa metropolitan network has 24 pairs of optical fiber. Of these two are used by the RNP for its Metro-JP academic network, and two are allocated to the 12 municipal governments in the metropolitan area.

Figure 9: Existing REPAD network in the João Pessoa metropolitan area



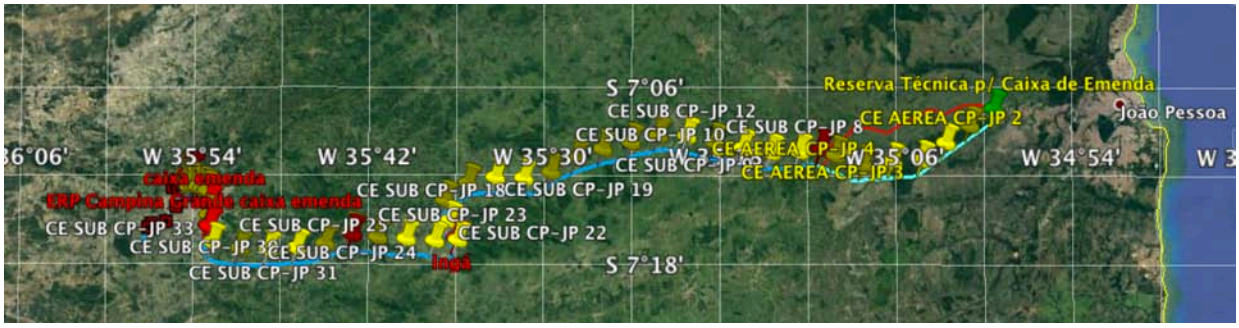
Source: CODATA

The expanded corporate network would update the existing physical and logical broadband network infrastructure outside the João Pessoa metropolitan area currently leased from Oi, the incumbent telecommunications company serving much of Brazil. Oi currently provides CODATA with connections to 101 *municípios* (see Annex III). The expanded corporate network, that would provide fiber connections to all 222 *municípios* in the state would increase the speed and agility with which CODATA can respond to demands for service, modernizing the technological base of government, reducing OPEX and optimizing the use IT resources.

Once the project is implemented, it will be possible to develop an integrated governance system to link all departments and public agencies, provide greater speed and efficiency in the delivery of public services, thereby reducing costs to the state through the use of an efficient multiservice communications infrastructure. The population will gain access to broadband Internet connectivity, allowing every citizen to have free access through public telecenters and schools.

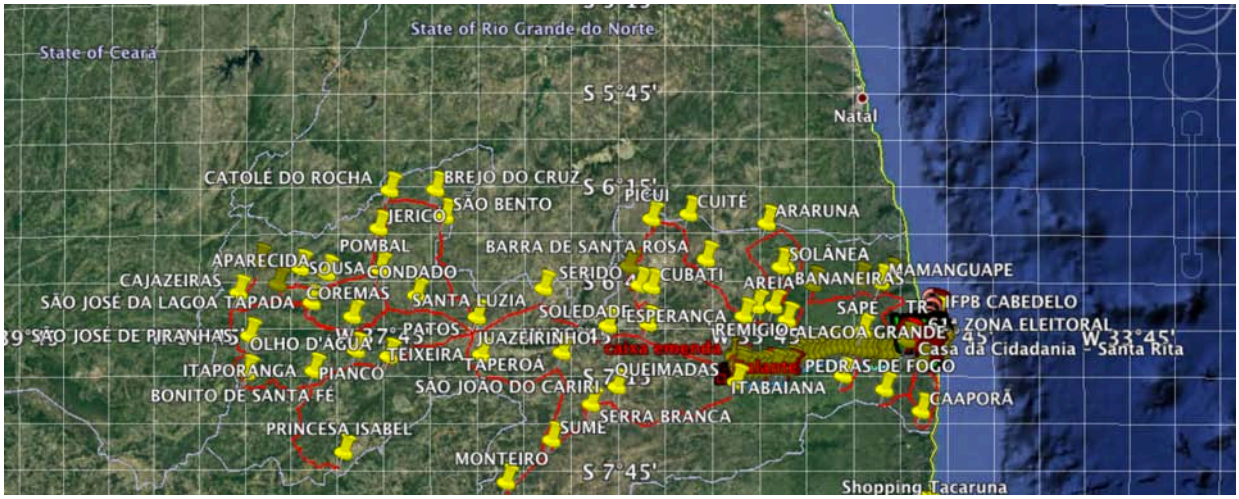
To achieve the REPAD project objectives, it will be necessary to build a statewide optical fiber network with radio extensions to smaller *municípios* where the use of fiber is determined to be un-economic. The new data network (see Figures 10 and 11) should reach all Paraíba's 185 *municípios,* providing efficient and low-cost telecommunications service. Then each point of presence (POP) will require at least a minimal ICT infrastructure allowing use of this network. Figure 10 shows the route connecting REPAD in João Pessoa with the RNP's metropolitan network in Campina Grande. It is composed of segments with 48 and 72 fiber cables partially financed by RNP. In Campina Grande, home of the Federal University of Campina Grande and FAPESQ, RNP ceded the use of two pairs of fiber to CODATA.

Figure 10: Interconnection between João Pessoa and Campo Greande



Source: CODATA

Figure 11: Complete Expanded REPAD Network



Source: CODATA

CODATA is responsible for implementing this project. Results that will be felt throughout society are expected to be:

- Better performance of public administration through the integration of state secretariats and agencies;
- Improved access to government enterprise systems;
- Improved communication between public officials and between the public and public agencies;
- Reduced communication costs;
- Democratization of access to information;
- Increased digital inclusion of the population;
- Improved access to the Internet in schools and telecenters;
- Interconnection of schools;
- Easier access to public services through integrated citizen service centers (*Progrma Cidadão*) and eventually online citizen service centers;
- Easier creation of public communication services in *municípios*, such as blogs, online radio and newspapers;
- Creation and deployment of virtual libraries;
- Using distance education for supplementing existing means of education;
- Dissemination of information about and interactive participation in cultural and scientific activities;
- Use of new technologies such as telemedicine, VoIP and video conferencing;
- Generation of employment and income driven by the inclusion of new technologies, access to information and training facilities.

A basic economic characteristic of fiber optic networks is that the cost of increasing the numbers of fibers in a cable before it is deployed is much less than proportional to the number of fibers. Doubling the number of fibers increases the price of the cable from 30 to 40 percent. But the total cost per kilometer of the deployed cable increases much less, from 10 to 20 percent if aerial and less than 5% if underground, since the cost of hanging or burying the fiber is about the same irrespective of the number of fibers in the cable. So when costs are shared among partners, usually in proportion to the number of dark (unlit) fibers to which each partner has rights, the result in a win-win situation, since each partner's costs are much less than if they had created their own fiber links. This provides a substantial incentive for the entity investing in the fiber link to find partners. Each partner usually "lights" its own pairs of fiber, though some other aspects of the infrastructure, like cabinets holding the electronic equipment, can also be shared.

Swaps (*Permutas*) are another way to reduce costs, and are widely used in the telecommunications industry between commercial telecommunications operators, though this fact is not widely known and it is extremely difficult to obtain maps showing each company's network and those parts that are shared or traded with other companies.[3] Several other Brazilian states, led by Pará and Ceará have invested in their own fiber networks and engaged in sharing of fiber cables with partners including RNP, Telebras, Petrobras, and federal and state electric power distribution companies. A number of other states have begun or are planning to do the same, among them Rio de Janeiro, Rio Grande do Sul, Santa Catarina,

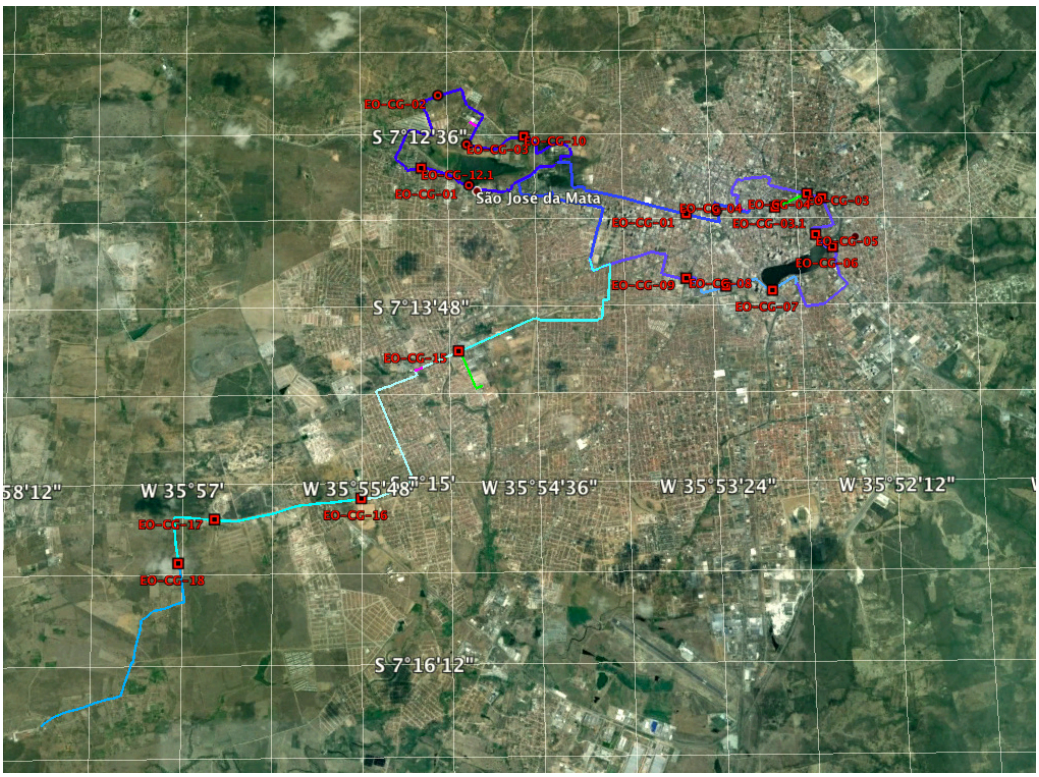
[3] See Knight, Peter T. (May, 2014) *The Internet in Brazil: Origins, Strategy, Development, and Governance*. Bloomington, IN: Author House, especially Chapter 1, "The Strategic Importance of the Internet for Brazil's Development" for further analysis. A Portuguese language version of the book is also available.

Sergipe, Tocantins, Bahia, and Paraíba.[4]

Potential partners for expanding CODATA's broadband network

The first logical partner for CODATA is the National Education and Research Network (*Rede Nacional de Ensino e Pesquisa* – RNP). RNP is already a partner in the CODATA's REPAD in João Pessoa (RNP's Metro-JP network and REPAD share a fiber optic cable). RNP has built another metropolitan network (Metro-CG) in Campina Grande, the state's second most populous city (Figure 12), in which CODATA has two pairs of fiber as explained above.

Figure 12: The RNP's Metropolitan Network in Campina Grande (Metro CG)



Source: RNP

As part of its *Veredas Novas* program to "interiorize" its network, RNP is interested in connecting the two existing metropolitan networks and also the 19 research and higher education institutions in the interior of the state not already connected by RNP fiber (Table 1). RNP has provided part of the fiber to connect João Pessoa and Campina Grande (Figure 10).

Table 1: Research and Higher Institutions in the Interior of Paraíba lacking REPAD connections

Organization	Institution	Município

[4] See *Ibid*, Chapter 5, "What Is Being Done to Improve Internet Connectivity". Also Carvalho, Feferman, Knight and Woroch, "Public-private partnerships for the expansion of access to broadband: lessons of Ceara's Digital Beltway", Chapter 13 in Knight, Feferman, and Foditsch, eds. (2016) *Broadband in Brazil: Past, present and future*. São Paulo: Figurati/Novo Século (free eBook in PDF format available from Google books). The Portuguese version was published in July 2016 and is available as an eBook in Kindle and Google Books.

Universidade Federal de Paraíba (UFPB)	***Subotal 4***	
UFPB	Campus de Areia	Areia
UFPB	Campus de Bananeiras	Bananeiras
UFPB	Campus Litoral Norte	Rio Tinto
UFPB	Unidade Mamanguape	Mamanguape
Universidade Federal de Campina Grande (UFCG)	***Subtotal 6***	
UFCG	Campus de Cajazeiras	Cajazeiras
UFCG	Campus de Cuité	Cuité
UFCG	Campus de Patos	Patos
UFCG	Campus de Pombal	Pombal
UFCG	Campus de Sousa	Sousa
UFCG	Campus de Sumé	Sumé
Instituto Federal de Paraíba (IFPB)	***Subotal 9***	
IFPB	Campus Cajazeiras	Cajazeiras
IFPB	Campus Catolé do Rocha	Catolé do Rocha
IFPB	Campus Guarabira	Guarabira
IFPB	Campus Monteiro	Monteiro
IFPB	Campus Patos	Patos
IFPB	Campus Picuí	Picuí
IFPB	Campus Princesa Isabel	Princesa Isabel
IFPB	Campus Sousa	Sousa
IFPB	Campus Bananeiras	Bananeiras
Total without connections to REPAD	**19**	**15**

PB

Source: RNP

RNP can convert its annual OPEX per institution of R$120,000 into CAPEX to invest in the expansion of REPAD. Thus establishing a partnership with RNP could result in a contribution of R$2.3 million

(About US$650,000) for the 19 institutions not yet covered by one of the two RNP metropolitan networks in return for a pair of fiber.

Energisa would be a good partner for CODATA, as it already is participating in REPAD in João Pessoa and Metro-CG, allowing free use of its transmission poles in return for use some fibers. This partnership with Energisa could be extended throughout the state.

The Paraíba State Water and Sewerage Company (*Companhia de Agua e Esgotos de Paraíba* – CAGEPA) might allow placing fiber cables in sewer systems, a technique that would eliminate the need for aerial cables that are more subject to damage. In João Pessoa 72% of the city has sewers, and in Campina Grande 87%.

CODATA can also work with existing federal government programs such as the My Smart City (*Minha Cidade Inteligente*) program of the new Ministry of Science, Technology, Innovation and Communications (the successor program of the Ministry of Communications Digital Cities program).

The program's objective is to modernize the management, expand access to public services and promote the development of Brazilian *municípios* through technology. It acts on the following fronts:

- Construction of fiber-optic networks that connect local public bodies;
- Provision of e-government applications *to municípios*, financial, tax, health and education;
- Training of municipal employees to use and network management;
- Provision of Wi-Fi access to the Internet for free use in public spaces in general circulation, such as squares, parks and roads.
- Under the Digital Cities Program 18 *municípios* in Paraíba were selected to receive local fiber optic networks. Table 2 provides a list of these *municípios*. As of June 2016 nine were had been completed, and the other nine were under construction. If the new government goes ahead with the planned Smart Brazil (*Brasil Inteligente*) program, it is likely partner for CODATA to reach government units in these and possibly other *municípios*.

Table 2: *Municípios* selected to participate in the *Cidades Digitais* program (Green fill indicates also a city with an institution RNP wants to connect)

Município
Algodão de Jandaíra
Cabaceiras
Cachoeira dos Índios
Esperança
Itaporanga
Lagoa Seca
Nova Floresta
Mari
Pocinhos
Queimadas
Riachão do Poço
São João do Rio do Peixe
Seridó
Sobrado
Solânea
Sumé

Teixeira
Vieirópolis

In sum, CODATA seeks USTDA funding for an international consultancy to conduct a full feasibility study for the expansion of the state broadband network. The smaller and more distant *municípios* could be reached by radio links, as has been done in other states, including Ceará and Pará, reducing costs.

III. GOVERNMENT COMMITMENT

The Multi-Year Plan (*Plano Plurianual* – PPA) for the period 2016-2019, approved by the state legislature on December 17, 2015, assigns to the Secretariat of Administration responsibility to expand the state data center and modernize the state broadband network, with an allocation of R$1.5 million (about US$ 430 thousand).[5]

IV. POSSIBLE SOURCES OF PROJECT FINANCING

Domestic sources of finance include The National Bank for Economic and Social Development (BNDES) or direct financing of the State of Paraíba budget (CODATA expects that budgetary resources for CODATA's services and those of and its client secretariats and state agencies will help finance the project), But CODATA hopes that the consultant team could look for complementary sources of funding, including a PPP for the REPAD project. Another source of finance could be through suppliers of equipment.

The US Overseas Private Investment Bank is another alternative. They have an active portfolio in Brazil and all over Latin America. OPIC mobilizes private capital to help solve critical development challenges and in doing so, advances U.S. foreign policy. The DM Contractors have spoken with OPIC and were told that they are active in underwriting investments in mobile and fixed broadband operators (using both licensed and unlicensed spectrum) in Latin America and are also interested in infrastructure products that relate to these investments. OPIC originates and underwrites project finance, commercial finance and risk sharing frameworks for investments in emerging markets.

Other international sources include the World Bank. They have some active program on Digital Identity and on broadband infrastructure and possibly could work to get Brazil into these current programs they are doing in other countries. Or possibly it might be possible to reprogram an existing loan to the state or the federal government having categories that embrace the projects' objectives and are not disbursing. This could be of interest to the federal government, given that the Ministry of Communications and other ministries, for example the Ministry of Health for its hospitals, clinics, and health posts) have an interest in using the network.

The Inter-American Development Bank (IADB) is another potential source of international funding, under conditions similar to the World Bank.

A fourth potential international source is supplier's credits from firms interested in providing equipment and/or software. Smaller US companies and other manufacturers who want to participate in this project can seek funding from the Export-Import Bank for low cost loans.

[5] Governo do Estado da Pernambuco Paraíba (2015). *Paraíba 2040: PPA 2016-2019: Anexo I – Programas Temáticos ao Estado*. João Pessoa, p 27 and 31. Available at http://www.al.pb.gov.br/wp-content/uploads/2015/10/PPA-2016-2019.pdf. Accessed June 12, 2016.

New loans from the World Bank or IADB would most likely be ruled out given the time it takes to receive federal government priority, appraise, approve and make them effective, though they cannot be ruled out, possibly in the context of a public administration reform loan. Another option would be to include the projects in a World Bank or IADB project already under preparation.

For the data center and the network, H&A ascertained that one option is to convert a capital expense into a current expense via a contract with a private enterprise or consortium of private enterprises. These companies then finance the project from their own or borrowed funds.

- Cisco. Cisco works closely with Aceco and other companies like EMC and Oracle. For this kind of project their main competitors are Hewlet Packard and IBM. They could participate in a PPP. It would also be possible to do an operation under Law 8666 to turn the investment cost into a series of rental payments. These would be higher in the first 3-4 years, because the 8666 operations cannot exceed five years each (4+1, 3+2) and, not knowing with certainty what would happen after the end of the contract, the consortium of suppliers would have to recover their entire investment, the costs of operation and maintenance, and their profit over only five years. The principle obstacle Cisco sees is how to guarantee that the payments, that could be monthly or quarterly, could be guaranteed to take place on time, in the contracted amounts, without interruption. The Cisco representatives also had a basic question: who would be the owner of the data center, the State of Paraiba, or the consortium.

- EMC. EMC is interested. It is possible to do this kind of operation. EMC would not construct the building, but frequently collaborates with Aceco, but it could participate in a consortium, for example with Aceco and Oracle and/or Cisco. VMware and EMC are now merged, and RSA is a subsidiary of EMC. EMC has a factory in São Paulo.
- Oracle. Oracle is now merged with Sun Microsystems, so it could supply both hardware and software. Oracle prefers not to participate in consortiums. But it has partnerships with firms like Deloitte and Odebrecht. It also has a financing department. It could do the kind of operation envisaged.
- IBM. IBM is interested in participating in the project, and can work as part of a consortium. But again, the problem is how to guarantee that the payments by CODATA would take place on time and in the amounts contracted.

V. POTENTIAL FOR US EXPORTS AND FOREIGN COMPETITION

In each data center we visited, we also noted that U.S. firms were extremely well represented in technologies in use. Oracle (or Sun Microsystems, which was acquired) servers and racks were extremely common. Cisco switches and routers were present in some degree at each data center. Storage and storage area network solutions from EMC were very common. Microsoft server software was very common. IBM solutions for mainframe computing and tape backup were either present or the first choice for new investment. HP user terminals, servers, and storage were also noted.

The cost of the hybrid fiber/wireless network could be on the order of R$489 million (about US$94 million), the datacenter subproject about R$143 million (US$44 million). The export potential for US producers of hardware, software and services would be US$94 million for the broadband network and US$27 million for the data center upgrade and containerized backup, for a total of U$131 million in exports estimated for the two components (Table 3). Full detail of the breakdown of these estimate are in the Appendix.

Table 3: Total Costs and Export Potential

Total Costs and Export Potential

Item	Total Cost R$	Total Export Potential USD
Broadband Network	**$94,703,135**	**$29,139,426**
Data Center Upgrade and Backup	**$132,492,750**	**$34,441,200**
Grand Total	**$227,195,885**	**$63,580,626**

In our view U.S. technologies will continue to be very competitive for data center projects in Brazil. A number of U.S. products continue to be viewed as best in class for the majority of the major equipment types required for data center construction. The state data centers we visited already have a history of employing U.S. technologies and this installed base creates incentives for continued employment of these technologies, such as seamless interoperability of new systems and old and reduced need for training of technical personnel.

US firms are very strong in the ICT sector. Those who might bid on RFPs for this project include

- Cisco (Network Infrastructure),
- HP (servers and storage, cloud services),
- Dell (servers),
- Oracle (Database, BI, Storage, and Cloud services),
- Microsoft (Datacenter Software, Database, OS, and cloud services (Azure),
- IBM (servers, application software and cloud services),
- VM Ware (virtualization software),
- BMC: (Infrastructure software),
- CA Technologies: (Infrastructure software)
- Cloudflare (software)
- Xterra (SDN solutions, Optical networking platforms)
- Ciena (consulting on intelligent networks)
- Blue Planet (network virtualization, orchestration, and management software)
- Microsoft Azure (cloud services)
- Amazon Web Services (AWS),
- Google Cloud Services and Software.
- APC & Eaton (Power supply & Generation)
- Fortinet and Symantec (Security Systems & Software)

Other US firms that manufacture equipment that could be used in the project and might interested in bidding include Corning (fiber); Brocade, Juniper, Force 10, and Extreme (high performance switches and routers); Supermicro (servers), Fusion IO (SSD Storage), Kingston (memory chips), Western Digital (storage); Emerson, Chatsworth, APC, and ADC (data center components including power distribution, cooling, and fiber guides); AMD and Intel (CPUs and servers); Fortinet, McAfee, Norton and Symantec (anti-virus, network security); Clearfield (wireless and fiber broadband equipment); and Ubiquiti Networks, Streakwave, Netgear and Belkin (wireless broadband equipment). Despite increasing competition, especially from Chinese companies like Huawei and ZTE and for fiber optic cable, Furukawa (that has a factory in Brazil), US firms in the ICT sector are very competitive. Several US suppliers with Brazilian operations contacted by H&A are open to providing supplier financing: Cisco, Oracle, EMC, IBM, Dell, and Hewlett Packard. Most US suppliers have Brazilian subsidiaries, so market entry should not be an issue for them.

VI. FOREIGN COMPETITION AND MARKET ENTRY ISSUES

Potential foreign competitors could include

- Huawei: Network Infrastructure
- Lenovo: servers
- Hitachi: Storage
- NEC: Storage, servers, telecom
- Alcatel Lucent: Network
- ZTE : Network
- SAP: BI
- Siemens: Network
- Fujitsu: Network
- Kaperski: Security software

VII. PRELIMINARY DEVELOPMENT IMPACT REVIEW

Development Impact Measures are designed to help quantify the impact of USTDA's support for infrastructure development in emerging economies. This information is essential to USTDA's ability to set clear goals and measure the results of its programs, relative to the Agency's core objective of promoting United States private sector participation in development projects around the globe. Understanding the local impacts of USTDA's program supports the Agency's ability to design projects with a higher likelihood of implementation and a higher likelihood of U.S. export generation, thus supporting the Agency's mission.

Development Impact Measures should be viable, realistic and quantifiable. During the initial stages of project definition, we evaluated the development impact from the attached list. At least one realistic and quantifiable Development Impact Measure is selected for each USTDA activity. In close consultation with the proposed project sponsor, a baseline measurement is established for each indicator, which is used to compare future outcomes. The baseline is also used to set an anticipated timeline and determine how the information will be measured and collected once a project moves to implementation. This baseline information is incorporated into the Terms of Reference, which provides reporting guidance to the contractor performing the USTDA activity. Here are some examples of indicators and baseline data. We selected to following indicators.

Telecommunications	Infrastructure Development and Efficiency Gains	Improved Digital Communication Access	Number of people affected by expansion in telecommunications infrastructure to both metropolitan and rural areas including Broadband, Wireless, Voice, and Data (particularly of note if reaching populations without prior access to internet, telephone, etc.)	Number of Individuals

In this indicator they wanted to add the amount of locations of the Government units attended by the project. This indicator may be a subset of the Improved Digital Communication Access.

As a secondary indicator they chose Improved Output Advanced through Technology to assist them in measuring the impact on the Internet providers that would be customers of the infrastructure built by the project

All	Infrastructure Development and Efficiency Gains	Improved Output through Advanced Technology	New technologies introduced to a host country resulting in an increase of efficiency, capacity, or output/process improvement	$ Value or Y/N

For the Data center the main indicator is

Telecommunications	Infrastructure Development and Efficiency Gains	Improved Data Management and Security	Capacity added, security/redundancy gained or reliability improved through implementation of data centers, cloud computing systems, or other storage infrastructure	Y/N*

VIII. EVALUATION STRATEGY

In addition to the following benchmarks to evaluate the success of the project the FS/TA contractors will also address the following questions within the Evaluation Strategy.

(1) The proposed project implementation timeline
(2) How the project will be developed (Engineering, Procurement and Construction, Turnkey, Build-Own-Transfer, Build-Own-Operate, etc.)
(3) Any potential difficulties CODATA might encounter during project implementation and how can these challenges be mitigated

Benchmarks to help USTDA evaluate success of project

- Financing for project is obtained. The amount from each source should be specified.
- Issue of RFPs for purchase of software and equipment with international competitive bidding, in months from date finance approved. This is a complex process in Brazil and sometimes takes months. The faster it is accomplished, the better managed is the state and the executing agencies.
- Bids received and winners selected. Metric: the percentage of total won by US firms
- Purchases completed. Metric; time in months from selection of winning bids.
- Percentage of total software and equipment purchased provided by US firms
- Construction and equipping initiated. Metric: time in months from purchase of equipment.
- Construction and equipping completed. Metric: time in months from the initiation of construction.
- Full planned network and datacenters in operation. Metric: time in months from completion of construction. Includes time for installing software and testing.
- Percent of state datacenter operations not previously integrated into the CODATA data center that now use the CODATA datacenter (principal and backup). The higher the better.
- Number of partners sharing costs of statewide network and extent of cost reduction compared with CODATA undertaking all investments and operational costs itself. Divide into capital and current costs.

Proposed project implementation timeline

Stage	**Objective**	**Months to Execute**
1	Signing of the contract with USTDA	4
2	Preparation of US firm's consultancy reports for the datacenter and network	6
3	Preparation of the RFPs (*editais*) for equipment, software, and services	4
4	Bidding process, including selection of winners	4
5	Acquisition and installation of fiber optic cables and wireless equipment to reach 75 *municípios*	15
5	Acquisition and installation of datacenter equipment and software	6

- According to this timetable the datacenter should be operational in 24 months from the time the project bids are received, the broadband network in 33 months.

Likelihood of development

- Is the project in the States' Multiyear Plan (*Plano Plurianual* – PPA)?

Potential difficulties

- Changes in CODATA management team that result in poorer project management
- Unfavorable changes in government policies under the Government to be elected in October 2018 such that the project no longer has strong political support

Other entities needed to approve project

- For domestic financing, approval of budgetary allocations for project finance and operation by Secretariat of Finance or higher authorities (Governor, *Casa Civil*). BNDES and any domestically approved suppliers' credits.
- For new international operations (e.g. loans by the World Bank or Inter-American Development Bank), approval by Federal authorities: Ministry of Planning (*Comissão de Financiamentos Externos* – COFIEX), STN with validation by PGFN, and finally by the Federal Senate.

IX. ENVIRONMENTAL IMPACT

The major potential impact for a data center is via generation of electric energy to power it. Modern data centers are much less intensive in energy than they were some years ago. Brazil has one of the "greenest" energy matrices of any country, given its extensive use of hydro power and growing use of solar and wind-generated electricity. The impact is not normally in the immediate vicinity of the data center, but rather where the power is generated. As for fiber optic networks, the impact is minimal, and for wireless extensions of the fiber network, there are clear regulations in Brazil regarding acceptable strength of signals and potential interference with other users of the electromagnetic spectrum.

A climate resilience assessment looks at the impact of climate on a potential project and involves two phases: (1) screening and (2) in-depth analysis. Screening identifies potential climate risks, vulnerabilities, and opportunities pertaining to a program or investment, determines if additional analysis is required, and if so, helps to scope that analysis. In other words, it is intended to either identify what further study is required or determine that further analysis is not warranted.

Where needed, In-Depth Analyses evaluate relevant technical, social, economic, and political aspects of climate risks, uncertainties, and design options. They produce recommendations on how to address the climate risks identified, both in the short term and the long term.

The DM Consultants along with senior staff in CODATA along with other Paraiba Government officials reviewed USTDA's Climate Resilience requirements for screening and in-depth analysis and determined that an in-depth analysis is not warranted for both the Broadband and the Data Center. The Government is already looking at buying ecologically correct electronic products. CODATA is taking care of the same issues highlighted in the Climate Resilience study so no need for an in-depth screening or analysis. Environmental management of resources is critically important during the consultants' recommendation deployment, but we find that there is no need for a special screening or in-depth analysis.

X. IMPACT ON US LABOR

The impact on US labor would be negligible or positive. Brazilian government data centers and broadband networks do not displace US data centers, since the Brazilian governments want the data centers to be in Brazilian territory. For broadband networks, there is no displacement of US facilities. Thus the impact on US labor is expected to be positive to the extent that US-based firm provide equipment, software and services produced in the US.

XI. JUSTIFICATIONS & RECOMMENDATIONS

As this report has documented, the new data center and broadband network will have high developmental impact in the State of Paraíba by supporting enhanced competition in the provision of broadband internet connectivity, hence reducing the prices for such connectivity. The statewide broadband network will allow improved delivery of e-government services throughout Paraíba, and promote private sector development. The project will also be a tool for developing an integrated governance system to link all departments and public agencies, provide greater speed and efficiency in the delivery of public services, thereby reducing costs to the state through the use of an efficient multiservice communications infrastructure.

The project also has a social objective. The population will gain access to broadband Internet connectivity, allowing every citizen to have free access to the Internet, educational opportunities, and e-government services through public telecenters and schools. .

The project will directly benefit U.S. companies that win contracts to provide goods and services needed in the project. It will also help create partnerships between Government agencies and US IT companies by bringing proven private sector solutions to the challenges that the Government faces. This project meets USTDA's goals of providing technical assistance in cases where that assistance helps create partnerships based on the premise that private sector experience, technology, and ingenuity are integral to development and project sustainability.

Moreover, the involvement of a U.S.-based Consultant Team in carrying out the proposed feasibility studies should work to the advantage of U.S.-based suppliers of telecom, IT, database solutions, such as Cisco, EMC, HP, VMware, IBM, Oracle and Microsoft as well as others mentioned above in forming key partnerships with different Government agencies. These suppliers are strong in the major technological areas but face growing competition from foreign suppliers.

Accordingly, H&A believes that funding of the feasibility study on behalf of the government of the State of Paraíba would represent a good use of USTDA resources.

XII. QUALIFICATIONS OF PROFESSIONALS IN PARAÍBA BROADBAND NETWORK AND DATA CENTER PROJECT

Our analysis has shown that we would require 12 staff for this project, including a Team Leader and Project Coordinator. Below you will find specific descriptions for each of the staff we are recommending.

Team Leader

- At least fifteen (15) years' experience in the ICT industry
- Strong background in at least one of major areas of the feasibility study (Datacenters, hybrid fiber optic and wireless broadband networks, integrated eGovernment systems, Definition of SLAs, economic and financial project analysis)

- Both a US and an international perspective on the ICT industry, with the international perspective preferably gained through on-the-ground project work, ideally in the area of datacenters, broadband networks and integrated eGovernment systems
- Management, organizational and cross-cultural skills and perspective to structure, oversee and carry out the Feasibility Study effectively
- Ability to communicate findings effectively and to liaise appropriately within the CODATA framework and with other stakeholders, including the Secretariat of Finance, other public sector entities and potential private sector partners
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Strong Portuguese language skills, written and spoken is required

Senior Data Center Electrical Engineer

- Post-graduate degree in electrical engineering or related discipline
- At least ten (15) years' experience in the telecom/ICT industry, including hands-on experience with datacenters and outsourcing contracts for datacenters
- At least five (5) years' experience in defining and monitoring service level agreements (SLAs) for ICTs
- Expertise in the economic and financial analysis of projects and feasibility studies involving rapid technological change, including total cost of operations (TCO) and return on investment (ROI) analysis
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Portuguese language skills, written and spoken, preferred

Junior Data Center Electrical Engineer

- At least an undergraduate degree in electrical engineering or related discipline
- At least five (5) years' experience in the telecom/ICT industry, including hands-on experience with datacenter design and implementation
- Knowledge of configuration management, problem management, change management, help desk, distribution and control of software, managing of service levels (SLM), capacity management, contingency planning, availability management, and cost management – as applied to datacenters
- Expertise in the economic and financial analysis of projects and feasibility studies involving rapid technological change, including total cost of operations (TCO) and return on investment (ROI) analysis
- Detail-oriented and able to prioritize

- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Portuguese language skills, written and spoken required

Data center Security Expert

- Post-graduate degree in electrical engineering or related discipline
- At least ten (10) years of experience in data center construction and operations
- Specialization in data center security, both logical and physical
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Portuguese language skills preferred

Senior Wireless Engineer

- Post-graduate degree in electrical engineering or related field
- At least fifteen (15) years' experience in the telecom/ICT industry, including extensive experience with wireless network design and operation
- At least five (5) years' experience in defining and monitoring service level agreements (SLAs) for ICTs.
- Expertise in the economic and financial analysis of projects and feasibility studies involving rapid technological change, including total cost of operations (TCO) and return on investment (ROI) analysis
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Portuguese language skills, written and spoken, preferred

Senior Fiber Optic Network Electrical Engineer

- Post-graduate degree in electrical engineering or related discipline
- At least fifteen (15) years' experience in the telecom/ICT industry, including hands-on experience with the design, operation and maintenance of fiber optic networks and their interface with wireless extensions
- At least five (5) years' experience in defining and monitoring service level agreements (SLAs) for ICTs.

- Expertise in the economic and financial analysis of projects and feasibility studies involving rapid technological change, including total cost of operations (TCO) and return on investment (ROI) analysis
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- **Portuguese language skills, written and spoken, preferred**

Junior ICT/Network Engineer

- At least an undergraduate degree in electrical engineering or a related discipline
- At least five (5) years' experience in the ICT industry including hands-on experience with the design, operation and maintenance of fiber optic networks and wireless extensions of such networks
- Experience in defining and monitoring service level agreements (SLAs) for ICTs.
- Expertise in the economic and financial analysis of projects and feasibility studies involving rapid technological change, including total cost of operations (TCO) and return on investment (ROI) analysis
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Portuguese language skills, written and spoken required

ICT Strategist & Regulatory Specialist

- Post-graduate degree in economics, public policy/administration or electrical engineering, preference for a multi-disciplinary background
- At least ten (10) years of experience in elaborating and/or analyzing national and sub-national ICT strategies from technical, economic, and social perspectives
- Knowledge of Brazilian telecommunications legislation and regulations demonstrated by publications and employment record
- Experience in cost-benefit analysis
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Excellent ability to clearly explain advanced technical issues in manner that is easily

Senior Economist

- At least a masters degree in economics, PhD preferred
- A minimum of ten (10) years of experience in economic analysis of ICT projects
- Experience with cost/benefit analysis
- Experience analyzing the development impact of ICT projects
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Strong Portuguese language skills, written and spoken, preferred

Brazilian Environmental Expert

- Post-graduate degree in environmental engineering or related discipline
- At least five years of experience with applying Brazilian environmental legislation in project analysis;
- Knowledge of environmental impact of data center and telecommunications projects
- Knowledge of Brazilian telecommunications regulations.
- Strong English language skills, written and spoken is required

Brazilian Lawyer Specializing in Brazilian legislation and regulation (regulamentação)

- Familiarity with the federal, Bahia, and other state legislation and regulations governing telecommunications and data centers in Brazil as well as with the legislation governing government purchasing (Law 8666), concessions, PPPs and service contracts
- Ability to conduct necessary research and legal/regulatory diligence
- High degree of fluency in English preferred

Project Coordinator/Local Manager

The responsibilities of the Project coordinator include, but are not limited to, the following:

- Basic support logistics for everyone on team and their support people to ensure a smooth running of the project, such as deliverable coordination (formatting, timeliness, and other coordination),
- Travel coordination,
- Arranging workshops and conferences in person and by telephone.
- Managing and editing of deliverables, thereby ensuring that the deliverables closely follow the scope of work outlined. This way there are no surprises.
- Reviewing, coordinating and distributing presentation materials, both the electronic and paper versions of presentations.
- Developing and creating a library of resource material so that all consultants have easy access to any resource material, 24 x7, maintaining the library
- Arranging housing and payments for project related expenses,

- Coordinating with Project Manager on Project Finance issues such as expense payments, consultant time
- Fluency in written and spoken Portuguese and English is required

XIII. SUGGESTED EVALUATION CRITERIA

It is suggested that the selection of the US firm for both of the studies be based on the following criteria:

Criterion	Max. Points
Expertise and skills of proposed personnel	50
Proposed approach to the TA and to the individual tasks	30
Pertinent international experience and cross-cultural skills	20
Total:	**100**

XIV: BUDGET

We are recommending a budget of $733,830 USD.

XV: TERMS OF REFERENCE

Objective

Terms of reference set forth the terms and specifications for the performance of a technical assistance (the "TA)" in connection with the planned (i) upgrade of the state data center system; and (ii) expansion of the state broadband network; in each case for the Brazilian State of Paraíba (the "Project"). The Grantee is the Companhia de Processamento de Dados da Paraíba ("CODATA"). References to the "State" or to "Paraíba" refer to the Brazilian State of Paraíba.

CODATA is the state IT company responsible for providing ICT services to all entities within the State Government of Paraíba.

CODATA seeks technical assistance for an international consultancy financed by USTDA to:

- Review the current organization and management model of the CODATA data center and its proposed integrated backup data center;
- Review the current plans to expand the Paraíba High Performance Network (Rede Parabaino de Alto Desempenho – REPAD) to interlink all units of the GEPB – both in the João Pessoa metropolitan region, and in the interior of the state in order to meet the demand for ICT throughout the state.
- Estimate GEPB demand for data center services over the coming five years;
- Assess the current capacity of CODATA's own data center, the other principal state data centers and smaller server rooms (with special attention to the Secretariat of Revenue (*Secretária de Receita*) as regards their equipment, software and physical facilities.
- Design a plan for the integration and consolidation of the state's data centers, including full active-active backup of all the data centers, so that they can operate securely under a cloud computing architecture, significantly reduce costs and improve quality of service as compared to the present system and satisfy the projected demand for data center services and
- Determine the requirements for new hardware and software for the integrated and consolidated

system of data centers, including the possible use of a private or public cloud computing architecture;

- Propose a design and business model for the expanded REPAD
- Support implementation of the upgraded data center and backup data center;

All deliverables for all tasks shall be provided in both English and Portuguese. The U.S. Firm shall ensure the quality and accuracy of the translations.

TASK 1: DATA COLLECTION

The U.S. Firm selected by CODATA to perform the TA (the "US Firm") shall conduct a review of the relevant literature on state-of-the art hybrid (fiber/wireless) networks. The U.S. Firm will then. Research past and current Brazilian state and federal government and international initiatives in the planning, financing, construction, and operation of municipal, state-wide and national broadband networks involving both fiber and wireless technologies and datacenters (reviewing at least four Brazilian and four international case studies), including security and emergency arrangements. In analyzing each of these Brazilian and international examples, the U.S. Firm shall identify, analyze and detail the best practices in technology, finance, construction and operation, devoting particular attention to business models that include, infrastructure sharing under different leasing, and exchange of rights for use of infrastructure, including fiber optic cables, towers, poles and ducts.

The U.S. Firm shall also analyze and detail the demands on these networks of typical e-Government activities, including:

- Internal administration;
- Tax collection;
- Operation of citizen service centers;
- Distance education;
- Telemedicine;
- Cloud computing, and
- Big data analysis.

Deliverable #1: The U.S. Firm shall prepare a report detailing all work performed under Task 1, including the case studies, and best practices identified and recommended for the State's data center system and hybrid broadband networks.

TASK 2: KICK-OFF MEETINGS, ASSESSMENT OF CURRENT INFRASTRUCTURE, AND NEEDS/REQUIREMENT ANALYSIS

The US firm shall familiarize itself with the Brazilian governmental public budget finance and project analysis via Internet research and any documents provided by CODATA.

DATACENTER

The U.S. Firm shall travel to Paraíba to review the State's existing datacenter and broadband network, meeting with CODATA and the key stakeholders in the Project. The U.S. Firm shall conduct a needs/requirements analysis of each State agency that is an existing or potential stakeholder or end-user

with regard to the Project. The U.S. Firm will also analyze options to locate the proposed new backup datacenter in other Government data centers. The U.S. Firm's analysis shall also include recommendations on the optimal methods for providing backup services for the State's data center system, considering other public or private cloud services, and conduct a thorough review of the request for proposals (RFP) for the backup data center prepared by CODATA. The U.S. Firm shall confirm and elaborate with CODATA the basic objectives for this data center system upgrade, which includes the need to meet the growing demand for information and communications technology in connection with the Government of Paraíba's eGovernment program (broadband network management, applications, services, and portals) with agility, flexibility and efficiency under the strategic management of CODATA.

The U.S. Firm shall:

- Meet with CODATA and other major stakeholders (with guidance from CODATA) to develop an assessment of their needs, priorities, and expectations;
- Visit the CODATA's two largest data centers and any other significant Paraíba state data centers and conduct a needs and requirement analysis for the CODATA datacenter system and backup datacenters, including cloud services;
- Conduct an evaluation of CODATA's existing data center and its planned organization and management model designed to integrate and consolidate all existing state data centers;
- Assess the current capacity of CODATA's own data center, the other principal state data centers and smaller server rooms (with special attention to the Secretariat of Revenue (*Secretária de Receita*) as regards their equipment, software and physical facilities;
- Conduct a security analysis, both physical and electronic, of all datacenters expected to remain in the CODATA data center system and its backup facilities to determine the best course of action to take to ensure the security and privacy of the information contained in the datacenters;
- Quantify the benefits in unit cost reduction and improved quality for datacenter services (using standard telecommunications network metrics) that can be achieved with the new integrated data center;
- Analyze at least three options for operation of the CODATA data center (i.e., options for data storage, mix of usage of cloud versus local data center, etc.) that would best suit the goals of CODATA, and provide detailed recommendations in terms of the strengths and weaknesses of each option (the U.S. Firm shall then use this analysis to inform the work under Task 3);
- Prepare an inventory of Requirements for Supporting Critical and Non-Critical State Applications;
- Estimate and project Data Center Power Supply Requirements and Cost over the next five years;
- Specify and project Data Center Cooling Requirements and Cost over the next five years;
- Specify Standby Power Requirements and Fire Safety requirements;
- Specify Guidelines for Selecting Data Center Construction Contractors; and
- Estimate demand for integrated state data center services of (a) the Paraíba state government secretariats and agencies and (b) municipalities in the state of Paraíba over the next five years.
- Help CODATA determine the appropriate scale of the new datacenter and potential backup facilities for all the data centers in the State data center system, considering the six largest

potential client secretariats/agencies of the State of Paraíba (Finance, Education, Health, Public Safety, and Transportation (DETRAN);

- Design a plan for the integration and consolidation of the state's data centers, including full active-active backup of all the data centers, so that they can operate securely under a cloud computing architecture, significantly reduce costs and improve quality of service as compared to the present system, and satisfy the projected demand for data center services.

BROADBAND NETWORK

The U.S. Firm shall travel to Paraíba to review the current State broadband network; meet with CODATA and the key stakeholders in the Project: the Secretariats of Finance, Education, and Health; DETRAN, and other Secretariats and government agencies; and conduct a needs/requirements analysis for the expansion of the hybrid broadband network. The U.S. Firm shall also analyze the needs and capabilities of potential partners in the upgraded hybrid network, including the main state electrical energy distribution company (Energisa), Telebras, the National Education and Research Network (RNP), the Ministry of Education and Culture (MEC), The Ministry of Science, Technology, Innovation and Communications, and private telecommunications companies (e.g. Oi, Vivo, Embratel, Claro) and local internet service providers. The U.S. Firm shall also assess the interest of such potential partners and conditions under which they would be willing to partner with CODATA to operate the expanded network. The expanded network should reach all 223 municipalities in the State of Paraíba, with preference for a fiber optic connection where economically viable but allowing some wireless extensions for small municipalities.

The U.S. Firm shall confirm and elaborate with CODATA the basic objectives for broadband network upgrade, which include meeting the growing demand for broadband connectivity to support the State of Paraíba's e-Government program (broadband network management, applications, services and portals) and promote digital inclusion of the population with agility, flexibility and efficiency under the strategic management of the state.

The U.S. Firm shall:

- Meet with CODATA and major state government stakeholders (with guidance from CODATA) to develop an assessment of their needs, priorities, and expectations;
- Recommend strategies which would help CODATA get municipal governments in the state to become clients of the hybrid broadband network;
- Conduct basic cost/benefit analyses for the expansion of the hybrid broadband network, taking into consideration the needs of its prospective clients; and
- Quantify the benefits in unit cost reduction and improved quality (using standard telecommunications network metrics) for broadband communications that can be achieved with the state-owned hybrid network compared with continued contracting with large commercial operators (Embratel, Claro, Oi and Vivo).

Deliverable #2: The U.S. Firm shall prepare a report of all work performed under Task 2, including, without limitation, a list of documents and other materials studied, details of all meetings and site visits, and all relevant findings and conclusions. The U.S. Firm shall also prepare a timetable, list of any additional data needed, a Needs/Requirement Assessment report, a Security Analysis report for the data center and the hybrid broadband network, and proposed work plan to carry out the remainder of these Terms of Reference. Any work plan shall fully reflect all tasks under, and shall be consistent with, these Terms of Reference.

TASK 3: DIMENSIONING AND ALTERNATE SCENARIOS

DATA CENTER

Based on the findings in Task 2, the U.S. Firm shall project the aggregated needs of the different stakeholders expected to use the integrated State data center system over the next five years and estimate the size, scope, and cost of data center requirements, including:

- Power Supply;
- Cooling Requirements;
- Standby Power Requirements and Fire Safety requirements;
- Guidelines for Selecting Data Center Construction Contractors;
- Estimate demand for integrated state data center services of (a) the Paraíba state government secretariats and agencies and (b) municipalities in the state of Paraíba over the next five years.
- A plan providing at least two options for integrating and consolidating the state's data centers, including full active-active backup of all the data centers, so that they can operate securely under a cloud computing architecture, significantly reduce costs and improve quality of service as compared to the present system, and satisfy the projected demand for data center services.

The plan should analyze the strengths and weaknesses of each proposed integration strategy. In consultations with CODATA, the U.S. Firm shall recommend an optimum strategy for integrating the existing data centers and providing an active-active backup for the full data center system, CODATA shall then decide on the scenario the U.S. Firm shall then analyze for the remainder of the Tasks below.

BROADBAND NETWORK

Based on the findings in Task 2, the U.S. Firm shall project the aggregated needs of the different stakeholders for broadband data communications over the next five years and estimate the need for bandwidth and links, taking into consideration the needs for redundant high-bandwidth connectivity between the integrated and consolidated data centers and the demands of cloud computing for all state secretariats, agencies, and other entities. Then the U.S. Firm shall detail three alternate scenarios for broadband data communications in the State of Paraíba:

a) Expansion and upgrading of the existing arrangements for outsourcing connectivity requirements to a commercial telecommunications operator;

b) Building a statewide broadband network of its own in partnership with other companies and entities requiring or owning telecommunications facilities; and

c) Some combination of options a) and b).

In consultations with CODATA, the U.S. Firm shall recommend the optimum strategy for expanding and updating broadband connectivity, detailing the strengths and weaknesses of each strategy and recommend a redundancy strategy to assure continuous service if links are broken due to accidents or disasters. Based on the strengths and weaknesses of each scenario and in consultation with the U.S. Firm, CODATA shall decide on the scenario that the U.S. Firm shall then analyze for the remainder of the Tasks below.

Deliverable #3: The U.S. Firm shall prepare a report on all work done under this Task, including

summarizing the alternative strategies studied and recommendations for the optimum strategies for both data center integration and consolidation and the development of the broadband network.

TASK 4: DEVELOP FUNCTIONAL SPECIFICATIONS, ARCHITECTURE, AND DESIGN

DATACENTER

The U.S. Firm shall:

- Analyze the findings from Tasks 2 and 3 and develop specifications regarding the architecture and design (including software) of the datacenter and backup data center;
- Develop precise and detailed estimates of data center design including building security, air conditioning, power provision, uninterruptable power supply, storage, processing, and fire prevention, equipment needs and capacity, and resulting capital expenditure and operating costs; and
- Propose and draft service level agreements (SLAs) for the upgraded datacenter system.

BROADBAND NETWORK

The U.S. Firm shall:

- Analyze the findings from Tasks 2 and 3 and develop specifications regarding the architecture and design of the hybrid broadband network;
- Develop precise and detailed engineering estimates of network designs, equipment needs and capacity, and resulting capital expenditure and operating costs; and
- Propose and draft service level agreements (SLAs) to specify degrees of redundancy, maximum response times to incidents, percentage of "up time" and other technical metrics for the statewide hybrid broadband network.

Deliverable #4: The U.S. Firm shall prepare a report on all work performed under this Task, including the datacenter and hybrid broadband network designs, functional specifications and architecture.

TASK 5: ROLES AND RESPONSIBILITIES

DATACENTER

The U.S. Firm shall conduct a study of the future roles and responsibilities of the various actors involved, including the legal, institutional, structural and service levels for the operation of the datacenter. The study of roles and responsibilities shall address, at a minimum, the following issues/questions:

- Will CODATA continue to operate the principal data center (and any new backup data center) with its own personnel?
- Could the operation of any new data center be conducted by a private sector company under policies set by CODATA with the support of an interagency committee?
- What will be the role of the secretariats and agencies with applications stored in the datacenter?
- How will performance of the datacenter be measured?
- If there is a private partner, how should it be remunerated?

- Assess the favorability of alternative structures and what role CODATA will play in each alternative structure, including the following: (i) CODATA serves as the supervisory authority for a private partner operating the new data center, with CODATA setting policies both for the partner and for submissions of data from the various state agencies, subject to review by an interagency committee; (ii) continuing the present arrangements under which CODATA both sets policy and operates its data center; (iii) CODATA sets policy, operates the data center system, and contracts some cloud services for backup of the data centers; and (iv) at least two more options for CODATA's role, as identified and detailed by the U.S. Firm.

The U.S. Firm shall also analyze alternative legal structures and arrangements, including contracts with a private sector partner to operate the datacenter or provide cloud services. The analysis shall include a complete discussion of the strengths and weaknesses of each alternative arrangement, including recommendations on the best option(s) and evaluation of the legal and tax implications and/or requirements for housing the datacenter and the backup datacenter under each of the options discussed.

BROADBAND NETWORK

The U.S. Firm shall conduct a study of the roles and responsibilities of the various actors involved, including the legal, institutional, structural and service levels for the operation of the network. The U.S. Firm shall identify and detail several alternative business models for the operation and maintenance of the network, including leasing and/or *permutas* of fiber pairs with partners such as telecommunications and electric power distribution companies. The study of roles and responsibilities shall address, at a minimum, the following issues/questions:

- Will the new broadband network be part of the administrative structure of the executive branch of the Paraiba government?
- Who will administer the hybrid broadband network?
- What will be the role of the secretariats and agencies that will use the network?
- How will performance of the broadband network be measured?
- If there is a private partner, how should it be remunerated?
- What should be the role of CODATA once the new network is operational?
- Assess the favorability of alternative structures and what role CODATA will play in each alternative structure, including the following: (i) CODATA serves as the supervisory authority for a private partner operating the new network, with the support of an interagency committee; (ii) Casa Civil sets policy, but supervisory and operating functions remain with CODATA; and (iii) at least two more options for CODATA's role, as identified and detailed by the U.S. Firm.

The analysis of business models should present at least three viable options for the operation and maintenance of the network, including leasing and/or exchange of infrastructure with partners such as telecommunications and electric power distribution companies, and shall include a discussion of the strengths and weaknesses of each alternative arrangement, including recommendations on the best option(s).

Based on the strengths and weaknesses of each option and in consultation with the U.S. Firm, CODATA shall decide on the business model for the operation and maintenance of the network that the U.S. Firm

shall then analyze under the remaining Tasks set forth below.

Deliverable #5: The U.S. Firm shall prepare a report on all work performed under this Task, including a report of the roles and responsibilities for the management and operation of the datacenter and the broadband network.

TASK 6: ECONOMIC AND FINANCIAL ANALYSIS

The U.S. Firm shall then prepare an economic and financial analysis report and a report recommending the chosen structure and the supporting legal, economic and financial rationales. As a basis for these reports, the U.S. Firm shall perform the following assessments and analysis, which shall be detailed in one or both of these reports:

- Quantify the benefits in unit cost reduction and improved service quality and reliability (using standard telecommunications network metrics) for the data center and broadband connectivity services that could be achieved with the new hybrid broadband network as compared with the current connectivity arrangements;
- Assess all aspects of the project's feasibility (technical, economic, financial, political, legal and organizational) and their interrelations for the data centers and broadband network; [WL3]
- Develop Business Continuity and Disaster Recovery Plans;
- Evaluate Total Cost of Ownership of the CODATA-operated state data centers and broadband network;
- Develop Implementation Plans, i.e., the roadmap, along with the chosen finance plan for the CODATA data centers and broadband network
- Prepare risk analysis, rate return analysis, and analysis of total cost of operation for chosen structure that the Contractor present during the technical assistance;

Deliverable #6: The U.S. Firm shall deliver a report of all work performed under this Task, including the economic and financial analysis report and a report recommending the most effective structure and their supporting legal, economic and financial rationales.

TASK 7: PRELIMINARY ENVIRONMENTAL ASSESSMENT

The U.S. Firm shall:

- Conduct, in consultation with the Paraíba Secretariat of Environmental Protection and municipal authorities, a preliminary review and evaluation of the expected environmental impacts of the data center and broadband network and their compatibility with all applicable regulations, including under federal, state, and municipal governments as well as the requirements of potential lending agencies, especially the World Bank, the IFC, and the IADB; and
- Discuss how any potentially significant negative impacts can be minimized.

Deliverable #7: The U.S. Firm shall prepare a report of all the work performed and findings under Task 7.

TASK 8: DEVELOPMENTAL IMPACT ANALYSIS

The U.S. Firm shall identify and assess the developmental outcomes that would be expected if the Project is implemented in accordance with the recommendations of the TA. Development Impact Measures are designed to help quantify the impact of USTDA's support for infrastructure development in emerging economies. This information is essential to USTDA's ability to set clear goals and measure the results of its programs, relative to the Agency's core objective of promoting United States private sector participation in development projects around the globe. Understanding the local impacts of USTDA's program supports the Agency's ability to design projects with a higher likelihood of implementation and a higher likelihood of U.S. export generation, thus supporting the Agency's mission.

At least one realistic and quantifiable Development Impact Measure is selected for each USTDA activity. In close consultation with the Project sponsor, a baseline measurement is established for each indicator, which is used to compare future outcomes. The baseline is also used to set an anticipated timeline and determine how the information will be measured and collected once a project moves to implementation.

Improved Digital Communications Access is the main development impact for the Broadband Project and the Data Center:

Sector	Category	Indicator	Description	Anticipated Outcome
Telecom	Infrastructure Development and Efficiency Gains	Improved Digital Communication Access	Implementation of updated data center and expanded broadband network will increase internet access to both metropolitan and rural areas.	TBD number of individuals

For the Data Center another main indicator is

All	Infrastructure Development and Efficiency Gains	Improved Data Management and Security	Implementation of the data center improvements will increase capacity, security and reliability of State ICT systems.	Y

The U.S. Firm shall update the indicators chosen and anticipated measurable outcomes, based on the recommendations resulting from the technical assistance. The U.S. Firm shall then incorporate the baseline analysis and adjust the findings, as needed, to explain how the proposed activity will directly impact development in Brazil. The U.S. Firm shall work closely with the Project sponsor as well as USTDA personnel at this stage to ensure that the final report clearly displays the anticipated outcomes that will be achieved when the Project is implemented. These updates are used in future evaluation efforts to monitor progress and expected timeframes when the development impact will be realized.

Deliverable #8: The U.S. Firm shall prepare a report of all the work performed and findings under Task 8.

TASK 9: PROJECT PLANNING AND IMPLEMENTATION

The U.S. firm shall assess and determine what the critical goals and success factors are for Project implementation and shall identify relevant risks and mitigation risks to achieve these goals/success factors. The analysis shall address the following goals/success factors:

- The government shares with any private sector partners the benefits of productivity increases arising from technological change, and not just the costs;
- Continual monitoring of the contractual conditions in relation to the market is carried out – provisions for this need to be incorporated in the contract itself;
- Contract objectives for any PPP, concession, Build Operate Transfer (BOT) agreement or other legal arrangement for the relationship between public and private entities involved (scope, service levels, metrics, length of contract, renewability, terms for renewability, requirements, etc.) are clearly specified;
- Top government managers necessary to achieve efficient Project implementation are involved and supportive of the Project;
- Priority is obtained for any payments to private sector partners for strategic and critical activities outsourced;
- Potential difficulties the CODATA may encounter during project implementation and how these challenges can be mitigated;
- Any new regulations that need to be enacted or whose enactment may be detrimental to the Project;
- Penalties for noncompliance with contract conditions are established and applied if violations are detected;
- A clear process is defined for exiting from the contract and transition to one or more other private sector partners with operating responsibilities for the Project or sharing infrastructure of the hybrid broadband network; and
- Other critical success factors inherent in any outsourcing for ICT services and means to achieve them defined.

The U.S. Firm shall prepare a Project Implementation Report, which shall include (i) a detailed recommendation concerning the most appropriate administrative structure for the Project, (ii) a detailed breakdown of the steps that need to be undertaken by CODATA and other government partners to implement the Project according to the recommended structure, including recommendations for handling any outsourcing or infrastructure sharing arrangements with private sector firms, and (iii) recommendations on planning and implementing the phased approach/evolving scope of the datacenter and hybrid broadband network. The Project Implementation Report shall also describe how to structure any service contract or infrastructure sharing arrangements to incorporate the evolving scope of the Project.

The U.S. Firm shall also identify U.S. sources of supply for all goods and services required to implement the Project. In particular, the U.S. Firm shall list U.S companies that provide the technologies or services to be implemented. Detailed information about U.S. companies shall be included in the Final Report, including potential products/services, a point of contact in Brazil if available, or where sales to Brazil are managed. The business name point of contact, address, telephone and e-mail address shall be

included for each commercial source.

Deliverable #9: The U.S. Firm shall prepare a report of all the work performed and findings under Task 9, including a Project Impact Report and a Project Implementation Report.

TASK 10: PRESENTATION OF THE DRAFT FINAL REPORT

Upon concluding all tasks listed above, the U.S. Firm shall travel to Paraíba to formally present to CODATA the findings and recommendations and a near final version of the report. CODATA will be able to use this opportunity to ask questions or provide further comments and suggestions based on the presentation and draft of the Final Report. To support the presentation of the study the U.S. Firm shall:

- Create an accompanying PowerPoint presentation; and
- Identify any additional suggestions or recommendations derived from CODATA's responses to the presentation.

Deliverable #10: The U.S. Firm shall travel to Paraíba to present the draft Final Report and PowerPoint Presentation.

TASK 11: FINAL REPORT

The U.S. Firm shall prepare and deliver to CODATA and USTDA a substantive and comprehensive final report of all work performed under these Terms of Reference ("Final Report"). The Final Report shall be organized according to the above tasks and shall include all deliverables and documents that have been provided to CODATA. The U.S. Firm shall provide one copy of the Final Report in Portuguese to CODATA. The Final Report shall be prepared and delivered to USTDA, in English, in accordance with Clause I (USTDA Final Report) of Annex II of the Grant Agreement. The U.S. Firm must identify prospective U.S. sources of supply in the Final Report to be submitted to CODATA and USTDA in accordance with Clause I of Annex II of the Grant Agreement.

The Final Report shall be a comprehensive document covering and synthesizing the findings of all the preceding tasks, providing CODATA with the appropriate information, recommendations and guidelines.

ANNEX I CODATA DATA CENTER EQUIPMENT LISTS

Introduction

This report describes the IT infrastructure of the Data Center that has CODATA for offering services to public companies and agencies. The reported specifications were based only on physical infrastructure of the data center and do not include staffing.

The first part describes the equipment from the Paraíba State Secretariat of Education (SEE). The second sets forth the computer services CODATA offers the entire state of Paraiba. Finally, the two infrastructures are compared. The activities were performed in the period from January to March 2016, in the following order: Total allocation of resources, SEE environmental replication environment, and availability reporting.

Infrastructure Supplied by the State Secretariat of Education (SEE/PB) as of January 2016

SEE/PB hosts a HP Blade and Storage solution in the CODATA data center with the following components:

- Chassis Blade c7000;
- 4 Blade BL 460c G7 servers with 2 CPU Intel Xeon 5650, 96GB of RAM e 2 146GB drives, with a total processing power of 128GHz and 384GB of RAM.
- Virtualization: VmWare vSphere 4.0 licenses for 8 CPU and VmWare vCenter Standard license;
- Storage EVA 4400 with 2 Array controllers with 12 600GB FC 10k RPM drives, giving a total of 7.2TB storage space;
- Backup Library with 2 LTO-5 internal units, together with 100 data media.

BL460c G7 01 – SEE

General

Manufacturer:	HP
Model:	ProLiant BL460c G7
CPU Cores:	12 CPUs x 2,666 GHz
Processor Type:	Intel(R) Xeon(R) CPU X5650 @ 2.67GHz
License:	VMware vSphere 5 Enterprise Plus - Licensed for 2 physic...
Processor Sockets:	2
Cores per Socket:	6
Logical Processors:	24
Hyperthreading:	Active
Number of NICs:	4
State:	Connected
Virtual Machines and Templates:	21
vMotion Enabled:	Yes
VMware EVC Mode:	Disabled
vSphere HA State	Connected (Slave)
Host Configured for FT:	No
Active Tasks:	
Host Profile:	
Image Profile:	(Updated) ESXi-5.1.0-2013...
Profile Compliance:	N/A
DirectPath I/O:	Supported

Resources

CPU usage: **7045 MHz** Capacity 12 x 2,666 GHz

Memory usage: **75516,00 MB** Capacity 98293,73 MB

Storage	Status	Drive Type
datastore1 (7)	Normal	Non-SSD
VV_3PAR01_VM...	Normal	Non-SSD
VV_3PAR02_VM...	Normal	Non-SSD
VV_VMWARE_FC.0	Normal	Non-SSD
VV_VMWARE_FC.1	Normal	Non-SSD
VV_VMWARE_FC.2	Normal	Non-SSD
VV_VMWARE_FC.3	Normal	Non-SSD
VV_VMWARE_FC.4	Normal	Non-SSD
VV_VMWARE_FC.5	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_NL.0	Normal	Non-SSD
VV_VMWARE_NL.1	Normal	Non-SSD
VV_VMWARE_NL....	Normal	Non-SSD
VV_VMWARE_NL....	Normal	Non-SSD
VV_VMWARE_NL.2	Normal	Non-SSD
VV_VMWARE_NL.3	Normal	Non-SSD
VV_VMWARE_NL.4	Normal	Non-SSD

BL460c G7 02 – SEE

General

Manufacturer:	HP
Model:	ProLiant BL460c G7
CPU Cores:	12 CPUs x 2,666 GHz
Processor Type:	Intel(R) Xeon(R) CPU X5650 @ 2.67GHz
License:	VMware vSphere 5 Enterprise Plus - Licensed for 2 physic...
Processor Sockets:	2
Cores per Socket:	6
Logical Processors:	24
Hyperthreading:	Active
Number of NICs:	4
State:	Connected
Virtual Machines and Templates:	15
vMotion Enabled:	Yes
VMware EVC Mode:	Disabled
vSphere HA State	Connected (Slave)
Host Configured for FT:	No
Active Tasks:	
Host Profile:	
Image Profile:	(Updated) ESXi-5.1.0-2013...
Profile Compliance:	N/A
DirectPath I/O:	Supported

Resources

CPU usage: **13321 MHz** Capacity 12 x 2,666 GHz

Memory usage: **89202,00 MB** Capacity 98293,73 MB

Storage	Status	Drive Type
datastore1 (1)	Normal	Non-SSD
VV_3PAR01_VM...	Normal	Non-SSD
VV_3PAR02_VM...	Normal	Non-SSD
VV_VMWARE_FC.0	Normal	Non-SSD
VV_VMWARE_FC.1	Normal	Non-SSD
VV_VMWARE_FC.2	Normal	Non-SSD
VV_VMWARE_FC.3	Normal	Non-SSD
VV_VMWARE_FC.4	Normal	Non-SSD
VV_VMWARE_FC.5	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_NL.0	Normal	Non-SSD
VV_VMWARE_NL.1	Normal	Non-SSD
VV_VMWARE_NL....	Normal	Non-SSD
VV_VMWARE_NL....	Normal	Non-SSD
VV_VMWARE_NL.2	Normal	Non-SSD
VV_VMWARE_NL.3	Normal	Non-SSD
VV_VMWARE_NL.4	Normal	Non-SSD

BL460C G7 03 – SEE

General

Manufacturer:	HP
Model:	ProLiant BL460c G7
CPU Cores:	12 CPUs x 2,666 GHz
Processor Type:	Intel(R) Xeon(R) CPU X5650 @ 2.67GHz
License:	VMware vSphere 5 Enterprise Plus - Licensed for 2 physic...
Processor Sockets:	2
Cores per Socket:	6
Logical Processors:	24
Hyperthreading:	Active
Number of NICs:	4
State:	Connected
Virtual Machines and Templates:	19
vMotion Enabled:	Yes
VMware EVC Mode:	Disabled
vSphere HA State	Connected (Slave)
Host Configured for FT:	No
Active Tasks:	
Host Profile:	
Image Profile:	(Updated) ESXi-5.1.0-2013...
Profile Compliance:	N/A
DirectPath I/O:	Supported

Resources

CPU usage: **5613 MHz** Capacity 12 x 2,666 GHz

Memory usage: **75775,00 MB** Capacity 98293,73 MB

Storage	Status	Drive Type
datastore1 (2)	Normal	Non-SSD
VV_3PAR01_VM...	Normal	Non-SSD
VV_3PAR02_VM...	Normal	Non-SSD
VV_VMWARE_FC.0	Normal	Non-SSD
VV_VMWARE_FC.1	Normal	Non-SSD
VV_VMWARE_FC.2	Normal	Non-SSD
VV_VMWARE_FC.3	Normal	Non-SSD
VV_VMWARE_FC.4	Normal	Non-SSD
VV_VMWARE_FC.5	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_NL.0	Normal	Non-SSD
VV_VMWARE_NL.1	Normal	Non-SSD
VV_VMWARE_NL....	Normal	Non-SSD
VV_VMWARE_NL....	Normal	Non-SSD
VV_VMWARE_NL.2	Normal	Non-SSD
VV_VMWARE_NL.3	Normal	Non-SSD
VV_VMWARE_NL.4	Normal	Non-SSD

BL460C G7 04 – SEE

General

Manufacturer:	HP
Model:	ProLiant BL460c G7
CPU Cores:	12 CPUs x 2,666 GHz
Processor Type:	Intel(R) Xeon(R) CPU X5650 @ 2.67GHz
License:	VMware vSphere 5 Enterprise Plus - Licensed for 2 physic...
Processor Sockets:	2
Cores per Socket:	6
Logical Processors:	24
Hyperthreading:	Active
Number of NICs:	4
State:	Connected
Virtual Machines and Templates:	18
vMotion Enabled:	Yes
VMware EVC Mode:	Disabled
vSphere HA State	Connected (Slave)
Host Configured for FT:	No
Active Tasks:	
Host Profile:	
Image Profile:	(Updated) ESXi-5.1.0-2013...
Profile Compliance:	N/A
DirectPath I/O:	Supported

Resources

CPU usage: **6520 MHz** Capacity 12 x 2,666 GHz

Memory usage: **89627,00 MB** Capacity 98293,73 MB

Storage	Status	Drive Type
datastore1 (3)	Normal	Non-SSD
VV_3PAR01_VM...	Normal	Non-SSD
VV_3PAR02_VM...	Normal	Non-SSD
VV_VMWARE_FC.0	Normal	Non-SSD
VV_VMWARE_FC.1	Normal	Non-SSD
VV_VMWARE_FC.2	Normal	Non-SSD
VV_VMWARE_FC.3	Normal	Non-SSD
VV_VMWARE_FC.4	Normal	Non-SSD
VV_VMWARE_FC.5	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_FC...	Normal	Non-SSD
VV_VMWARE_NL.0	Normal	Non-SSD
VV_VMWARE_NL.1	Normal	Non-SSD
VV_VMWARE_NL....	Normal	Non-SSD
VV_VMWARE_NL....	Normal	Non-SSD
VV_VMWARE_NL.2	Normal	Non-SSD
VV_VMWARE_NL.3	Normal	Non-SSD
VV_VMWARE_NL.4	Normal	Non-SSD

Table showing the equipment supplied by Plugnet

RESUMO DA PROPOSTA PARA SEE-PB - SOLUÇÃO EM ADESÃO A UFRN RP 152/2010

Item	Descrição	Qtd.	Valor Unitário	Valor Total	Orgão / Gerenciador	No. da ATA	Item / adesão
SOLUÇÃO DE BLADE							
1	HP C7000: 6 Fontes, 10 Exaustores Redundantes (N+N) e Hot-Plug, 02 Módulos de Gerência, 16 Baias SVR, 08 Baias Swiches LAN,SAN, INFINI-BAND, Licença Full de HP ICE. Garantia para hardware de 36 meses on-site 24x7 com tempo de solução de 6 horas e suporte para software de 36 meses on-site 24x7 . Serviço de instalação e startup.	1	R$	R$	UFRN	152/2010	Item 3
2	HP GbE2c Layer 2/3 Ethernet Blade Switch for c-Class BladeSystem: Switch com 24p. Garantia de 36 meses on-site 24x7 com tempo de solução de 6 horas. Serviço de implementação, hands-on e documentação.	4	R$	R$	UFRN	152/2010	Item 56
3	Brocade 8Gb SAN Switch for HP BladeSystem c-Class: Switch com 24p (16 INT, 8 EXT) 8Gb, acompanha 4 SFPs. Garantia de 36 meses on-site 24x7 com tempo de solução de 6 horas. Serviço de implementação, hands-on e documentação.	2	R$	R$	UFRN	152/2010	Item 54
5	HP BL 460c G7: 02 Processadores Intel Xeon 5650 (6C de 2.66GHz, L3 12MB), memória de 48GB PC3-8500 DDR-3, 2 discos de 146GB 10krpm SFF SAS, Controladora de discos P410i com 256MB de cache e RAID 0 e 1, 04 interfaces de rede 10GbE e 02 interfaces HBA FC de 8Gbs. Garantia de 36 meses on-site 24x7 com tempo de solução de 6hs. Serviço de Instalação e startup.	4	R$	R$	UFRN	152/2010	Item 7
SOLUÇÃO DE STORAGE							
1	HP EVA4400: 02 Controladoras de Array, 04GB Cache, 01 Enclosure M6412A (12 discos), 12 discos de 600GB FC 10.000 RPM. Software Command View EVA para Administração e Gerencia de Performance com Licença ilimitada. Garantia para hardware de 36 meses on-site 24x7 com tempo de solução de 6 horas e suporte para software de 36 meses on-site 24x7. Serviço de instalação e startup.	1	R$	R$	UFRN	152/2010	Item 53
2	HP M6412A: capacidade para até 12 discos, suportando discos FATA e FC simultaneamente. Garantia de 36 meses on-site 24x7 com tempo de solução de 6 horas.	3	R$	R$	UFRN	152/2010	Item 4
SOLUÇÃO DE BACKUP							
1	Biblioteca de Backup HP Storageworks MSL4048, conectividade Fibre Channel 8Gbs com leitor de código de barras integrado. Capacidade instalada de 02(duas) unidades internas de leitura e gravação LTO-5 ,suportando expansão para até 02 (duas) unidades adicionais e mesma capacidade e tecnologia. Acompanha 100 (cem) unidades de midia de dados LTO-5 com respectivos codigos de barras e 04 (quatro) unidades de midias de limpeza LTO. Garantia 36 meses on-site 24x7 com tempo de solução em até 6hs. Serviço de instalação e startup.	1	R$	R$	UFRN	152/2010	Item 1
SOLUÇÃO DE VIRTUALIZAÇÃO							
1	Kit de Licenças Vmware vSphere 4.0 para 02(dois) processadores com suporte e subscrição por 1 ano 9x5.	4	R$	R$	UFRN	152/2010	Item 70
2	Licença vCenter Standard 4.0 com suporte 1 ano 9x5. Serviço de implementação, Documentação técnica e Transferência do conhecimento sobre a operação e administração da ferramenta (Hands-On).	1	R$	R$	UFRN	152/2010	Item 66
ITENS COMPLEMENTARES PARA SOLUÇÃO							
1	Kit memória 16GB DDR-3 para Servidores Blade BL460c	12	R$	R$	UFRN	152/2010	Item 28

CODATA Data Center Infrastructure

CODATA has two computing environments, High Platform and Low Platform. The High Platform environment (mainframe) uses the newest equipment from IBM, where multiple systems in the financial sector and state government payroll are processed. The Low Platform uses BLADE server architecture, configured in CLUSTERS uniting the processing power of multiple servers.

- **High platform:**
    - Server IBM 2818-z114 M10;
    - Tape virtualizer CGx LUMINEX with approximately 4TB useful area;
    - Machine with a central processor at 80 MIPS;

- Capacity Setting H01 (80 Mips - 10 MSU´s);
- Three Integrated Facilities processors IFL de 3,8 GHz for Linux;
- Two Cryptos (Criptographic processors for secure transactions ad Access operating at 3.8 GHz;
- Memory96GB;
- Storage IBM DS6800 2.3TB gross. Configured in raid-5;
- Operating System z/VM e z/VSE e z/Linux.

- **Low platform:**
  - 2 Chassi Blade c7000;
  - 9 Blade servers BL 460c com 2 CPU Intel Xeon E5440, 16GB RAM and 2 146GB drives;
  - 3 Blade servers BL 460c G7 with 2 CPU Intel Xeon 5650, 96GB RAM e 2 146GB drives;
  - 3 Blade servers BL 460c Gen8 with 2 CPU Intel Xeon E5-2670, 128GB RAM and 2 300GB drives;
  - 4 Blade servers BL 460c G7 with 2 CPU Intel Xeon 5650, 32GB RAM e 2 146GB drives;
  - 4 Proliant servers DL 380 Gen9 with 2 CPU Intel Xeon E5-2630v3, 128GB RAM e 2 900GB drives;
  - Storage EVA 4400 with 2 Array controllers with 28 300GB drives, 27 600 GB drives, 14 discos de 1TB e 14 discos de 2TB, totaling 66.6TB de storage space
  - Storage EVA 4400 with 2 Array controllers with 12 600GB drives and 16 2TB drives, making a total of 46.4TB storage space;
  - Storage 3par with 2 controllers NODEs with 48 900GB FC drives and 44 3TB drivews, making a total of 175.2TB storage space;
  - Backup library with 2 LTO-5 internal units and 2 LTO-4 internal units, together with 100 LTO-5 data media units and 200 LTO-4 data media units.

CODATA Clusters

CODATA - BL460c G1 CLUSTER 2

Getting Started | Summary | Virtual Machines | Hosts | DRS

General

vSphere DRS:	On
vSphere HA:	On
VMware EVC Mode:	Disabled
Total CPU Resources:	90 GHz
Total Memory:	127,98 GB
Total Storage:	68,17 TB
Number of Hosts:	8
Total Processors:	32
Number of Datastore Clusters:	0
Total Datastores:	35

CODATA CLUSTER 1

Getting Started | Summary | Virtual Machines | Hosts | DRS

General

vSphere DRS:	On
vSphere HA:	On
VMware EVC Mode:	Disabled
Total CPU Resources:	425 GHz
Total Memory:	1,53 TB
Total Storage:	71,89 TB
Number of Hosts:	12
Total Processors:	164
Number of Datastore Clusters:	0
Total Datastores:	40

Total available processing and memory resources:

DATACENTER RESOURCES	More Details
Running VMs:	254
Total CPU Capacity:	516 GHz
Total CPU Usage:	20 %
Total Memory Capacity:	1,696 GB

STORAGE 3PAR 01

Systems : Storage Systems : 3PAR_CODATA_01

Summary | Settings | Capacity | Software | Alerts

General

Name	3PAR_CODATA_01
Model	HP_3PAR 7200
Serial Number	1690269
OS Version	3.1.2 (MU3)
Encryption Status	Not Licensed
FIPS Mode	Not Compliant
Controller Nodes	2
Ports	18
Host	8
Disk	4
Free	2
Remote Copy	4
Drive Cages	4
SAS Daisy Chain	Port 0:0:2 (2 Cages, Max Supported 5)
	Port 1:0:1 (2 Cages, Max Supported 5)
	Port 1:0:2 (2 Cages, Max Supported 5)
	Port 0:0:1 (2 Cages, Max Supported 5)
Physical Disks	48
FC	24
NL	24
Hosts	26
Provisioning	
CPGs	3
Virtual Volumes	62

Capacity

Device Type: All

Overview

Allocated:	42,319.000 GiB
Free:	42,329.000 GiB
Total:	84,648.000 GiB

Data Compaction

Compaction Ratio	2.745:1 (52,953.789 GiB)
Deduplication Ratio	1:1 (0.000 GiB)

STORAGE 3PAR 02

Systems : Storage Systems : 3PAR_CODATA_02

Summary | Settings | Capacity | Software | Alerts

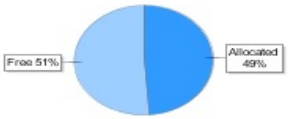
General

Name	3PAR_CODATA_02
Model	HP_3PAR 7200
Serial Number	1690274
OS Version	3.1.2 (MU3)
Encryption Status	Not Licensed
FIPS Mode	Not Compliant
Controller Nodes	2
Ports	18
Host	8
Disk	4
Free	2
Remote Copy	4
Drive Cages	4
SAS Daisy Chain	Port 0:0:1 (2 Cages, Max Supported 5)
	Port 1:0:2 (2 Cages, Max Supported 5)
	Port 1:0:1 (2 Cages, Max Supported 5)
	Port 0:0:2 (2 Cages, Max Supported 5)
Physical Disks	48
FC	24
NL	24
Hosts	26
Provisioning	
CPGs	8
Virtual Volumes	54

Capacity

Device Type: All

Overview



Allocated:	41,327.000 GiB
Free:	43,321.000 GiB
Total:	84,648.000 GiB

Data Compaction

Compaction Ratio	2.625:1 (48,161.191 GiB)
Deduplication Ratio	1:1 (0.000 GiB)

STORAGE EVA 4400 NL

HP P6000 Command View Software 10.2.0.121112

Storage Systems
- Storage Network
  - EVA4400_CODATA
    - Virtual Disks
    - Hosts
    - Disk Groups
      - DG_NEARONLINE_7K
      - DG_ONLINE_10K
      - DG_ONLINE_15K
      - Ungrouped Disks
    - Data Replication
    - Hardware
  - P6300_SEEPB

DG_NEARONLINE_7K

Disk Group Properties

General | Vdisks

Save Changes | Add Disks | Locate | Delete

Identification

Name: DG_NEARONLINE_7K

UUID: 6005-08b4-0008-9ffc-0001-5000-007f-0000

Condition/State

Operational state: Attention

Transition state: Inactive

Attributes

Total disks: 25

Drive type: Near-Online

Disk group type: Enhanced

Disk drive failure protection

Requested level: Double

Actual level: Double

Capacity

This disk group is 0% allocated

Summary

Total:	26807 GB
Allocated:	0 GB
Allocation level:	0 %
Requested:	0 GB
Oversubscribed:	0 GB

Available (estimated)

	Physical	Thin provisioning
Vraid0:	26231 GB	112880 GB
Vraid1:	12089 GB	112880 GB
Vraid5:	20845 GB	112880 GB
Vraid6:	15274 GB	112880 GB

STORAGE EVA 4400 10k

HP P6000 Command View Software 10.2.0.121112

Storage Systems
- Storage Network
  - EVA4400_CODATA
    - Virtual Disks
    - Hosts
    - Disk Groups
      - DG_NEARONLINE_7K
      - DG_ONLINE_10K
      - DG_ONLINE_15K
      - Ungrouped Disks
    - Data Replication
    - Hardware
  - P6300_SEEPB

DG_ONLINE_10K

Disk Group Properties

General | Vdisks

Save Changes | Add Disks | Locate

Identification
Name: DG_ONLINE_10K
UUID: 6005-08b4-0008-9ffc-0001-5000-00c0-0000

Condition/State
Operational state: Attention
Transition state: Inactive

Disk drive failure protection
Requested level: Double
Actual level: Double

Attributes
Total disks: 28
Drive type: Online
Disk group type: Enhanced

Capacity
This disk group is 84% allocated

Summary
Total: 13405 GB
Allocated: 11259 GB
Allocation level: 84 %
Requested: 11250 GB
Oversubscribed: 0 GB

Available (estimated)

	Physical	Thin provisioning
Vraid0:	2136 GB	112880 GB
Vraid1:	1067 GB	112880 GB
Vraid5:	1709 GB	112880 GB
Vraid6:	1424 GB	112880 GB

STORAGE EVA 4400 15K

HP P6000 Command View Software 10.2.0.121112

Storage Systems
- Storage Network
  - EVA4400_CODATA
    - Virtual Disks
    - Hosts
    - Disk Groups
      - DG_NEARONLINE_7K
      - DG_ONLINE_10K
      - DG_ONLINE_15K
      - Ungrouped Disks
    - Data Replication
    - Hardware
  - P6300_SEEPB

DG_ONLINE_15K

Disk Group Properties

General | Vdisks

Save Changes | Add Disks | Locate

Identification
Name: DG_ONLINE_15K
UUID: 6005-08b4-0008-9ffc-0001-5000-0057-0000

Condition/State
Operational state: Attention
Transition state: Inactive

Disk drive failure protection
Requested level: Double
Actual level: Double

Attributes
Total disks: 28
Drive type: Online
Disk group type: Enhanced

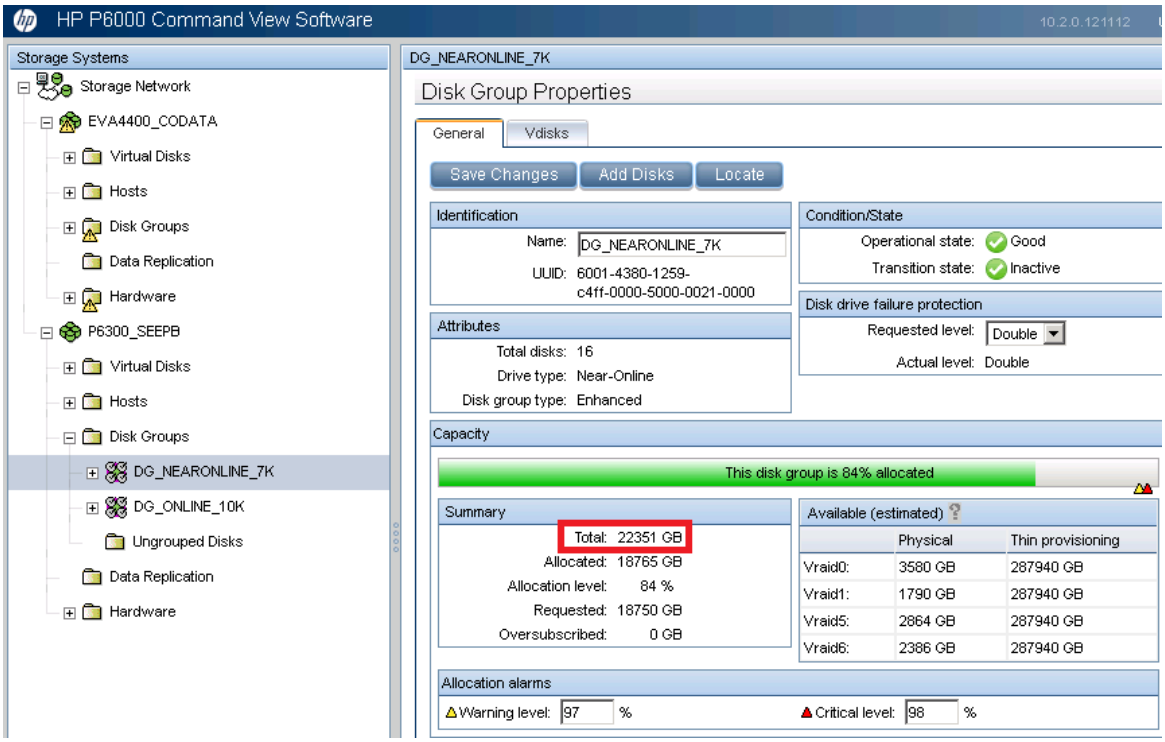
Capacity
This disk group is 19% allocated

Summary
Total: 6700 GB
Allocated: 1251 GB
Allocation level: 19 %
Requested: 1250 GB
Oversubscribed: 0 GB

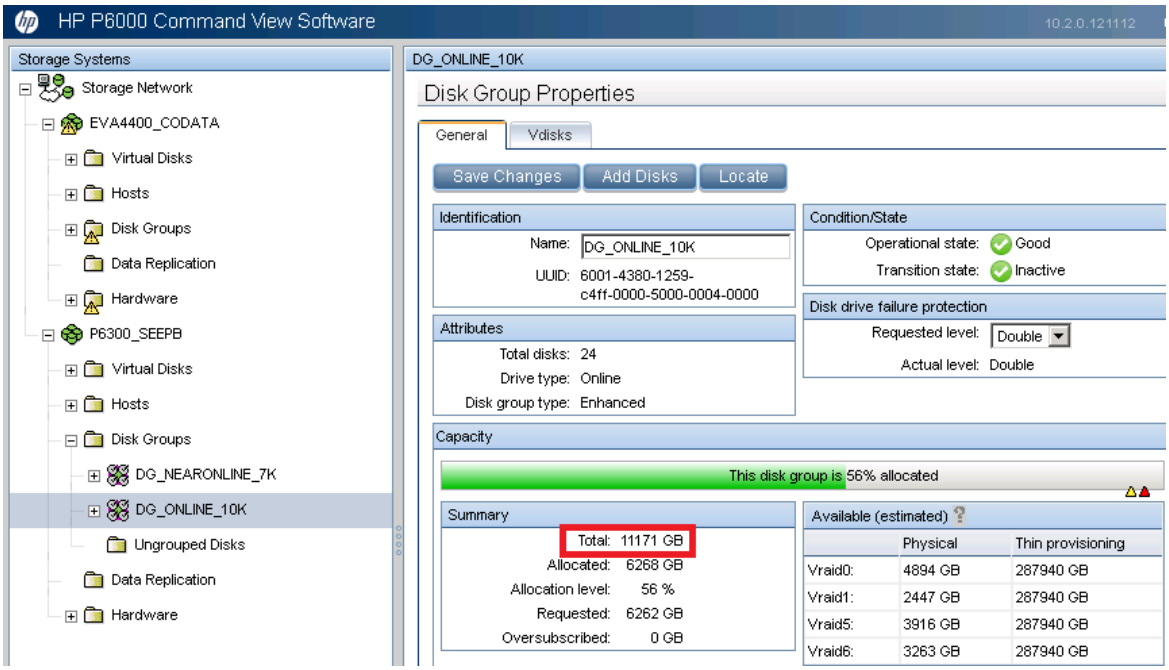
Available (estimated)

	Physical	Thin provisioning
Vraid0:	5438 GB	112880 GB
Vraid1:	2719 GB	112880 GB
Vraid5:	4351 GB	112880 GB
Vraid6:	3626 GB	112880 GB

STORAGE P6300 NL



STORAGE P6300 10k



The total processing, memory and storage available in the CODATA data center is 645Ghz of CPU, 1.45TB of RAM and 287.2TB of physical storage, of which 249.7TB is useful storage.

ANNEX II: REPAD

1. INTRODUCTION

The city is the gateway for accessing citizens' rights. That children have education, that families have health, that all citizens have the right to mobility, housing, culture, and so on determine quality of life that the city offers. Therefore, the city's administration is essential to provide the conditions for prosper businesses to prosper – in the present and the future – and for those who cannot access city services – the poor of the towns, the steppes, and the hinterlands (*sertões*) – to find means for their social and economic reintegration.

When we think of modernity to the Brazilian society by absorbing new Information and Communication Technologies (ICTs), we are driven to seek answers to quote the song "We want to know, what they will do with the new inventions (...) and their implications for the emancipation of man, of large populations, poor men of the cities, the steppes, the backlands."

The city has the ideal scale to think about inclusive projects, a fact that was recognized by the Federal Constitution to favor the administrations and management of inclusive public policies. Incorporating people to the benefits of new technologies today involves the discussion and implementation of digital cities and metropolitan networks.

The REPAD (High Performance Metropolitan Network) and Digital Cities go beyond the execution of the basic procedures necessary to allow taxpayer access to broadband Internet services. The managers of Digital Cities have to make use of ICT management tools to ensure citizen rights to Education, Health, Information, Culture, Leisure etc.

2. INFRASTRUTURE AND TOPOLOGY

There are approximately 205-km of high performance data communication network with 12, 24, 48, and 72 fiber optic cables structured to build 12 physical rings, each consisting of two fiber pairs. These are divided into two optical rings, North and South Ring from which linear extensions can be made, aiming at the most cost-effective network. The two rings have a common point in the Information Technology Center of the Federal University of Paraíba (NTI / UFPB).

3. REPAD's TARGET POPULATION AND OBJETIVE

REPAD, by adopting an open design, in addition to benefiting the major research institutions and higher education, will enable the interconnection of other institutions with non-academic interests. The integration of beneficiaries participating institutions ensures their self-support and promotes continuous improvement by using advanced applications and exchanging large volumes of data.

REPAD's objective is to interconnect the institutions of the State System of Science, Technology and Innovation in the state capital and its metropolitan region through its own fiber optic infrastructure.

4. DESCRIÇÃO DOS SERVIÇOS

4.1. Basic Services

Connection service refers to connectivity to the metropolitan network REPAD by an agency or other entity. This service begins with the assessment of internal and external viability, and then a pre-budget and, after approval, the service is implemented. Regarding service availability, the network provides

initial installation and support for configuration of the network assets and network management. We have the following service modes:

4.1.1. STANDARD 1 Connection

This is a connection by which the client has access to the REPAD optical network through deployment of optical fiber and one Access switch, thereby providing service to the agency or entity. When there is more than one entity at a given locality, each organ Will be considered as an additional client.

DESCRIPTION OF STRUCTURE: The client Will have a physical electrical port, 10/100/1000 Mbps in the Access Switch with capacity of up to 1 Gbps. It is necessary to have a minimum infrastructure for this equipment to be allocated to the client.

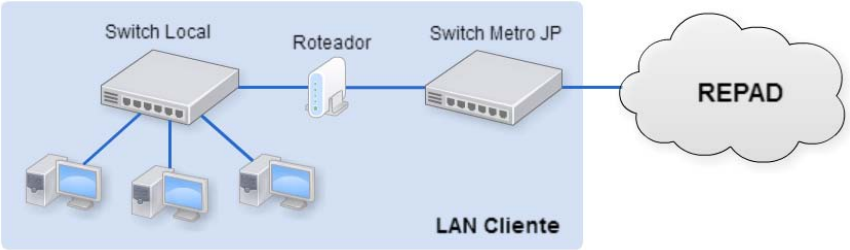


Figure 1: REPAD Topology with a STANDARD 1 Connection

4.1.2. STANDARD 2 Connection

This is a connection whereby the client has Access to the REPAD optical network without redundant fibers. The optical structure is supplied through 1 Internal Optical Distributor (DIO). In this type of connection, the client will not have any REPAD Access Switch in its structure. The fiber available to the client will originate in an agency located close to the client, where there is a REPAD network asset (Standard 1 or 3 connection). For this standard of connection, If the client's asset has no optical gate, it will be necessary to use a media converter.

DESCRIPTION OF THE STRUCTURE: A DIO will be provided by the contracting entity. The equipment will provide, at a minimum, 4 ports (two optical pairs). In this manner, the fiber connection will be implemented between the DIO and the REPAD Access Switch of the nearest client entity in another building. The fiber link will be connected in a 10/100/1000 Mbps port with a total capacity of 1Gbps.

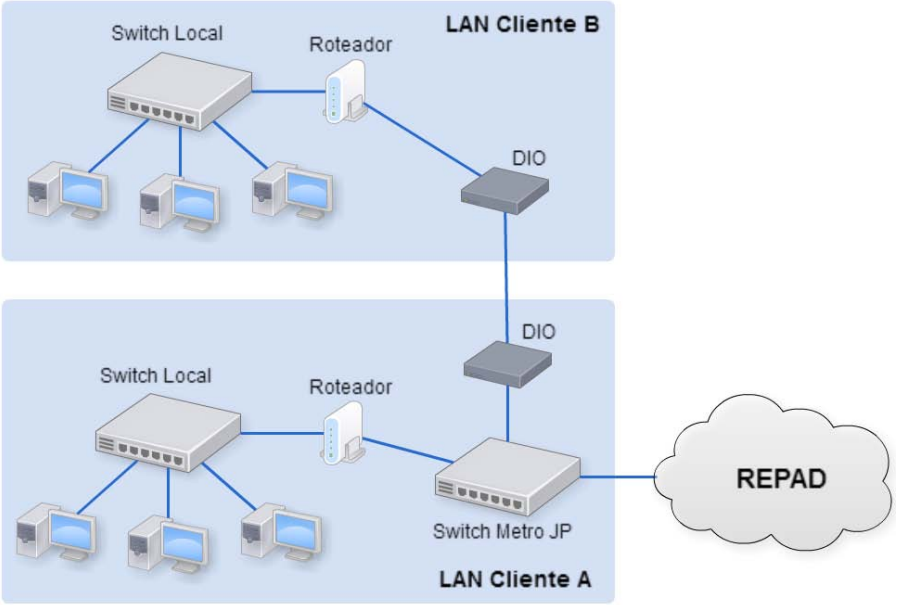


Figure 2: Topology of a REPAD STANDARD 2 connection

4.1.3. STANDARD 3 Connection.

This is a connection that provides redundant physical fiber optic links to the network backbone using double connections. For this standard of installation two links to the network backbone are provided making the connection more secure and thus increasing the level of availability. Each entity located in the same location that uses the connection is considered as a new client contracting the service.

DESCRIPTION OF THE STRUCTURE: The client will have a physical electric port (10/100/1000 Mbps), with a capacity of up to one Gbps. It is necessary to have a minimum infrastructure for this equipment to be allocated to the client.

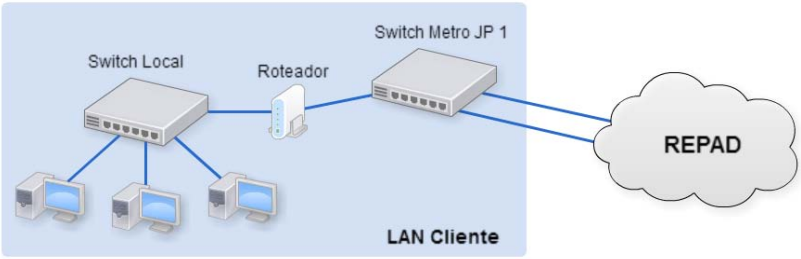


Figure 3: REPAD topology for a Type 3 Connection

4.1.4. Comparative Service Table

CHARACTERISTICS	TYPE 1	TYPE 2	TYPE 3
Redundant Access Fiber			√
Network Management	√	√	√
24x7 Technical Assistance	√	√	√

Management Reports	√	√	√

4.1.5. Services Common to the Connection Types

The Type 1 and 2 Basic Connection services also include:

Access to the optical backbone ring of 10 Gbps;

Technical assistance 24/7;

Management of outages and availability indicators: this includes the repair of defects and interruptions with generation and monitoring of availability indicators;

SNMP Access to data of the Access port for use in management by the client;

Indicators provided in the Monitoring Portal of the metropolitan IP network (https://monitor.pb.gov.br/repad):

Bandwidth use: graphs of bandwidth use contracted at the entry and exit of the access equipment;

Outage history: history of all outages over a week;

Service level report: a report showing the percentage of support provided within and outside the agreed service period contracted, weekly availability and impacts that have occurred.

4.2. ADDITIONAL SERVICES

These include services described below whereby the participating institution can contract services beyond the basic level, in accord with its needs. They comprise the services described below, in which the participating institution may contract in addition to basic services, according to demand and need.

4.2.1. INTERNET ACCESS SERVICE

INTERNET SERVICE PROVISION. THE BANDWIDTH CONTRACTED IS GUARANTEED TO THE CLIENT AT THE EXIT FOR THE PUBLIC INTERNET TRUNKSWHERE CODATA IS CONNECTED. THIS SERVICE INCLUDES THE PROVISION OF PUBLIC IPV4 ADDRESSES AS PER THE FOLLOWING TABLE;

BANDWIDTH	IPv4 ADDRESSES
100Mbps	8

Note: To contract speeds above 100 Mbps, an analysis of technical and financial viability to be requested from CODATA.

4.2.3 (In the original document) Additional port.

If the contracting party is interested, it is possible to configure additional ports on the Access switch, including the installation and maintenance process.

Service	Quantidade de Portas Disponibilizadas
Basic Internet Connection	1

Note: Should any port be unused, it cannot be used by another entity.

4.2.4 (In the original document) Optical adaptation

Delivery of the single mode optical interface and patch cord with the LC APC x SC PC standard connection for installation in the equipment of the contracting entity. The interface uses the standard

Mini GBUC single mode with LC PC connecters for installation in the participating entity's equipment. The interface used follows the Mini GBIC single mode LC PC connecters.

4.2.5 (In the original document) Additional public IP address

Providing a batch of public IP addresses, beyond the address provided to the client on delivery of the Internet access link. A prior analysis of the justifications and needs of the requesting client agency is required to support the allocation of an additional public address. This analysis will be carried out by the responsible REPAD technical team.

4.2.6 LAN2LAN Service

REPAD's LAN2LAN product is a telecommunications service to interlink two LAN networks within the REPAD Metro Ethernet network, with 100% digital circuits. It is possible to Interconnect a headquarters with its respective subsidiaries with high speed and low latency links, carrying their VLANs (802.1Q) from the origin to the destination. This makes possible voice and video transmission in these circuits. Speeds: 10 Mbps, 20 Mbps, 50 Mbps, 100 Mbps, 200 Mbps, 500 Mbps, 1 Gbps.

4.2.7 VPN L3

REPAD's VPNL3 product is a telecommunications service to interlink two distinct networks, using the REPAD Metro Ethernet network, with 100% digital circuits. It is possible to Interconnect a headquarters with its subsidiaries using routing. We assure low latency and high transmission speeds: 10 Mbps, 20 Mbps, 50 Mbps, 100 Mbps, 200 Mbps, 500 Mbps, 1 Gbps.

5. PROCEDURE FOR CONTRACTING SERVICES

Below the procedure for contracting REPAD services is presented in a succinct form:

5.1. Information on services

The information relating to the description of services provided by REPAD will be available at the REPAD Portal address: http://www.repad.pb.gov.br. For new clients, that do not yet have a relationship with REPAD, there is a service channel (83) 3222-8721, to provide the service and network Access support provided the company.

5.2. Documentation for contracting services

The standard documentation for contracting basic and additional services is composed of three standard documents. These documents are described below and are available at the address of the REPAD Portal: http://www.repad.pb.gov.br

5.2.1. BASIC PROJECT

For basic and additional services a standard document will be prepared that will contain the full solution to be contracted as well as technical specifications and solution details, that will be in accord with this business model

5.2.2. Contract form

For basic and additional services a standard contract form is available that facilitate contracting services. This document will be used to specify the contractual conditions (object, description of services, term, prices, service levels of payment, official index tor annual price adjustments and other relevant conditions) as determined in Law 8,666 of June 29, 1993 (Norms for bidding and contracts by the, Public Administration and other measures).

5.2.3. Additional form

For basic and additional services standard documents are provided to be used by the participating entity whenever an increase or reduction of services provided under a contract in force, respecting the limits imposed by Article 6t5 of Law 8,666 for services acquired in contracts with REPAD.

ANNEX III MUNICIPIOS WITH DATA CONNECTIONS LEASED FROM OI

1. AGUA BRANCA
2. AGUIAR
3.ALAGOA GRANDE
4.ALAGOA NOVA
5.ALAGOINHA
6.ALCANTIL
7.ALHANDRA
8.ARACAGI
9.ARARA
10.ARARUNA
11.AREIA
12.AROEIRAS
13.BAIA DA TRAIÇÃO
14.BANANEIRAS
15.BARRA DE SANTA ROSA
16.BAYEUX
17.BELEM
18.BOM SUCESSO
19.BONITO DE SANTA FE
20.BOQUEIRAO
21.BREJO DO CRUZ
22.CAAPORA
23.CABACEIRAS
24.CABEDELO
25.CACIMBA DE DENTRO
26.CAICARA
27.CAJAZEIRAS
28.CAMALAU
29.CAMPINA GRANDE
30.CAMPO DE SANTANA
31.CATOLE DO ROCHA
32.CONCEICAO
33.CONDADO
34.CONDE
35.COREMAS
36.CRUZ DO ESPIRITO SANTO
37.CUBATI
38.CUITE
39.ESPERANCA
40.GAMELEIRA
41.GUARABIRA
42.GURINHEM
43.IGARACY
44.INGA
45.ITABAIANA
46.ITAPORANGA
47.ITAPOROROCA
48.JACARAU
49.JUAZEIRINHO
50.JUNCO DO SERIDO
51.JURIPIRANGA

52.LAGOA DE DENTRO
53.LAGOA SECA
54.LUCENA
55.MALTA
56.MAMANGUAPE
57.MARI
58.MATARACA
59.MOGEIRO
60.MONTEIRO
61.MULUNGU
62.NATUBA
63.PATOS
64.PEDRAS DE FOGO
65.PEDRAS DE FOGO RURAL
66.PIANCO
67.PICUI
68.PILAR
69.PILOES
70.PIRPIRITUBA
71.POCINHOS
72.POMBAL
73.PRATA
74.PRINCESA ISABEL
75.QUEIMADAS
76.REMIGIO
77.RIO TINTO
78.SANTA LUZIA
79.SANTA RITA
80.SANTA TEREZINHA
81.SANTANA DOS GARROTES
82.SAO BENTO
83.SAO JOAO DO CARIRI
84.SAO JOAO DO RIO DO PEIXE
85.SAO JOSE DA LAGOA TAPADA
86.SALGADO DE SÃO FELIX
87.SAO JOSE DE PIRANHAS
88.SAO MAMEDE
89.SAPE
90.SERRA BRANCA
91.SERRARIA
92.SOLANEA
93.SOLEDADE
94.SOUSA
95.SUME
96.TAPEROA
97.TEIXEIRA
98.TRIUNFO
99.UIRAUNA
100.UMBUZEIRO
101. JOÃO PESSOA