

Definitional Mission to Evaluate ICT Projects in Brazil: Public Record Report for Volumes 1-6

Final Report

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I. Executive Summary

Hellerstein and Associates (H&A), an international consulting firm based in Washington, DC, was selected by USTDA to conduct a Definitional Mission (DM) to review and assess the feasibility and impact of the 12 ICT projects proposed to USTDA in nine different Brazilian States: Bahia, Goiás, Mato Grosso, Minas Gerais, Paraíba, Pernambuco, Rio Grande do Norte, Rio de Janeiro, and São Paulo. Rodrigo Motta, USTDA staff resident in Brazil, added an additional project in São Paulo to the list. This project was proposed by the São Paulo state government's Secretariat of Governments Sub-secretariat for Technology and Citizen Services (*Secretaria de Governo Subsecretaria de Tecnologia e Serviços ao Cidadão*). This project was for a feasibility study on integration and consolidation of state data centers.

H&A's (the DM Contractor) analysis of these projects assessed the potential of the proposed technical assistance projects to improve competition in the Brazilian ICT market, lower costs for e-government services, foster the adoption of new ICTs, and result in significant export opportunities for US producers of telecommunications and computer equipment.

The Definitional Mission's objectives were to evaluate the terms, feasibility, and impact of all 13 projects the proponents of which are located in the states of Bahia, Goiás, Mato Grosso, Minas Gerais, Paraíba, Pernambuco, Rio Grande do Norte, Rio de Janeiro, and São Paulo. Prior to departure for Brazil, Hellerstein & Associates (H&A) met with Country Manager Gabrielle Mandel, Country representative Rodrigo Motta, and the USTDA evaluation team to discuss these projects' objectives and different ways to measure their economic, trade, and development impact.

H&A also assessed the degree to which each of the 13 proposed projects 1) meets USTDA goals and objectives, 2) is consistent with federal and state government priorities, 3) is likely to obtain funding, and 4) could achieve their stated objectives if implemented. This rating allowed H&A to recommend six projects that merit USTDA funding for technical assistance or feasibility studies, and reject seven projects for various reasons detailed below.

Below we list are recommended projects as well as the priority given to them. Each of the projects can be found in a separate volume, which contains detailed information about the project along with detailed terms of reference and a budget.

For the six projects selected for field visits, the DM contractors evaluated the project information received and followed up to collect additional information necessary to meet USTDA's criteria for project finance. Meetings were guided by the checklist of issues and questions used to gather information. This process required follow-up communications with the "shortlisted" potential project sponsors to ascertain detailed requirements and capacities, as well contacts with potential funding sources and US businesses to investigate funding and U.S. business opportunity prospects for these projects.

Meetings with potential project sponsors were guided by a more detailed checklist of issues and questions:

- A more detailed description of the project objectives and desired support from USTDA
- An analysis of the project's technical, economic, and financial prospects

- An assessment of the project sponsor’s commitment to project implementation and ability to implement the project
- Information on financing options for project implementation, including:
 - An overall cost estimate, proposed ownership and financing structure, and schedule for project implementation; and
 - Evidence that financing is available or likely to be available for the project
 - A list of the procurements likely to be subject to competitive tenders in which international suppliers can participate, and a list of the equipment and services that are likely to be imported for project implementation
- A description of the most important benefits that the project will provide to Brazil
- An explanation of why USTDA’s funding is needed

Our recommendations for funding of six of the 13 projects were arrived after an extensive analysis of the technical, financial and economic aspects of the projects in question. Each of the projects can be found in a separate report, which contains detailed information about the project along with detailed terms of reference and a budget. We have assigned different priority levels to the projects with the Sao Paulo and Bahia projects as our suggestions for top priority followed closely by the CPFL Broadband Backbone Network and Business Model.

The six projects were:

1. São Paulo state data center integration and consolidation
2. Bahia state broadband and data center equipment and software update
3. Paraíba state broadband network and data center upgrade
4. Pernambuco data center upgrade and statewide broadband network
5. CPFL broadband backbone and business model
6. Goiânia Integrated Operations and Control Center

II. Recommended Projects

A. Grantee: São Paulo State Secretariat for Government, Sub-Secretariat for Technology and Citizen Services (STSC/SG/SP)

Activity Budget: USD \$762,210

U.S. Export Potential: servers, switches, storage, virtualization software, and other data center equipment; cloud services, fiber optic cables; optical electronics; wireless equipment such as antennas, transmitters, and receivers; systems and application software, total approximately **US\$39.3 million**.

STSC/SG/SP seeks technical assistance for an international consultancy financed by USTDA to develop detailed plans to:

1. Optimize the resources already employed in existing state government data centers;
2. Increase the redundancy, fault tolerance, security, and ability to recover from disasters of state government data centers by integrating, consolidating, and/or upgrading the existing data centers and, if necessary, building a new data center;
3. Provide the necessary connectivity to achieve the above-stated objectives and improve the quality of e-government services to government units (G2G), private sector

businesses (G2B and B2G), and citizens (G2C and C2G) over the next five years, either through re-negotiating the existing contracts with Embratel and Telefónica/Vivo or partnering with other public and private entities to develop a statewide hybrid fiber optic and wireless broadband network;

4. Identify potential partners to undertake the needed investments for carrying out the project; and
5. Help develop the basis for bidding documents to select private sector partners for implementing the project.

B. Grantee: Government of the State of Bahia

Activity Budget: \$898,330

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, and other data center equipment, and eGovernment software; total approximately US\$250 million.

The Government of the State of Bahia (GEBA) seeks technical assistance for an international consultancy financed by USTDA to develop detailed plans to for the execution of three components summarized below.

1. Extend the existing Bahia hybrid fiber/wireless public broadband network to reach all 417 (*municípios*) in Bahia, to offer (a) Internet connectivity to all government offices in the state (including schools, health clinics, fiscal posts, and police stations, and telecenters), (b) wholesale Internet connections to small and medium internet service providers (ISPs) so that they can increase the population's access to broadband Internet, (c) e-government services to the entire population of the state through telecenters and schools as well as commercial ISPs – all using a Public-Private Partnership (PPP model). This subproject to be executed by the Bahia State Secretariat for Science, Technology and Innovation – SECTI/BA), a secretariat of the State of Bahia Government.
2. Upgrade the equipment of the existing State of Bahia Data Processing Company (*Companhia de Processamento de Dados do Estado da Bahia* – PRODEB) data center and design and equipping of a backup data center. This subproject would be executed by PRODEB.
3. Design an improved integrated and interoperable eGovernment system and (*Projeto de eGov – Cidadão 360º*) and a digital transformation strategy making use of the upgraded PRODEB data center and the statewide broadband network. This subproject would be executed by PRODEB.

PRODEB is a public company operating under private sector law (*empresa pública de direito privado*), with the Chairman of its board being the Secretary of Administration.

C. Grantee: São Paulo Electric Company (*Companhia Paulista de Luz e Força* – CPFL ENERGIA)

Activity Budget: \$504, 481.

U.S. Export Potential: Fiber optic cables; optical electronics, total approximately US\$9.7 million.

CPFL ENERGIA seeks technical assistance for an international consultancy financed by USTDA to develop detailed plans to

1. Expand a growing fiber optic network based on optical ground wires (OPGW) hung from its transmission towers;
2. Identify potential partners to share in the investment and operating costs of the network through the exchange or rental of dark fiber and/or infrastructure (poles, ducts, cabinets, etc.);
3. Develop a business plan for building and operating the network at minimum cost to the company.

D. Grantee: Goiânia Municipal Government (*Prefeitura de Goiânia*)
Activity Budget: \$893,720.

Title: Goiânia Integrated Operations And Control Center

U.S. Export Potential: Fiber optic cables; optical electronics; wireless equipment such as antennas, transmitters, and receivers; systems and application software, sensors for street traffic, traffic control cameras, ITS - Intelligent Transportation System; Adaptive Traffic Signal Control System; Automatic Enforcement Solutions; Video Content Analytics; Public Building Monitoring; Disaster Identification and Prevention System; Geo-referencing and Communication System; Solutions for Government Monitoring and Evaluation (M&E); Sensors: we're interested in all kind of sensors that can be used in a city context (sensors for air quality, water quality, fire, pluviometers etc), total approximately US\$26.8 million.

The Goiânia Municipal Government (GMG) seeks technical assistance for an international consultancy financed by USTDA to

1. Determine global best practices in the six (or more) technologies currently envisioned for use in the IOCC
2. Review existing project documentation for possible updating of technologies and addition of new components, e.g.
 - a. Automatic RFID-based realtime, possibly variable, tariffs for congested areas of the city,
 - b. Adaptation of project data collection and analysis components for open data, encouraging development of applications using this data by private sector, public sector, and civil society entities, and
 - c. Use of drones to collect information about zoning code violations, new buildings, etc. rather than sending out personnel in cars to investigate.
3. Undertake a full feasibility study for the project as
4. Specify equipment and software needed and possible sources for acquisition

E. Grantee: The Pernambuco State Information Technology Agency (ATI)
Title: Pernambuco Data Center Upgrade And Statewide Broadband Network

Activity Budget: \$736,930.

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\$73 million.

The Pernambuco State Information Technology Agency (*Agência Estadual de Tecnologia da Informação – ATI*) is a semi-autonomous agency (*autarquia especial*) linked to the Secretariat of Administration of the Government of the State of Pernambuco – (*Governo do Estado de Pernambuco - GEP*), and created in 2003 by Complementary Law 049/2003.

ATI is responsible for providing technical coordination to implement the Public Information Model established by the Information and Communication Technology System that has two basic two premises: coordinated management and decentralized operations that involve sharing and assuring interoperability of IT assets and ensuring the safety and quality of products and services, all with a view to rationalizing costs.

Accordingly, ATI 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. ATI is responsible for technical coordination of distributed data processing units called Sectoral Informatics Centers (*Núcleos Setoriais de Informática – NSIs*) in state secretariats. All NSI staff are ATI employees.

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

1. Review the recently defined organization and management model of the ATI data center, based on cloud computing;
2. Help define the technology to be used to implement the cloud computing architecture;
3. Support implementation of a pilot project and full implementation of the ATI cloud;
4. Design and help implement a statewide broadband network to interlink all units of the GEP – both in the Recife metropolitan region and in the interior of the state in order to meet the demand for ICT throughout the state.

F. Grantee: The Paraíba State Data Processing Company (CODATA)

Title: Paraíba State Broadband Network And Data Center

Activity Budget: \$731,430 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.

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:

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

Below is an overview of the conditions in each of the states where our recommended projects are located.

III. Host Country Sector and Market

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 and 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 was more on digital inclusion than e-government. As of May, 2016 the new interim government was in the early stages of evaluating its ICT policies.

In 2010 the federal government launched a major broadband infrastructure development initiative to help improve broadband coverage and reduce the cost of broadband access. Ambitious targets were set 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. The principal instrument for supporting the PNBL is Telebras, a federal state enterprise dormant since the privatization of telecommunications companies in 1998 that was re-activated for this purpose in 2010. 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, including for e-government services. But at the other extreme there are the vast hinterlands of unconnected rural and remote areas,

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.

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 officials (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 in some 16,000 km of optical ground wire (OPGW) cables owned by 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 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.

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 fiber optic 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. Their 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 of 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.

Most states and major municipal governments have one or more data centers, though they vary greatly in size, security, integration, degree of obsolescence, and access to connectivity needed to conduct e-government operations supporting state and government offices throughout the state or allow these offices to use efficient cloud computing applications. A number of private-sector providers are available to offer outsourced data center services, including cloud applications such as Microsoft's Azure and similar offerings by Google and Amazon.

The State of São Paulo

The state of São Paulo is located in the Southeast region of Brazil, bordering the Atlantic Ocean on the East; Minas Gerais and Rio de Janeiro on the north, Mato Grosso do Sul on the west, and Paraná on the South. (Figures 1 and 2).

Figure 1: Political Map of Brazil

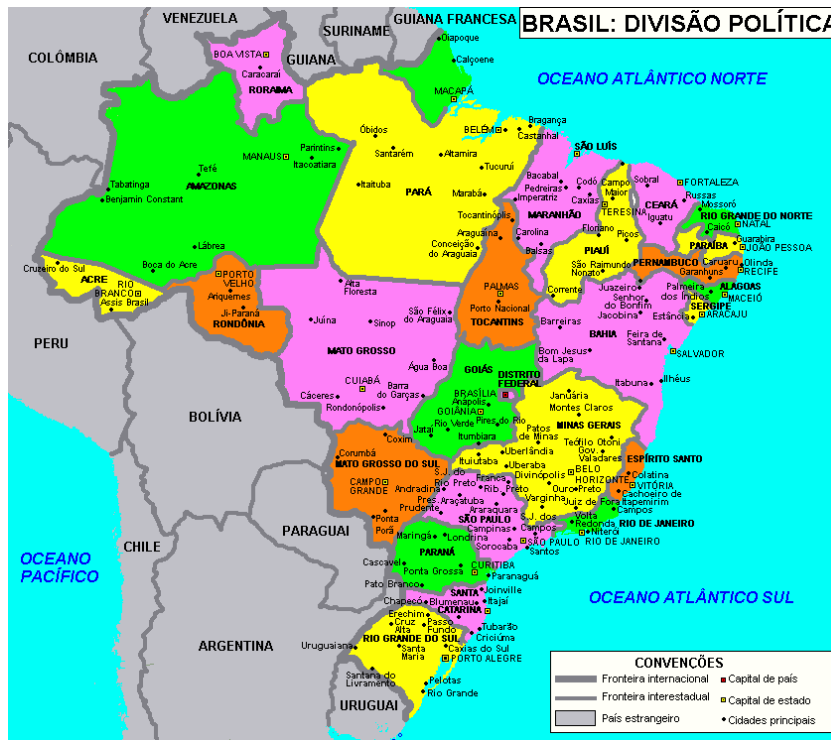


Figure 2: Map of São Paulo



São Paulo occupies an area of 248,209 square kilometers, about the same as Texas. São Paulo is the richest and most populous state in Brazil and its capital city, bearing the same name, is the largest city in all of South America. It is the major industrial and economic powerhouse of the Brazilian economy. Often dubbed the "locomotive of Brazil", the state alone is responsible for

32.1% of the Brazilian GDP in 2012, being the state with the highest GDP. In that year São Paulo was responsible for: 30% Brazil's industrial, 11% of agricultural, 30% of service output.

Wealth is unequally distributed in the state, however. The richest *municípios* are centered around Greater São Paulo (such as Campinas, Jundiaí, Paulínia, Americana, Indiatuba, São José dos Campos, and Santos), as well as a few other more distant nuclei, such as around São Carlos, [Jaú](#), Riberão Preto, São José do Rio Preto and Franca.

São Paulo also plays a dominant role in a number of strategic sectors:

- Aerospace and Defense - The largest aerospace hub in Latin America, São Paulo accounts for 73% of the local units, 95% of employed persons and 96% of the industrial transformation of the Brazilian aeronautics industry. Embraer, located in São José dos Campos, also the home of the Aeronautical Technical Institute (*Instituto Tecnológico de Aeronáutica* – ITA), is the third largest aircraft producer in the world.
- Agribusiness - With significant participation in the Brazilian trade balance, São Paulo is the largest producer of orange juice, cane sugar, and alcohol fuel, and an important producer of beef, coffee, and other agricultural products.
- Food - São Paulo is among the leading producers in the world of industrial food, concentrating around 35.5% of the industrial production of food in Brazil. Moreover, it is reference in trade and service in the industry.
- Automotive - 15th largest producer in the world of vehicles, the state of São Paulo is the cradle of the automobile industry in Brazil, concentrating over 41% of the national automotive complex plants.
- Green Economy - Greater Green Country market economy, 142,000 companies operating in the sector in São Paulo, employing 1.6 million people, especially in the sectors of Biofuels and Renewable Energy.
- Machinery and Equipment - São Paulo accounts for 57% of the value of manufacturing and 49% of employed persons (about 288,000 employees) in Brazil, playing a leading role in generating new technologies.
- Real Estate Market - With over 90% of its population concentrated in urban areas, São Paulo has 20% of the total population of Brazil and represents 28% of the national construction output.
- Research and Development - With one of the best R&D systems in Latin America, São Paulo has an intensive network of universities, research centers, incubators and technology parks, accounting for 86% of investments received in the industry.
- Oil and Natural Gas - In addition to housing 34% of domestic suppliers of equipment and services geared to the sector, São Paulo has five refineries representing 42.7% of the country's capacity and enormous potential extraction with the findings in the pre-salt offshore petroleum and gas fields.
- Health and Life Sciences - Leader in the industry and excellent research structure and skilled labor, São Paulo is home to 38% of life science companies and 71% of the pharmaceutical industry in Brazil, and 53% of people working in sector.
- Financial Services - São Paulo concentrates more than 31% of banks and 32% of loans in Brazil. The state capital is home to the BM & Bovespa, one of the five largest in the world stock exchanges in the world.

- Information and Communication Technology - Being the largest pole of information and communication technology (ICT) in Brazil, São Paulo concentrates 41% of the national computer equipment industry, as well as a wide range of services focused on computers, tablets and smart phones.

As the most populous state in Brazil, the state had an estimated population of 44,8 million in August 2016, according to the Brazilian Institute for Geography and Statistics. São Paulo is the third most populous political unit of South America, only surpassed by that country and Colombia, ahead of all other South American countries. São Paulo's capital city is ranked twelfth among the largest cities on the planet and its metropolitan area, with 20,935,204 inhabitants, is the ninth largest in the world and second in the Americas after Greater Mexico City. São Paulo's capital city is ranked twelfth among the largest cities on the planet and its metropolitan area, with 21.1 million inhabitants in 2015 was the ninth largest in the world and second in the Americas after Greater Mexico City.

Regions near the city of São Paulo are also metropolitan areas, such as Campinas, Santos, and São José dos Campos; other nearby cities include urban areas such as Santo André, São Bernardo do Campo, São Caetano do Sul, [Diadema](#), [Piracicaba](#), [Guarulhos](#), [Osasco](#), [Taboão da Serra](#), and [Jundiaí](#). The total population of these areas coupled with the capital – the so-called Expanded Metropolitan Complex – exceeds now exceeds 30 million inhabitants, i.e. approximately 67.1% of the population of São Paulo statewide. The metropolitan regions of Campinas and São Paulo together have a population of 24.2 million and now form the first macro-metropolis in the southern hemisphere, joining 65 *municípios* that together are home to 11.7% of the Brazilian population.

The State of Bahia

The state of Bahia is the southernmost state in the Northeast Region, bordering the Atlantic Ocean on the East; Alagoas, Pernambuco, and Piauí on the North; Tocantins and Goiás the West and Minas Gerais and Espírito Santo to the South (Figures 1 and 2).

Figure 1: Political Map of Brazil

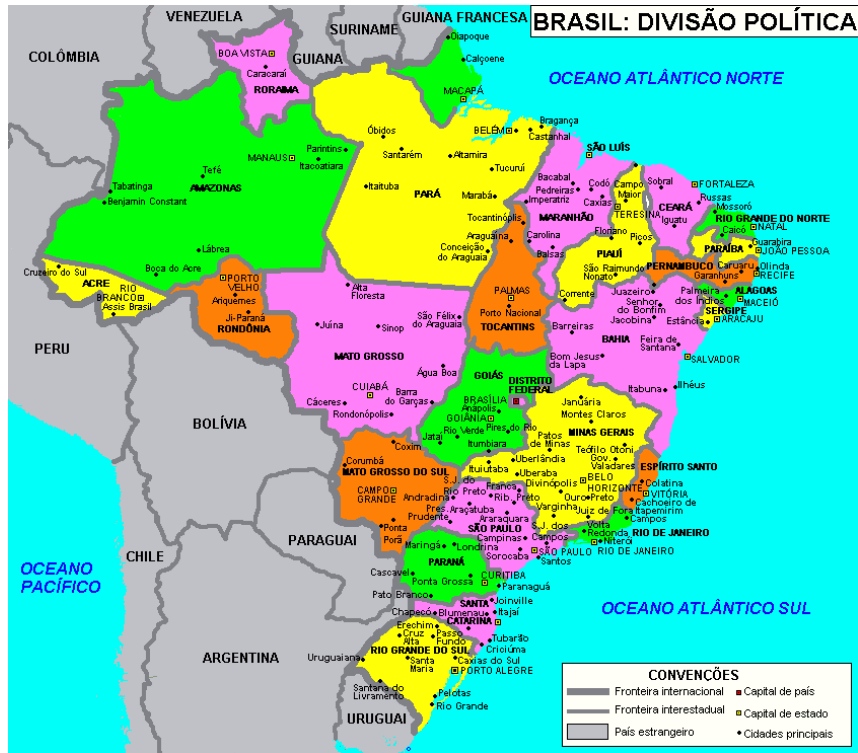


Figure 2: Map of Bahia



Bahia occupies an area of 564,733 square kilometers, a little more than France, and is the largest state in the Northeast Region of Brazil. The state’s estimated population in 2016 is 15.3 million living in 417 *municípios*. Bahia’s estimated per capita GDP was about US\$6214 in 2011, 53% of the national average. Bahia's geographical regions comprise the Atlantic Forest (including the cocoa producing region centered on Itabuna); the maritime region (*Recôncavo*) radiating from the Bay of All Saints (*Bahía de Todos os Santos*), the site of sugar and tobacco cultivation; and the *Planalto*, which includes the *sertão* region of Bahia's far interior. The state is crossed from north to south by the Diamantina Tableland (*Chapada Diamantina*), which divides it into two distinct geographical zones. To the east, the soil is fertile and the rain falls regularly. The western area is more arid, and it’s predominate vegetation savanna (*cerrado*). Bahia’s semi-arid region is the largest in Brazil and this area has a great potential for developing renewable energy sources (wind and solar).

Bahia’s GDP is Brazil's fifth largest. The state's economy is diverse, including agricultural activities, industry, mining, tourism and services.

In agriculture Bahia stands out nationally as producer of cocoa, sisal, castor, coconut, beans and cassava. Near Ilheus and Itabuna conditions are favorable for cocoa production, helping to preserve Brazil’s Atlantic Forest. Bahia is the sixth largest livestock producing state in Brazil. Recently the state has been emerging as a major soybean producer. The state also has a diverse agro–industrial system, which encompasses a wide range of products, such as soybeans, coffee, corn, rice, cotton sugarcane, beans, sorghum, fruits, grapes, wines, eucalyptus, beef, milk and dairy products.

In extractive activity, specifically in mining, the state produces petroleum, natural gas, gold, copper, magnetite, chromite, rock salt, barite, magnesium, lead and talc. Bahia’s economic potential is supported by an energy supply with approximately 80% of renewable origin: hydroelectric plants, wind power and solar power. There are 8 hydroelectric plants, 5 thermoelectric plants, 170 thousand km of electricity grid, and 286 power substations installed in the state. The seven hydro power stations on the São Francisco River have a capacity of 6,849 MW), wind (Bahia is the second largest producing state in Brazil, and solar (the largest solar energy generation in Latin America is scheduled to enter operation in 2017).

Bahia has the largest industrial and integrated petrochemical complex in the southern hemisphere – the Industrial Hub of Camaçari. Located 50 Km from Salvador, it is composed of more than 100 companies in electric power, chemicals, petroleum, petrochemicals, automobiles, textiles, metallurgy, pulp, copper, beverages, and services.

Tourism is an important activity, based on the state’s impressive colonial architecture, Afro-Brazilian traditions, Salvador’s colorful carnival and two National Parks.

In addition to good road, rail, ship, and air transport facilities, Bahia is crisscrossed by fiber optic networks built by major telecommunications companies (Figure 3).

Figure 3: Fiber optic backbones of four major telecommunications companies



Source: Governo do Estado de Bahia: *Bahia Brasil*

The city of Goiânia

Goiânia is the capital of Goiás and is located in the center of the state (Figure 3). Goiânia occupies an area of 739 square kilometers, and had an estimated population of 1.4 million in 2015, and is the center of a metropolitan area of 2.3 million. Goiania is the second-largest city in the Central-Western Region and the 13th-largest in the country. Its metropolitan area has a population of 2,063,744, making it the 11th-largest in Brazil. Goiânia is a planned city founded on October 24, 1933 by then Governor Pedro Ludovico to serve as the new state capital and administrative center. Before this, the state capital was the town of Goiás.

Figure 3: Map of Goiânia



The original plan of Goiânia was designed only for a population of 50,000. Before this, the state capital was the town of Goiás, also known as Goiás Velho. Goiânia is the second most populous city in Brazil's Midwest, only surpassed by the country's capital Brasília, and is an important economic hub of the region's economy that is dominated agriculture and agro-industry. The city is considered a strategic center for such areas as industry, medicine, fashion and agriculture.

The structure of Goiânia's municipal government is shown in Figure 4. The Secretariat of Government is shown in the second row below the Mayor (*Prefeito*). The first row includes the Mayor's Chief of Staff (*Chefe de Gabinete*) advisory units.

The state of Pernambuco

Pernambuco is located in Brazil's Northeast Region, bordering the Atlantic Ocean on the East; Paraíba and Ceará on the North; Piauí to the West and Pernambuco and Alagoas on the South (Figures 1 and 2). The archipelago of Fernando de Noronha (Figure 3), located 543 km (220 miles) to the Northeast of the state capital, Recife, is also a state district (*distrito estadual*) of Pernambuco.

Figure 1: Political Map of Brazil

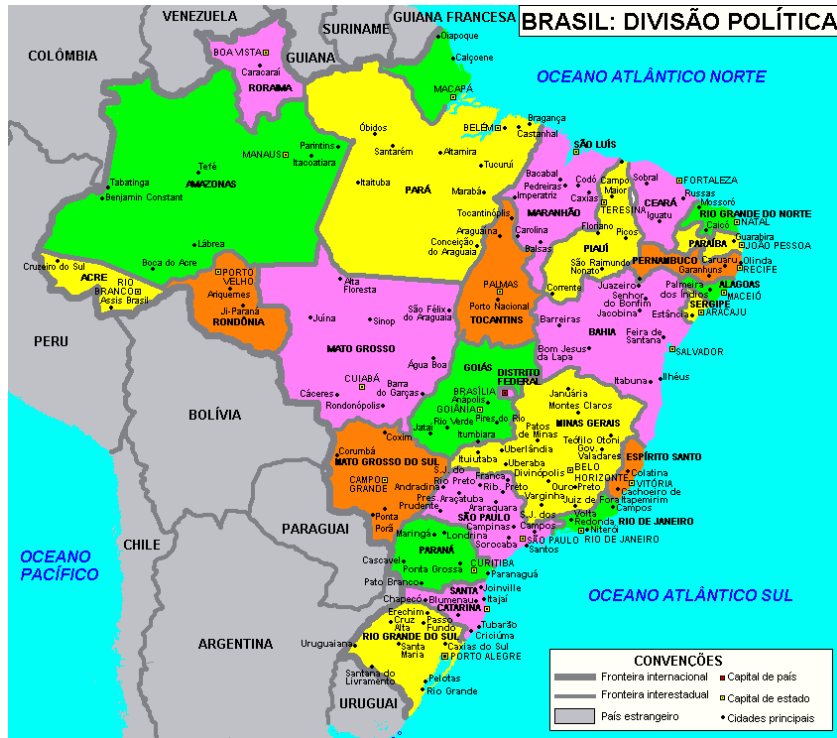


Figure 2: Map of Pernambuco



Figure 3: Archipelago of Fernando de Noronha



Pernambuco occupies an area of 98,312 square kilometers, a little more than South Korea or Portugal. The state’s estimated population in June 2016 is 9.4 million living in 185 *municípios*, including Fernando de Noronha.

Pernambuco’s GDP in 2013 Brazil's eighth largest, and its per capita GDP US\$6,048, about 58% 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.

The economy is based on agriculture (sugarcane, manioc), livestock raising, as well a growing industrial sector (ICT, shipbuilding, automotive, chemical, metallurgical, electronic, textile, food processing).

Pernambuco’s capital, Recife, is part of a metropolitan area with a population of 3.9 million in 2015, 41% of the state’s population. The Recife metropolitan area is the dynamic center of the state’s economy, having important medical, education and ICT poles and the Industrial Port Complex of Suape, mainly linked to the oil sector, gas, offshore and shipbuilding. It has two ports - Recife and Suape - and the Guararapes International Airport Gilberto Freyre.

Recife has an ICT a technology park known as the Digital Port (*Porto Digital*). The *Porto Digital* is home to 250 businesses, development organizations, and government agencies employing some 7,100 highly skilled professionals, of whom 500 are entrepreneurs. It has two incubators, two business accelerators, and two associated research institutes as well as associated service organizations and government offices. It also has an institution of higher education, The Center for Studies and Advanced Systems of Recife (*Centro de Estudos e Sistemas Avançados do Recife* – CESAR) twice chosen as the best science and technology institution in the country. Since the end of 2014 it also has branches operating in the cities of Caruaru and Petrolina, located respectively in the *agreste* and *sertão* regions.

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

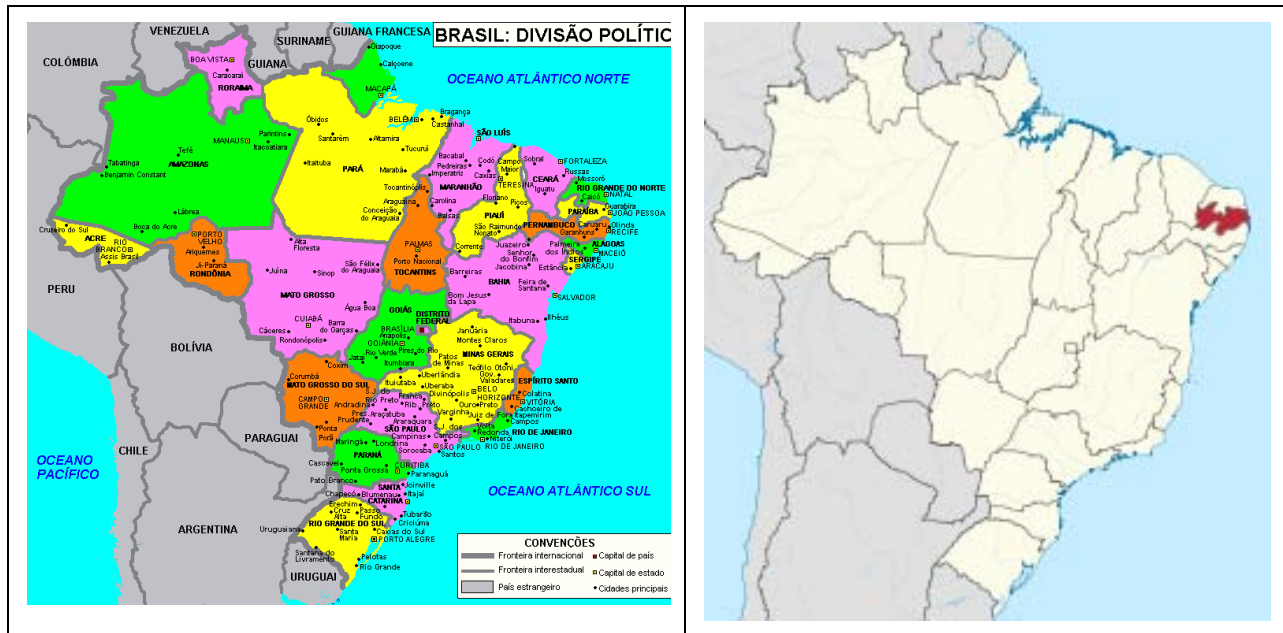


Figure 2: Map of Paraíba



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 2013.

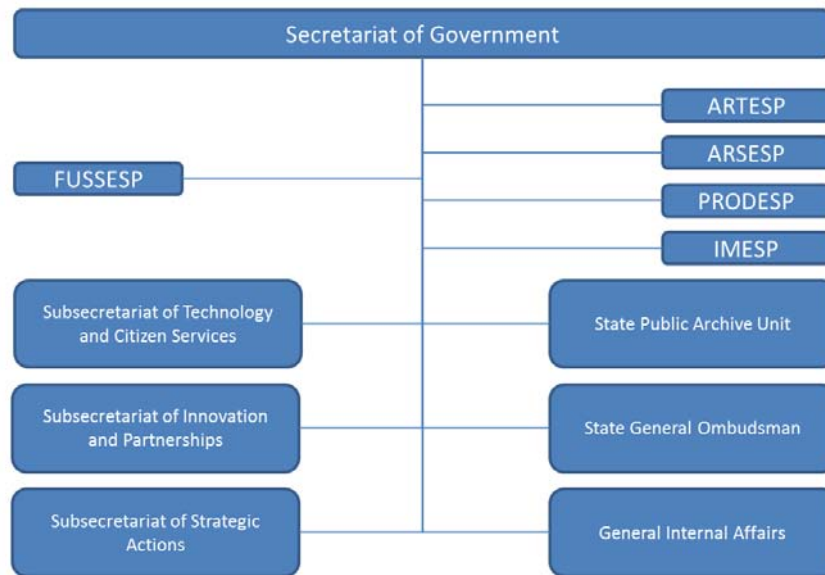
Paraíba's capital, João Pessoa, is at the center of a metropolitan area including 12 *municípios* with a population of 1.2 million in 2015, 31% of the state's population. The João Pessoa metropolitan area is the dynamic center of the state's economy, having important medical, education poles and the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

IV. The Recommended Projects

São Paulo State Secretariat for Government, Sub-Secretariat for Technology and Citizen Services (STSC/SG/SP)

The Secretariat for Government is a body responsible for coordinating the high-impact projects, work and state services, as they almost always require the involvement of more than one Secretariat and/or entity. In such cases, the relationship between the various sector entities, either at the time of conception or execution of the projects, is essential to the success of government action. The secretariat seeks to stimulate a dynamic relationship between agencies and entities involved in major projects of the São Paulo government, aligning agendas, expectations, needs and duties of all stakeholders, with a view to a organizing fully integrated government actions. Among its responsibilities are to coordinate projects considered as strategic by the State Public Administration, public service concessions, public-private partnerships (PPP), partnerships with social organizations and programs involving innovation in government and technology services to the citizen. The structure of the secretariat is shown in Figure 3.

Figure 3: Structure of the São Paulo State Secretariat of Government



The Sub-secretariat of Technology and Citizen Services promotes intensive use of new information and communication technologies (ICT) seeking improvements in administrative efficiency, increased quality in the provision of public services, transparency, and cost reduction. This leveraging of ICT has been one of the priorities of the State of São Paulo, which concentrates its efforts on new ways to meet and interact with the citizen without his need to travel and queuing. The search for technological and innovative solutions has focused on better service to the citizen includes the integration of databases so that society perceives the government as a connected system capable of simplifying the relationship and meet your needs quickly and efficiently. The technological expansion in the public service takes into account the best corporate governance practices, to ensure the security of information systems without interruption risk and without increasing the cost of government services.

The sub-secretariat aims to encourage the use of ICT in providing services to better meet the needs of users within the government, in businesses, and residents of the state. It oversees the *Poupatempo* program that brings together, in one place various public services, provided within a high standard of quality (there are 71 of these centers around the state) and the *Acessa São Paulo* program, which provides citizens in 600 of the state’s 645 *municípios* with access to new information and communication technologies (ICTs), especially the Internet, contributing to the social, cultural, intellectual and economic development of citizens. To achieve its objectives, the *Acessa São Paulo* has 850 public spaces with computers for free access and free Internet service.

STSC/SG/SP seeks technical assistance for an international consultancy financed by USTDA to develop detailed plans to:

1. Optimize the resources already employed in the creation and operation of existing state data centers;
2. Increase the redundancy, fault tolerance, security, and ability to recover from disasters of state government data centers by integrating, consolidating, and/or upgrading the existing

- São Paulo state data centers;
3. Provide the necessary connectivity to achieve the above-stated objectives and improve the quality of e-government services to government units (G2G), private sector businesses (G2B and B2G), and citizens (G2C and C2G);
 4. Identify potential partners to undertake the needed investments for carrying out the project; and
 5. Help develop the basis for bidding documents to select private sector partners for implementing the project.

São Paulo State data centers

The Government of São Paulo State (*Governo do Estado de São Paulo* – GESP) owns a number of data centers located at various departments and agencies, to support its systems and services, for the purpose of offering citizen services as well as hosting software for internal use.

Some of these data centers have high capacity and availability, such as those of the São Paulo State Data Processing Company (*Companhia de Processamento de Dados do Estado de São Paulo* – PRODESP) located on the city of Taboão da Serra, the Secretariat of Finance (*Secretaria da Fazenda* – SEFAZ/SP), and the one from the Military Police (*Polícia Militar do Estado de São Paulo* – PMESP), the last two located on the center of São Paulo city. The H&A consultants visited these three data centers.

Even though they have high tolerance to faults and provide government entities an excellent platform for hosting data and software, the main data centers of the state do not integrate between themselves, which could leave some of the systems down in case of a disaster in one of the data centers. Besides, the idle resources in each of them could be better used if some form of sharing were established.

The GESP also has tens of other data centers and server rooms of various sizes that it seeks to integrate and consolidate with the main data centers. These datacenters – varying greatly in size, security, and degree of equipment obsolescence use more than 600 servers (many of them outdated and lacking adequate capacity to meet rapidly increasing demand and lacking adequate security and monitoring tools) to meet the needs of the 25 State Secretariats various other São Paulo state agencies such as the Transportation Department (*Departamento de Trânsito* – DETRAN) and State Hospitals, Technical Schools, and the São Paulo Metro.

Therefore, this project intends to integrate the various data centers throughout the state and consolidate the smaller data centers and server rooms, with the larger data centers. The aim here is optimize the resources already employed in the creation and operation of these centers, and significantly raise the redundancy of the systems used by the government, as well as their fault tolerance and ability to recover from disasters.

PRODESP

PRODESP's data center serves multiple clients; in physical and virtualized servers and some co-located servers using PRODESP's vault rooms and connectivity. It is the largest data center in the São Paulo state public sector and is located in a 28,000m² building housing all of PRODESP's offices on a 150,000 m² campus in Taboão da Serra, about an hour's drive from the center of São Paulo city. This modern data center has:

- 3 ASECO-built vault rooms with serving different purposes;

- 1. Robotic tape storage and virtual servers, 132 m²
- 2. Mainframes, storage and robotic tape storage, 141 m²
- 3. Telecommunications equipment, 325 m²
- a total data center area of 800 m²;
- backup capacity of 6.6 petabytes, provider: Storagetek/Oracle;
- IBM z13 mainframe with 66 virtual servers in zLinux environment;
- Unisys Platform; 600 servers with Intel/AMD architecture (3,147 servers – 547 physical, 2,600 virtual), major suppliers of Intel technology are Dell, HP, Itautec, Oracle/Sun and Novadata;
- Hitachi and EMC storage units with 1.1 petabyte capacity;
- Power Plant: 6000 KVA;
- Modern fire control, refrigeration, UPS, and backup diesel power station;
- Connectivity via the São Paulo INTRAGOV leased line network (contracts are re-negotiated every five years and is currently with Telefônica and Embratel) that reaches all the state's 645 *municípios* via 17,033 leased links ranging from 16 kbps to 40 Gbps (The highest-speed link is used to interface INTRAGOV with the Internet). Telefonica is responsible for the all links and their redundancies;
- The Backbone is a Cisco Nexus 7000, capacity of 10 Gbps;
 - 400 regular employees plus some 100 outsourced staff; and
 - Four ISO certifications: 9001, 27001, 20000 and 14001.

PRODESP has no separate backup data center that appears to be the principal security issue that needs to be addressed by this project. This is key if the smaller data centers and server rooms from various state entities are to be consolidated in the PRODESP data center. One possibility would be backing up the most sensitive data in another existing data center, such as that of the Secretariat of Finance (SEFAZ) described below. Another might be to use public cloud service providers such as Microsoft's Azure, Amazon Web Services (AWS), and Google Cloud Services.

PRODESP runs a private cloud serving various state agencies including DETRAN, the *Poupatempo* integrated citizen service centers (70 around the state), the Civil Police, and almost all other Secretariats and is considering putting some of its less sensitive data using public cloud services. PRODESP replaces most of its hardware on a three-year cycle except for storage hardware, which is on a five-year cycle and software on a three-year cycle. The annual CAPEX is about R\$80 million (US\$23 million). It is shared almost equally between software, hardware and local software development. The majority of the IT equipment and software comes from US firms. PRODESP maintains standing agreements with US firms such as Microsoft, IBM and Oracle.

PRODESP sees its major challenges as

- Making greater use of outsourced cloud services,
- Increasing the number of servers and storage capacity,
- Implementing hyper-converged systems,²

² Hyperconvergence is a type of infrastructure system with a software-centric architecture that tightly integrates compute, storage, networking and virtualization resources and other technologies from scratch in a commodity hardware box supported by a single vendor. Hyper-convergence grew out of the concept of converged infrastructure.

- Establishing policies for data center consolidation,
- Reducing costs, and
- Upgrading connectivity.

The proposed USTDA-funded consultancy would provide technical assistance to address these challenges.

The Secretariat of Finance (SEFAZ/SP)

SEFAZ/SP has a very sophisticated system of data centers, with a principal one with ASECO-built vault room (350 m²) and 70 m² more in the data center, all located in the SEFAZ/SP building in the center of São Paulo and a second major one serving as a backup in the city of Campinas, also with vault room 144 m². There are 110 physical servers in the São Paulo vault room, 70 in the São Paulo data center outside the vault room, and 110 in Campinas. Together the data centers employ 220 people. SEFAZ replaces the storage equipment every five years and replaces the other equipment every three years. SEFAZ is already exploring the use of cloud solutions by firms such as Microsoft, Google, and Amazon and the proposed consultancy could help support this effort. The SEFAZ budget for 2016 is R\$ 295 million, 24% used in software and 28% to acquire hardware, the remaining is mostly used in IT services.

The São Paulo Military Police (PMESP)

PMESP has a modern data center located in central São Paulo. It has an area of 191 m² with 40 servers, uses mainly US hardware running software from US suppliers including Microsoft and Oracle, and employs 21 police officers and 36 contract personnel. In its control center (*Central de Operações da Polícia Militar – COPOM*) are personnel responding to 911 calls and dispatching vehicles. This Control Center is highly integrated with systems running in the Datacenter to allow a quick response to the police operation (Figure 5).

The Secretariat for Science, Technology and Innovation of the State of Bahia (*Secretaria de Ciência, Tecnologia e Inovação do Estado da Bahia - SECTI/BA*)

SECTI/BA is a Secretariat of the Government of the State of Bahia and is responsible for elaborating and implementing policies in the areas of science, technology and innovation, including those for the Bahia State Broadband Project.

The Bahia State Data Processing Company (*Companhia de Processamento de Dados da Bahia - PRODEB*)

Prodeb is a public company operating under private sector law (*empresa pública de direito privado*). It was founded as a public/private company (*Sociedade de Economia Mista* with majority state control. In July 1987, as specified in state Law 4,697, PRODEB became part of the Bahia State Secretariat of Administration.

Under the converged infrastructure approach, a vendor provides a pre-configured bundle of hardware and software in a single chassis with the goal of minimizing compatibility issues and simplifying management. If required, however, the technologies in a converged infrastructure can be separated and used independently. The technologies in a hyper-converged infrastructure, however, are so integrated that they can not be broken down into separate components. See <http://searchvirtualstorage.techtarget.com/definition/hyper-convergence>. Accessed May 29, 2016.

PRODEB's mission is to provide Information and Communications Technology solutions to modernize and improve governmental management and relations with society. The Chairman of its Board of Directors (*Conselho de Administração*) is the Bahia State Secretary of Administration and the Board includes the State Secretary of Science, Technology and Innovation.

PRODEB is a corporation of mixed economy that is independent of the state treasury funds to pay their personal expenses or cost in general. The resources for its operation come from the billing service. Currently PRODEB's annual revenue is on the order of R\$ 100 million. Providing its services requires constant investment in technological updating and management, which implies continued investment of both its own resources and capital contributions made by the State of Bahia, its main shareholder. PRODEB's new business plan establishes a markup of approximately 5%, over the cost of all services provided by the company to generate resources for investment in priority projects.

The Project

The Government of the State of Bahia seeks technical assistance for an international consultancy financed by USTDA to develop detailed plans to:

1. Extend the existing Bahia hybrid fiber/wireless public broadband network to reach all 417 *municípios* in Bahia, to offer (a) Internet connectivity to all government offices in the state (including schools, health clinics, fiscal posts, and police stations, and telecenters), (b) wholesale internet connections to small and medium internet service providers (ISPs) so that they can increase the population's access to broadband internet, (c) e-government services to the entire population of the state through telecenters and schools as well as commercial ISPs. This subproject to be executed by the Bahia State Secretariat for Science, Technology and Innovation – SECTI/BA), a secretariat of the Government of the State of Bahia.
2. Upgrade the equipment of the PRODEB's data center and design and equipping of a backup data center. This subproject would be executed by PRODEB.
3. Design an improved integrated and interoperable eGovernment system and (*Projeto de eGov – Cidadão 360º*) and a digital transformation strategy making use of the upgraded Prodeb data center and the statewide broadband network. This subproject would be executed by Prodeb.

The Bahia State Broadband Project

Bahia considers the intensive use of information technology as a strategic tool for economic and social development and improving the quality of education in the state of Bahia. The objective of this subproject is to expand the horizons of the state and the citizen, democratizing access to the media and communication, generating improvements to teaching and opportunities for economic and social development.

The project includes two principal lines of action:

1. Bringing Bahia's population closer to the government, establishing a two-way communication process. Improved e-government services should improve public access to government services and provide greater transparency to public management.

2. Facilitating the digital inclusion of Bahia’s population by connecting connect all 417 *municípios* in Bahia through a high-speed broadband network.

Once the subproject 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.

This project also has a social objective. The population will gain access to broadband Internet connectivity, allowing every citizen to have free access through public telecenters and schools. At the municipal level, priority will be given to population groups with the lowest Human Development Index (HDI).

To achieve the Broadband project objectives, it will be necessary to build a digital superhighway that allows efficient exchange of information. For this it is necessary to build a high performance network infrastructure based on state-of-the-art technology, allowing the exchange of information in various formats and for multiple purposes. A public-private partnership (PPP) model of financing is proposed, whereby a private enterprise or consortium of private enterprises would bid to construct the network.

A hybrid fiber and wireless data network should reach all Bahia’s 417 *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.

In pursuit of greater effectiveness and better efficiency, this subproject intends to work with existing federal government projects such as the National Program for Educational Technology – ProInfo, One Computer per Student (*Um computador por Aluno – UCA*), the e-Tec Brasil program that offers technical courses using distance education, and Technological Vocational Centers (CVT), such as the Digital Towns (*Cidades Digitais*), Smart Brazil (*Brasil Inteligente*) and Technological Vocation Centers (*Centros Vocacionais Tecnológicos*).

SECTI/BA is responsible for implementing this subproject, the more specific objectives of which are to:

- Promote and disseminate the use and supply of goods and ICT services, in order to democratize access to information;
- Promote digital inclusion by helping to reduce socioeconomic inequalities and to promote the generation of employment and income and thus accelerate economic and social development;
- Expand the eGovernment services and facilitate citizens' use of state services such as health, education, security, culture, economy;
- Promote the training of the population for the use of information technology;
- Increase Bahia’s capacity for innovation, technological autonomy and competitiveness;
- Facilitate interaction between educational and research institutions in the interior and the capital, giving greater dynamism to research, and thus contribute to encouraging researchers to remain in their *municípios* and increase scientific production in those *municípios*;
- Improve public safety by facilitating the transmission of surveillance camera images;

- Strengthen telemedical services like transmitting (MRIs, CAT scans, Xrays, etc.) and videoconferences for consultation with medical specialists;
- Increase the availability of distance training for training public school teachers, as well as allow students to benefit from access to updated content;
- Increase provision of Internet services to citizens and the business community.
- Better the performance of public administration through integration of state secretariats and agencies;
- Improve access to government enterprise systems;
- Improve communication between public officials and between the public and public agencies;
- Reduce communication costs;
- Improve access to the Internet in schools and telecenters;
- Interconnect schools;
- Facilitate creation of public communication services in *municípios*, such as blogs, online radio and newspapers;
- Create and deploy virtual libraries;
- Use distance education for supplementing existing means of education; and
- Disseminate information about and interactive participation in cultural and scientific activities;

SECTI/BA seeks to extend its existing broadband network to reach all 417 *municípios*, using a combination of optical fiber and radio links. A fiber backbone would link major regional pole cities with fiber or radio backhaul links to the remaining *municípios*, and last-mile extensions to points of interest to the state, such as estate educational and health units, citizen service centers (*Serviço de Atendimento ao Cidadão – SAC*), and telecenters), police stations, re-socialization centers, electronic surveillance points (e.g. video monitoring cameras, and decentralized Secretariat of Finance units, among others.

CPFL ENERGIA (Formerly Companhia Paulista de Força e Luz)

CPFL ENERGIA is one of two private electric power companies operating in the state of São Paulo. Its territory is the entire state with the exception of the São Paulo metropolitan area, served by AES Eletropaulo (Eletropaulo Metropolitana - Electricidade de São Paulo S.A.). Founded over 100 years ago, CPFL ENERGIA became a complete power company with businesses in distribution, generation, sale of electricity and services. Today, it is one of the largest companies in the Brazilian electric sector. It delivers power to nearly 20 million customers and is leading the renewable energy segment in Brazil with a diverse array of power sources: large and small hydroelectric power plants, wind farms, biomass plants, thermo-electric plants using fuel oil, and more recently, the first solar power plant in the state of São Paulo. CPFL ENERGIA also is conducting conservation and awareness programs on the efficient use of electric energy, investing in smart grids, electric urban transport, city management technologies, and more.

THE PROJECT

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

1. Expand a growing fiber optic network based on optical ground wires (OPGW) hung from

- CPFL’s transmission towers;
2. Identify potential partners to share in the investment and operating costs of the network through the exchange or rental of dark fiber and/or infrastructure (poles, ducts, cabinets, etc.); and
 3. Develop a business plan for building and operating the network at minimum cost to CPFL.

In its concession area in the state of São Paulo, CPFL ENERGIA has power transmission lines that form a large ring, with an approximate length of 1300 km, where OPGW cables can replace lightning rod cables, forming a high-capacity fiber optic backbone.

CPFL ENERGIA seeks to develop a business model that enables the commercial exploitation of this backbone, with the application of third-party resources, respecting the rules of granting the power sector and ensuring the use by CPFL ENERGIA for its operation.

Since the year 2000 CPFL ENERGIA has been planning to construct an OPGW backbone, holding initial discussions with Embratel and Eletronet to partner in this project. These negotiations fell through, and the project remained dormant until in 2011 CPFL ENERGIA began negotiations with TIM as a new partner for a 1,200 km OPGW ring (Figure 3) that would use CPFL’s transmission towers to hang OPGW cables that would replace existing ground wires. But the project did not go forward because the electric power regulator (*Agência Nacional de Energia Elétrica – ANEEL*) determined that CPFL ENERGIA could not use the investment costs of the optical backbone in determining its rate base. The argument was that the power consumers would be forced to pay for investments not directly related to electric power. The problem is that telecommunications it is not the core business of CPFL ENERGIA, and the risk of CAPEX not be recognized is very high. As for the telecom operators, the issue is the matter of timing. Other investments were prioritized.

The city of Goiânia

Goiânia is the capital of Goiás and is located in the center of the state (Figure 3). Goiânia occupies an area of 739 square kilometers, and had an estimated population of 1.4 million in 2015, and is the center of a metropolitan area of 2.3 million. Goiania is the second-largest city in the Central-Western Region and the 13th-largest in the country. Its metropolitan area has a population of 2,063,744, making it the 11th-largest in Brazil. Goiânia is a planned city founded on October 24, 1933 by then Governor Pedro Ludovico to serve as the new state capital and administrative center. Before this, the state capital was the town of Goiás.

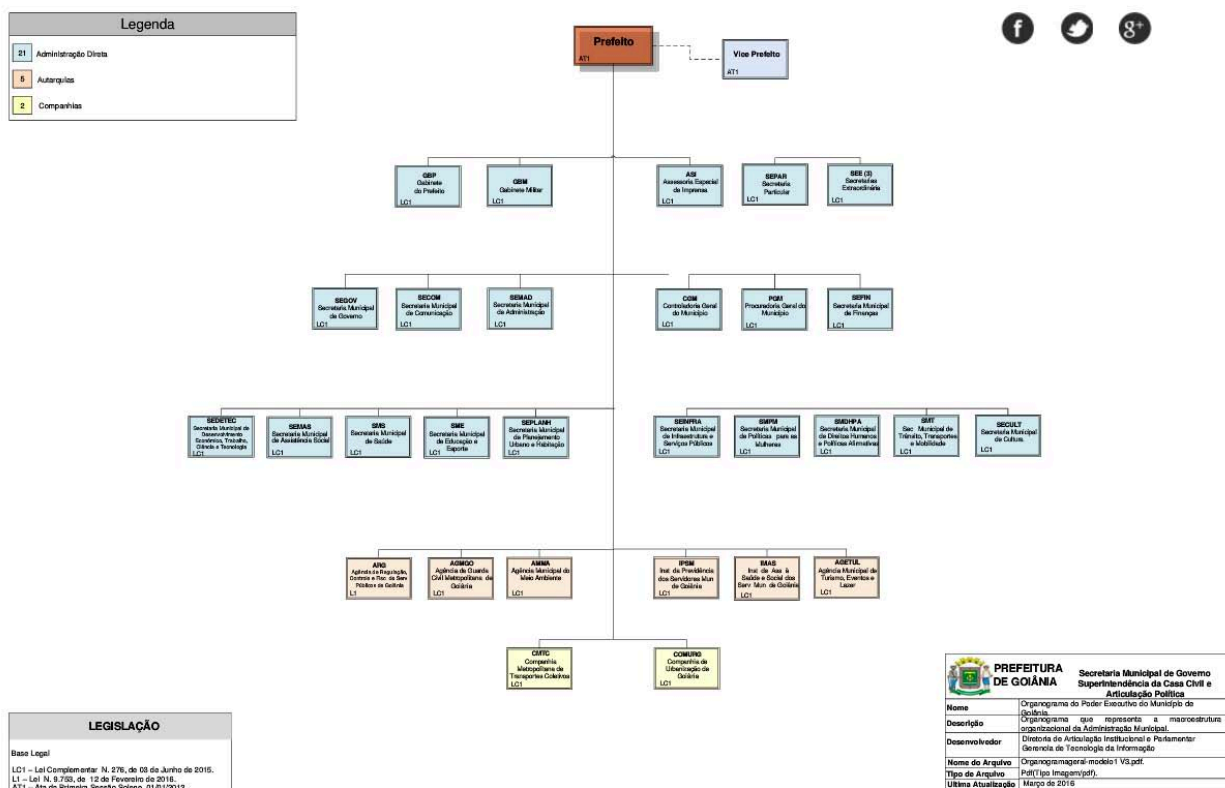
Figure 3: Map of Goiânia



The original plan of Goiânia was designed only for a population of 50,000. Before this, the state capital was the town of Goiás, also known as Goiás Velho. Goiânia is the second most populous city in Brazil's Midwest, only surpassed by the country's capital Brasília, and is an important economic hub of the region's economy that is dominated agriculture and agro-industry. The city is considered a strategic center for such areas as industry, medicine, fashion and agriculture.

The structure of Goiânia's municipal government is shown in Figure 4. The Secretariat of Government is shown in the second row below the Mayor (*Prefeito*). The first row includes the Mayor's Chief of Staff (*Chefe de Gabinete*) advisory units.

Figure 4: Structure of the Goiânia Municipal Government



Source: <http://ptdocz.com/doc/1576101/organograma---prefeitura-de-goi%C3%A2nia> (Accessed May 27, 2016)

The GMG has been interested in technologies to manage the pressures occasioned by rapid economic and population growth. In 2012 Michael Flaxman of MIT’s GIS department did a preliminary study of Goiânia using Landsat images collected over a 25-year period (1985-2010). The study warned the government about the urgent need to take measures to avoid disorderly occupations that can lead to degradation of natural resources with negative impacts on water supply sources in the areas of permanent environmental preservation and even in the economic development and competitiveness of the city. It was clear to the GMG that the city needed to improve the quality of services and at the same time deal with increasingly scarce resources. Expanding the use of technology to communicate and to manage the city was one of the chosen paths. An example was the implementation of a GIS (Geographic Information System), which contains dozens of geo-referenced information layers and supports not only the city’s planning but also routine activities such as authorizing the opening of a company or approving a new development. In 2011, Goiânia was selected by the Inter-American Development Bank’s (IADB) Emerging and Sustainable Cities Initiative (ESCI)³ as one of five pilot cities in Latin America to be studied using a two-stage methodology:

³ See <http://www.iadb.org/en/topics/emerging-and-sustainable-cities/cities-using-a-sustainable-urban-development-approach.6693.html> (Accessed May 27, 2016).

Stage one began by executing a rapid diagnostic tool to identify the sustainability challenges of a city. Afterwards, topics (i.e. water, air quality, transparency, etc.) are prioritized through the use of multiple filters – environmental, economic, public opinion and sector specialist expertise – to identify issues that pose the greatest challenges in a city’s pathway towards sustainability. Finally, an Action Plan is formulated, containing prioritized interventions and a set of strategies for their execution across the short-, medium- and long-term.

In stage two, the execution phase began with the preparation of pre-investment studies for prioritized interventions and the implementation of a citizen monitoring system.⁴

ESCI’s methodology is “based on the premise that urban development strategies that are well-planned, integrated, and cross-sectoral, can ensure improvements in the quality of life for citizens and help materialize a more sustainable, resilient, and inclusive future for emerging cities in Latin America and the Caribbean.”⁵

The Coordination Unit for the Sustainable Goiânia Action Plan (*Unidade de Coordenação do Plano de Ação Goiânia Sustentável* - UPCA), located in the Secretariat of Government was established in April 2013 in response to the IADB interest in Goiânia.

The project the DM was charged to review was for a Sustainable Cities Initiative, including an Integrated Operations and Control Center. The DM consultants Judith Hellerstein & Peter Knight met with the Goiânia municipal government officials in charge of special projects to review their potential projects. Within this department there is a special Coordination unit in charge of implementing the action plan for a Sustainable Goiania. One of the projects coordinated by this unit has elements of a Smart City.

A smart city is a vision to integrate multiple ICT solutions in a secure fashion to manage a city’s assets – the city’s assets include local departments information systems, schools, libraries, transportation systems, hospitals, power plants, water supply networks, waste management, law enforcement, and other community services. The goal of building a smart city is to improve quality of life by using technology to improve the efficiency of services and meet residents’ needs. ICT allows city officials to interact directly with the community and the city infrastructure and to monitor what is happening in the city, how the city is evolving, and how to enable a better quality of life. Through the use of sensors integrated with real-time monitoring systems, data are collected from citizens and devices - then processed and analyzed. The information and knowledge gathered are keys to tackling inefficiency.

ICT is also used to enhance quality, performance and interactivity of urban services, to reduce costs and resource consumption and to improve contact between citizens and government. Smart city applications are developed with the goal of improving the management of urban flows and allowing for real time responses to challenges. A smart city may therefore be more prepared to respond to challenges than one with a simple 'transactional' relationship with its citizens.

Smart cities make more efficient use of physical infrastructure (roads, built environment and other physical assets) through artificial intelligence and data analytics to support a strong and healthy economic, social, cultural development. They do this by engaging with citizens in local

⁴ See <http://www.iadb.org/en/topics/emerging-and-sustainable-cities/implementing-the-emerging-and-sustainable-cities-initiative-approach.7641.html> (Accessed May 27, 2016).

⁵ Ibid.

governance and decision making by using open data applications, improving the collective intelligence of the city’s institutions through e-governance, citizen participation and co-design.

ICT is also used for cities to make more efficient use of their physical infrastructure (roads, built environment and other physical assets) by using artificial intelligence and data analytics to support a strong and healthy economic, social, cultural development.

The GMG seeks technical assistance for an international consultancy financed by USTDA to

1. Determine global best practices in the six (or more) technologies currently envisioned for use in the IOCC
2. Review existing project documentation for possible updating of technologies and addition of new components, e.g.
 - a. Traffic control and possibly a system of automatic RFID-based real-time, possibly variable, tariffs for congested areas of the city,
 - b. Adaptation of project data collection and analysis components for open data, encouraging development of applications using this data by private sector, public sector, and civil society entities,
 - c. Enhanced e-government system for internal government use and interaction with citizens,
 - d. Visual dashboard and situation rooms
 - e. Use of drones to collect information about zoning code violations, new buildings,
3. Undertake a full feasibility study for the project as re-defined from a project prepared in 2014 by a Korean team operating under an Inter-American Development Bank (IADB) program, and
4. Specify equipment and software needed and possible sources for acquisition thereof.

In 2012 an IADB team, working in collaboration with municipal government, completed and published a 67-page document entitled *Goiânia Sustentável: Plano de Ação* (Sustainable Goiânia Action Plan), thereby completing stage one of the methodology. This report prioritized five areas for interventions to improve areas of found to be problematic:

1. Public Transport and Urban Mobility
2. Competitiveness and Connectivity Modernization of Public Management - Management by results
3. Public Safety
4. Management of Urban Expansion
5. Disaster management and adaptation climate changes

The Action Plan for Goiânia included carrying out a variety of studies funded by the Ministry of Strategy and Finance (MOSF) of the Republic of Korea via the Korean Knowledge Sharing Program (KSP) of the Korea Export-Import Bank (KEXIM) in accordance to the Memorandum of Understanding (MOU) signed between the IDB and MOSF. These studies were developed by the Korea Research Institute for Human Settlements (KRIHS) and were supervised by IADB’s

Competitiveness, Technology and Innovation Division (CTI), and in collaboration with the Fiscal Municipal Management Division (FMM).

As a means of solving urban problems, later in 2012 the GMG opted to build a pilot Integrated Control Center and Operations (IOCC). That project focused on a basic design and implementation plans for transit, disaster prevention, and crime prevention.

Subsequently a group of consultants from the Republic of Korea visited Goiânia to execute a stage-two study⁶ using the IADB/ESCI methodology, producing a very detailed Request for Proposals (RFP) of the nine subsystems needed for the effective operation and management of IOCC system. These are:

1. IOCC Center System (CS)
2. Adaptive Traffic Signal Control System (ATSCS)
3. Advanced Traveler Information System (ATIS), unsuitable for USTDA
4. Automatic Enforcement System (AES), unsuitable for USTDA
5. Bus Information System (BIS)
6. Incident Management System (IMS)
7. Crime Prevention System (CPS), unsuitable for USTDA
8. Disaster Prevention System (DPS)
9. Network System (NS)

The report includes a detailed complete bidding document with five annexes listing detailed designs and lists of software and hardware, all prepared in accordance with IADB's Financial Management and Procurement (VPC/FMP) regulations. The components of the project that H&A is recommending for inclusion in a USTDA-financed feasibility study are summarized below making use of some of the figures in the report.

ATI

The Pernambuco State Information Technology Agency (*Agência Estadual de Tecnologia da Informação – ATI*) is a semi-autonomous agency (*autarquia especial*) linked to the Secretariat of Administration of the Government of the State of Pernambuco – (*Governo do Estado de Pernambuco - GEP*), and created in 2003 by Complementary Law 049/2003.

ATI is responsible for providing technical coordination to implement the Public Information Model established by the Information and Communication Technology System that has two basic two premises: coordinated management and decentralized operations that involve sharing and assuring interoperability of IT assets and ensuring the safety and quality of products and services, all with a view to rationalizing costs.

Accordingly, ATI 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. ATI is responsible for technical coordination of distributed data processing units called Sectoral Informatics Centers (*Núcleos Setoriais de*

⁶Republic of Korea, Design of the Technical Specifications for the pilot implementation of an “Integrated Operating Control Center” for the município of Goiania-Brazil (BR-T1281), with the contribution from the KPK - Knowledge Partnership Korea Fund for Technology and Innovation. Goiânia: BID and Prefeitura de Goiânia, September 2014.

Informática – NSIs) in state secretariats. All NSI staff are ATI employees.

The Multi-Year Plan (*Plano Plurianual* – PPA) for the period 2016-2019⁷, approved by the state legislature on 21 December 2015,

THE PROJECT

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

1. Review the recently-defined organization and management model of the ATI data center, based on cloud computing;
2. Help define the technology to be used to implement the cloud computing architecture;
3. Support implementation of a pilot project and full implementation of the ATI cloud;
4. Design and help implement a statewide broadband network to interlink all units of the GEP – both in the Recife metropolitan region and in the interior of the state in order to meet the demand for ICT throughout the state.

Upgrading the existing ATI data center and designing a backup data center design and implementation of an integrated and consolidated data center system based on cloud computing

The US consulting firm would conduct an evaluation of ATI'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 recently-defined organization and management model of the ATI data center, based on cloud computing;
- Estimate demand for data center services over the coming five years; and
- Assess the current capacity of ATI's own data center, the other principal state data centers and smaller server rooms (with special attention to the data centers of the Secretariats of Finance and Education) as regards its their services, its equipment, software and physical facilities.

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

The U.S. firm would then help ATI implement a pilot project serving as proof of concept for the new cloud computing based data center system architecture, and subsequently provide advisory services for the implementation of the full-scale project. ATI has a plan for upgrading the datacenter equipment to a state-of-the-art facility capable of serving forecast demand over the next ten years. It has a modern vault room constructed by Aceco located on its premises. It was

⁷ Governo do Estado da Pernambuco (2015). Lei do Plano Plurianual 2016-2019: Lei 15,703/2015

inaugurated in 2015 (Figure 6). Much of this equipment is either obsolescent or of insufficient capacity to handle expected demand, including cloud services to be made possible by the statewide Broadband PPP project that will provide reliable high-speed connectivity to state installations in both in Recife and the interior of the state.

CODATA

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 and was and created in 2003 by Complementary Law 049/2003.

Created to provide information and communications technology services (ICT) to centralized and decentralized organs of the State Public Administration, CODATA'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.

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).⁸

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;

⁸ 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.

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.

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

V. US EXPORT POTENTIAL

SAO PAULO

STSC/SG/SP has made a direct estimate of the amount of hardware and software that would be purchased from US suppliers under the data center consolidation project, considering investments in the PRODESP, SEFAZ/SP, PMESP, and minor data centers (Table 3). The total comes to US\$ 35.1 million, of which US\$ 23.8 million is software, US\$9.8 million hardware, and US\$1.6 million cloud services. For comparison, the annual CAPEX of PRODESP and SEFAZ/SP datacenters is running at R\$ 207 million (US\$ 65 million), and the entire state of São Paulo’s annual budget for hardware and externally purchased software totaled R\$ 768 million (US\$ 240 million).

It is extremely difficult to estimate the cost of the increase in capacity of the broadband network that would be required to meet the objectives specified above, since there are three options specified (build a new network, increase the capacity of the leased links from Telefônica, or some combination of the two) for achieving this objective. Determining how much additional network capacity will be needed would be one of the tasks of the US consultancy firm. But as a very rough and conservative estimate, PRODESP’s annual cost for leasing the INTRAGOV Network is approximately US\$ 37.5 million per year. Supposing that the increased capacity and SLAs would result in a 30% increase in cost, and that one third of this would require Telefônica

to purchase additional US equipment, the US export potential would be US\$4.2 million. Under these assumptions, the total export potential would increase from \$35.1 to \$39.3 million USD.

In our view U.S. technologies will continue to be very competitive for data center construction projects in Brazil. A number of U.S. products continue to be viewed as best in class for the majority of the major equipment and software 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 (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.

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, Schneider, 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.

BAHIA

The cost of the hybrid fiber/wireless network could be on the order of R\$705 million (about US\$215 million), the datacenter subproject about R\$124 million (US\$38 million). The export potential for US producers of hardware, software and services would be US\$147 million for the network and US\$101 million for the data center, and US\$1.5 million for eGovernment software, for a total of US\$250 million in exports estimated for the three components of the project (Table 2). Full detail of the breakdown of these estimate are in the Appendix.

Table 2: Total Costs and Export Potential

Total Costs and Export Potential		
Item	Total Cost R\$	Total Export Potential USD
Broadband Network	\$705,489,194	\$146,825,474
Data Center Upgrade and Backup	\$402,112,750	\$101,309,200
eGovernment software	\$6,012,500	\$1,480,000
Grand Total 3 projects	\$1,113,614,444	\$249,614,674

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.

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, and 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, Schneider, Chatsworth, APC, and ADC (data center components including power distribution, cooling, and fiber guides); AMD and Intel (CPUs and servers); Fortinet, McAfee, Norton e 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.

CPFL EXPORT POTENTIAL

		Potential Exports
Total for CPLF OPGW		
Broadband Network	R\$123,734,778	82% \$9,711,591

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

- Cisco (Network Infrastructure),
- Alcatel Lucent USA (optical network equipment)
- 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)
- Tellabs (optical network components and consulting)

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); and Clearfield (fiber 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. Most US suppliers have Brazilian subsidiaries, so market entry should not be an issue for them.

GOIANIA

While we have not visited other smart city locations or other integrated operational centers, we have reviewed the equipment, hardware, and software used for these centers and US manufacturers are very strong in this area. There are various approaches to smart cities and each one is a bit different from the others, but what they have in common is a core focus on infrastructure, IT hardware and software for

all of which US products are often the first choice. They also have a large reliance on sensors, cameras, GPS and IT equipment to help with the identification of problems and make sure the right resources are available.

The network and operation center envisioned by GOIANIA is heavily based on IT equipment, sensors in the roads, buildings, cameras, to enable the city to be more efficient and effective in traffic monitoring, provide immediate resources for emergency and disaster management, and in health crises.

The cost of the data center upgrade could be on the order of US\$13.4 million, the hybrid network expansion about US 6.0 million, and smart city hardware, software and installation about US\$12.7 million. The export potential for US producers of hardware, software and services would be US\$11.1 million for the data center upgrade, US\$ 3.3 million for the hybrid network expansion, and \$12.4 million for smart city hardware, software and installation for a total of U\$26.8 million in exports estimated (Table 1). Full detail of the breakdown of these estimates may be found in the Appendix.

Table 1: Estimated Costs and Export Potential for the Data Center Upgrade, Network Expansion, and Smart City Hardware, Software, and Installation

GOIÂNIA MUNICIPAL GOVERNMENT		
TOTAL COSTS AND EXPORT POTENTIAL		
Item	Total Cost RS	Total Export Potential USD
DATACENTER	\$43,407,000	\$11,129,600
NETWORK	\$19,349,988	\$3,309,124
SMART CITY	\$41,275,000	\$12,354,000
Grand Total	\$104,031,988	\$26,792,724

In our view, U.S. technologies will continue to be very competitive for future smart city type of projects as well as integrated operational centers that rely on an expanded data centers. 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. Many of the 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 that might bid on RFPs for this project include:

- GE (Smart Building, Smart City Infrastructure & Public Building Monitoring)
- ESRI and App Geo (Geospacial Software and applications)
- Hexagon/Intergraph
- Rhythm Engineering (Adaptic Traffic and Signal systems)
- Xylem Analytics (water level and quality detectors)

- Climatronics (weather sensors)
- McCain Inc
- Siemens USA (made ACS-Lite under contract for the FHWA)
- IBM (Smart City Infrastructure, servers, application software, and cloud services),
- Cisco (Network Infrastructure),
- HP (servers and storage, and cloud services),
- Dell (servers),
- Hitachi (Servers, Disaster preparedness)
- Oracle/Sun (Database, BI, Storage, and Cloud services, adaptive traffic control signals),
- Microsoft (Datacenter Software, Database, OS, Smart City, and cloud services (Azure)),
- VM Ware (virtualization software),
- BMC: (Infrastructure software),
- CA Technologies: (Infrastructure software)
- Cloudflare (software)
- Xterra (SDN solutions, Optical networking platforms)
- Sensys Networks
- Transcore (integrated traffic management systems)
- 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
- American Traffic Solutions, Brekford Solutions, Redflex North America, Ventech International, Vigilant Solutions (Automatic Enforcement Solutions),
- Aventura Technologies, Mango Intelligent Video Solutions, Diamond Digital LLC,(Video content Analytics)
- APC & Eaton, Emerson, Schneider, Chatsworth, S& C Electric, (Power supply & Generation, data center components including power distribution, cooling, and fiber guides)
- Fortinet, McAfee, Norton, and Symantec (Security Systems & Software)

Other US firms that manufacture equipment that could be used in the project and might be interested in bidding include Qualcomm (Wireless and Cellular), Motorola (Portable radios with GPS, battery chargers, mobile terminals with GPS, Repeaters); 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); Underwriters Lab, CH2M, Sensus, Itron (Smart city Infrastructure), AMD and Intel (CPUs and servers); 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.

PERNAMBUCO

The cost of the hybrid fiber/wireless network could be on the order of R\$318 million (about US\$98 million), the datacenter subproject about R\$147 million (US\$42 million). The export potential for US producers of hardware, software and services would be US\$68 million for the broadband network and

US\$38 million for the data center upgrade and containerized backup, for a total of U\$106 million in exports estimated (Table 10). Full detail of the breakdown of these estimate are in the Appendix.

Table 10: Estimated costs and Export Center for the Broadband Network and Data Center

Total Costs and Export Potential		
Item	Total Cost R\$	Total Export Potential USD
Broadband Network	\$199,462,963	\$34,919,431
Data Center Upgrade and Backup	\$146,670,875	\$37,821,950
Grand Total 2 subprojects	\$346,133,838	\$72,741,381

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 (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.

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 e 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.

PARAIBA

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 US\$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 RS	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

SAO PAULO

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

BAHIA

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

CPFL

Potential foreign competitors could include

- Alvarian
- Huawei: Network Infrastructure
- Alcatel Lucent: Network
- ZTE: Network

GOIANIA

Potential foreign competitors could include

- Transportation Research Lab
- Jenoptics
- Axis Communications (CCTV cameras, video encoders)
- Mirasys
- Sydney Coordinated Adaptive Traffic System,
- Swarco (urban transport management systems)
- Huawei: Network Infrastructure
- Lenovo: servers
- Hitachi: Storage
- NEC: Storage, servers, telecom
- Alcatel Lucent: Network
- Videotec (traffic management systems)
- ZTE: Network
- SAP: BI
- BMW
- Kaperski: Security software
- Allied Telesis

PERNAMBUCO

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

Paraiba

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
- Kasperski: Security software