

Definitional Mission to Evaluate ICT

Projects in Brazil: Volume 1:

São Paulo State Government Datacenters Governance and Integration Project (Volumes 2-6 Issued Separately)

Final Report

**Submitted by
Hellerstein & Associates**



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São Paulo State Data Center Integration and Consolidation Project Definitional Mission Report

I Executive Summary

GRANTEE: COMPANHIA DE PROCESSAMENTO DE DADOS DO ESTADO DE SÃO PAULO – PRODESP

PRODESP 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.

Summaries of all meetings held and contact details for participants are included as Annex 1 to this Final Report. The scope of work of the DM requires the development of detailed terms of reference (TOR) for activities recommended by the consultants, detailed consultant qualifications and a detailed project budget, with final approval of the activities by USTDA. This Final Report contains a summary of the DM process and findings. The DM Contractor's recommendations, the TOR, consulting team qualifications, and budget for the project are presented below.

I Project Description

A. INTRODUCTION

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 (2010-2016), 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

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.

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, 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 PNBL 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.

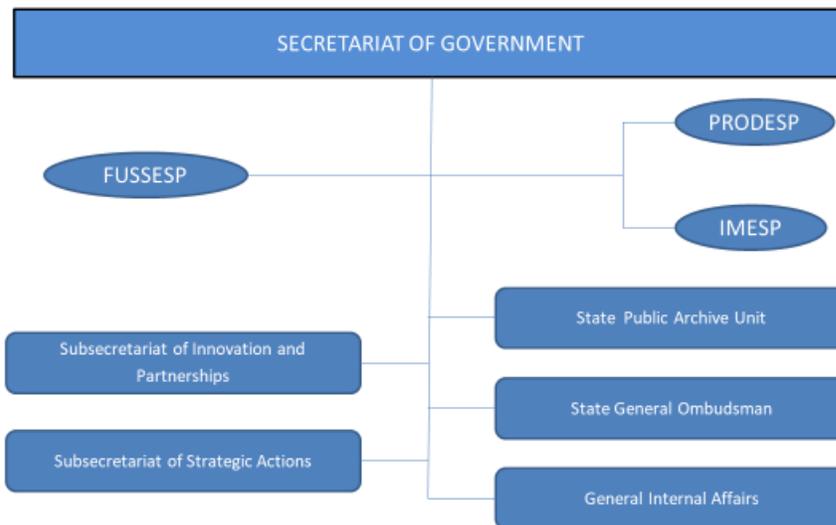
- Information and Communication Technology - Being the largest pole of information and communication technology (ICT) in Brazil, São Paulo concentrates 41% of the national computer equipment industry, as well as a wide range of services focused on computers, tablets and smartphones.

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 in the conurbation process, 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 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.

The São Paulo State Information Technology and Communications Coordination Department (Coordenação de Tecnologia da Informação e Comunicação – CTIC) is a public entity within the São Paulo State Secretariat and is responsible for the planning and coordination of ICT resources for the state. They are housed under the Undersecretariat of Strategic Actions/Business (Accoes). CTIC was chosen by the Secretariat to be the Grantee for this project.

B. THE PROJECT

PRODESP 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, Itaotec, 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. Figure 4 shows the main control room for the data center.

Figure 4: PRODESP data center operations center



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
- 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)

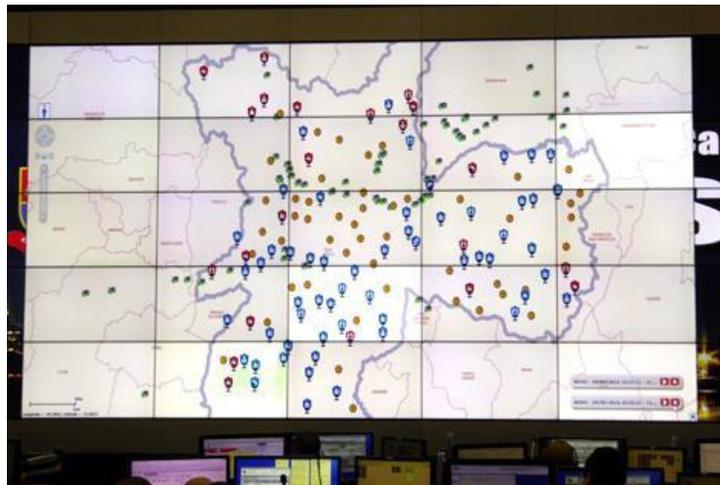
PMESP has a modern data center located in central São Paulo. It has an area of 191 m² with 40 servers, uses mainly US hardware running software from US suppliers including Microsoft and Oracle, and employs 21 police officers and 36 contract personnel. In its control center (*Central de Operações da Polícia 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).

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. 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.

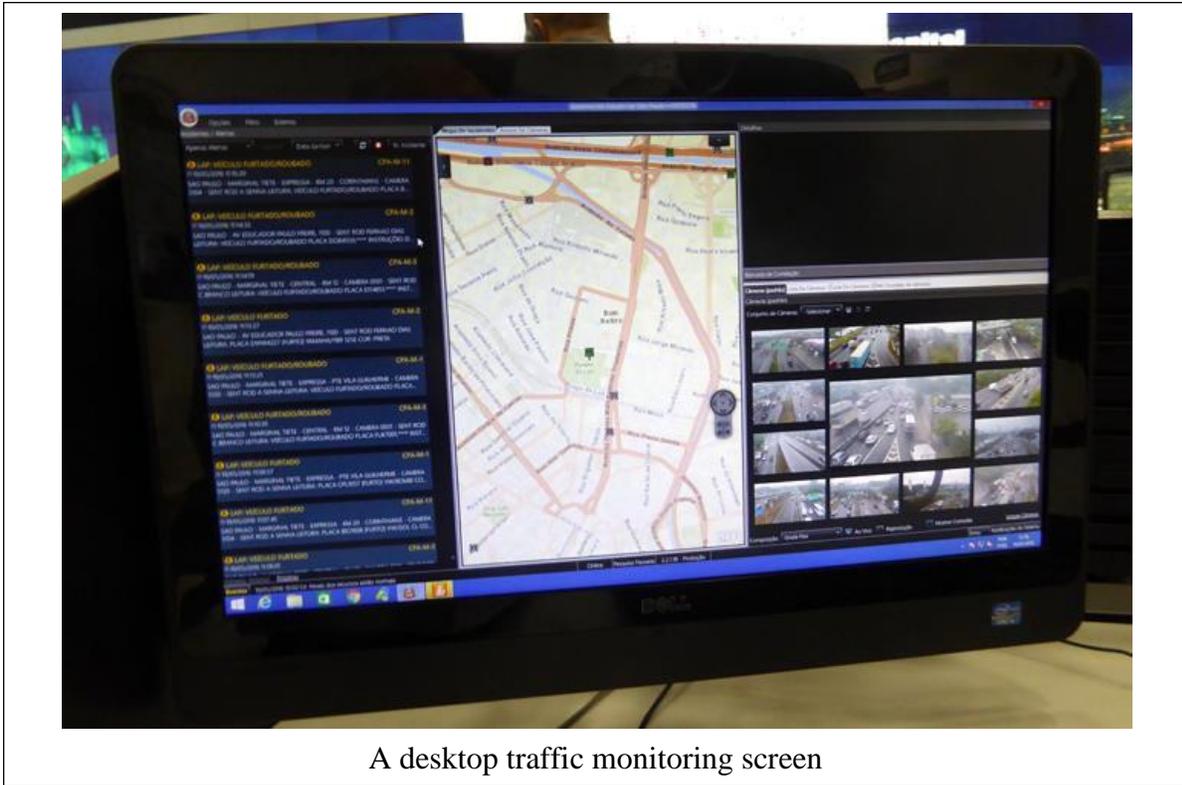
Figure 5: PMESP COPOM



COPOM main room



COPOM real time wall screen



A desktop traffic monitoring screen

The PMESP has police stations in all 645 municípios and the INTRAGOV network is used for connectivity. There is no active-active backup, and PMESP is seeking one in the context of the PRODESP project. PMESP has close relations with the New York Police Department and seeks to benchmark its data center and communications technology with international best practices. Another area of interest for PMESP is linking private video surveillance cameras (e.g. in commercial and residential buildings) with the public sector ones in use for traffic control and crime prevention/detection. The DM Consultants believe that it important to look into creating backup of the PMESP data center in PRODESP’s data center as part of the integration and expansion project. PMESP does not currently have any expansion projects.

Other São Paulo State data centers

PRODESP has already collected some data on some smaller data centers located in the Secretariats of Health (20 m²), Planning (40 m²), and Public Safety (33 m²) and the Metro (41 m²). However, there are many other small data centers and server rooms that PRODESP would like to consolidate, integrating them into the PRODESP data center.

Total IT expenditures

Table 1 provides data on GESP expenditure on information technology for all branches of the government.

Table 1: GESP IT expenditures

2015 Top consumers:	
Secretariat of Government	R\$ 493 million (includes Poupatempo costs)
Justice Court	R\$ 363 million
Secretariat of Education	R\$ 337 million
Secretariat of Finance	R\$ 295 million
Secretariat of Planning and Management	R\$ 253 million (includes DETRAN)
Secretariat of Public Safety	R\$ 209 million
Secretariat of Economic Development	R\$ 102 million (includes Technical schools)
Secretariat of Transportation and Logistics	R\$ 91 million
Healthcare Secretariat	R\$ 48 million
2015 Top Types of IT Expenditures:	
Services provided by PRODESP to Government secretariats and bureaus	R\$ 981 million
Software	R\$ 715 million
Equipment rental	R\$ 207 million
Equipment acquisition	R\$ 193 million
Third party services	R\$ 102 million

Source: CTIC

Note: PRODESP acts as a service provider to the government, signing contracts and billing every month. To provide these services PRODESP also buys software and hardware.

Connectivity

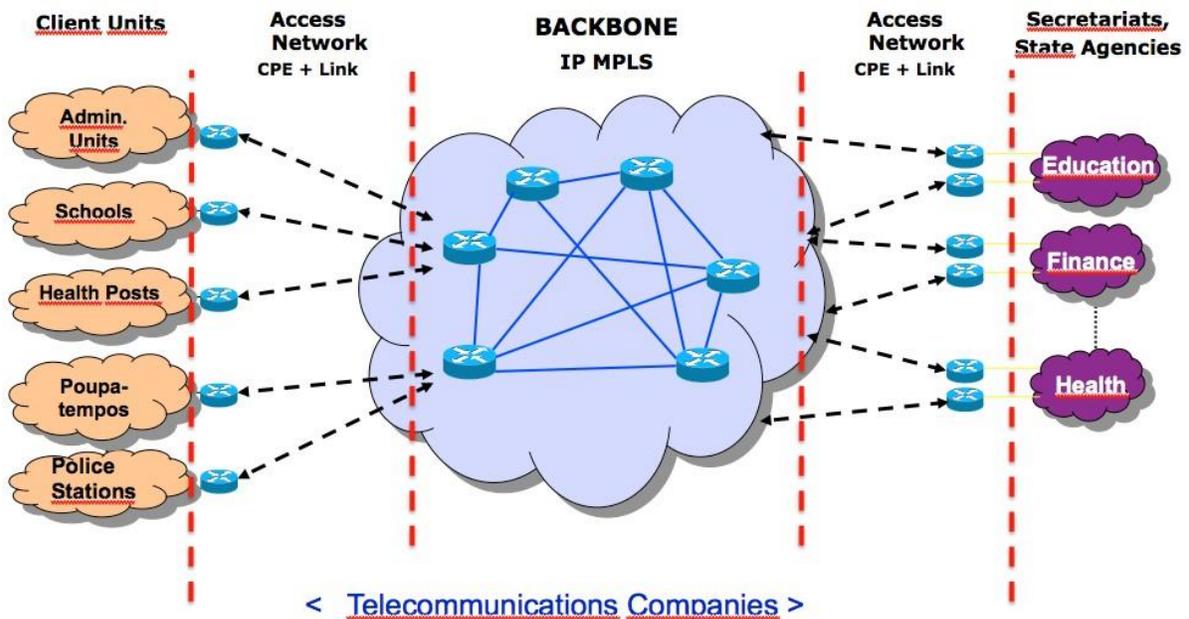
The INTRAGOV Network (*Rede INTRAGOV*) is the State Government of São Paulo's communications network for data, voice and video traffic (multimedia). In 1999, the Government decided to try and integrate and consolidate the communication's infrastructure of various agencies within the Government. The network was first designed to save on communication costs, but it soon spread beyond this into helping the agencies plan and organize their own IT investments. In the past, each agency signed its own contract with the incumbent operator, Telefônica, and often multiple agencies purchased the same communication equipment or software without the discounts that can often be obtained with large purchases. Instead of each agency purchasing their own communication services, the goal was to have all agencies come together and aggregate their information and communications needs into one package and get a significant discount on the cost of service. This was the genesis of the INTRAGOV network.

In early 2000 only a few Agencies participated, but gradually others were won over and by 2004 all the Government Agencies, the Police, and the Judiciary joined INTRAGOV. Today's INTRAGOV Network integrates the networks of all secretariats and agencies of government allowing better use of material, human, financial and budgetary resources by all participants. All of the State Secretariats and Agencies of the Judiciary and Legislature have integrated their networks with over 17,000 communication lines installed (schools, police stations, penitentiaries, hospitals, health centers, citizen service centers (*Poupatemplos*), state tax centers, courts of justice, universities, subway stations, agricultural centers, environmental control and water agencies, etc.) into the INTRAGOV Network.

All conventional telephone and IP connectivity for the INTRAGOV Network is leased from private sector operators through contracts let by competitive bidding every five years. The current contract (INTRAGOV IV) is with Telefônica and runs from 2014 through 2019 or until the funds allocated in the contract (R\$597.244.876 when the contract was signed in December 2013, or roughly US\$187 million at R\$3.2/US\$) are exhausted. Data communications expenditures are thus approximately R\$10 million per month, or R\$120 million (about US\$38 million) per year.³

The State Government of Sao Paulo has around 17,000 administrative units in 645 *municípios*. A large number of *municípios* have also joined the INTRAGOV network to communicate with the State Government and to access the Internet. The general concept of the INTRAGOV Network is shown below in Figure 6, and its topology in Figure 7.

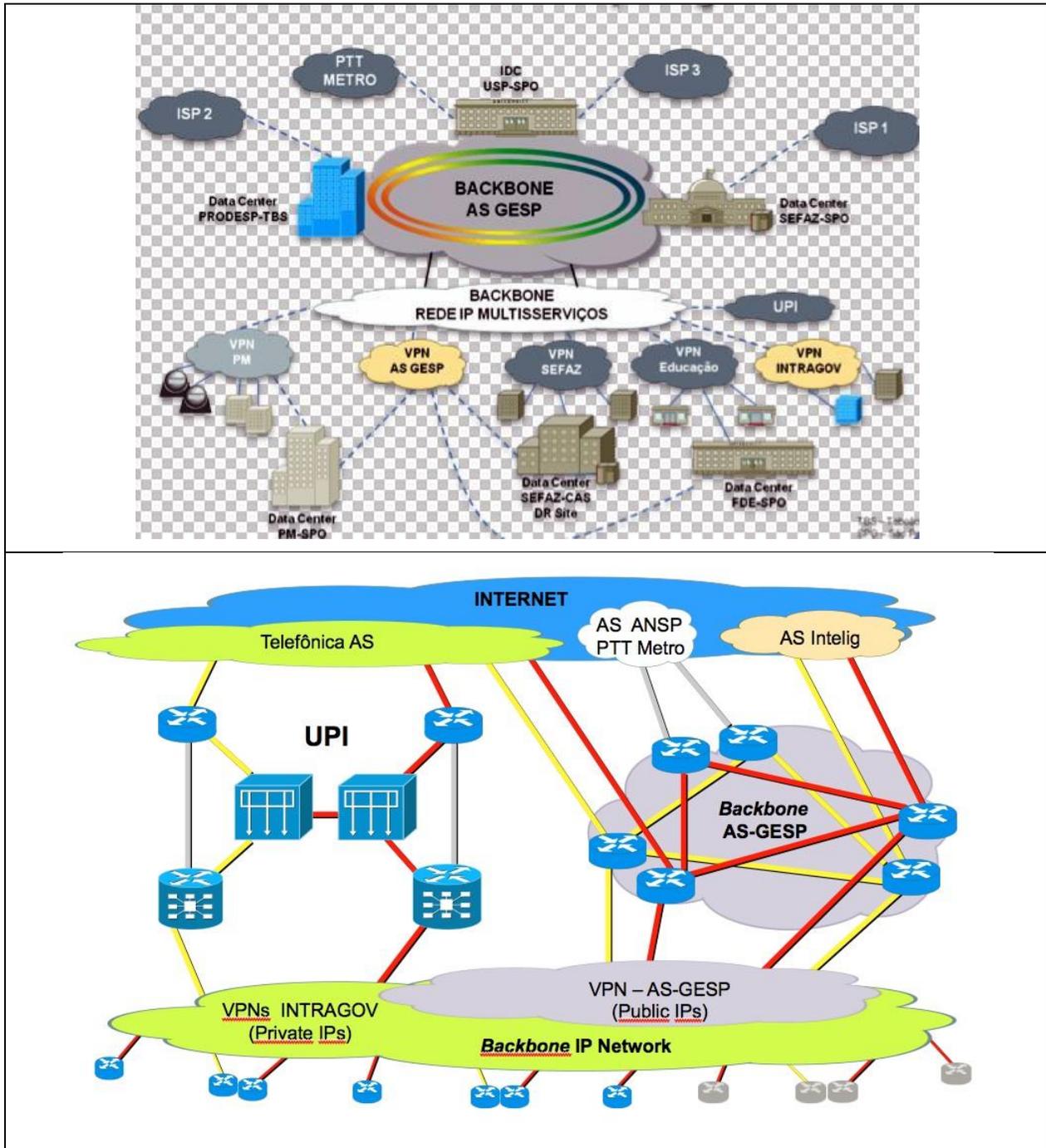
Figure 6: Conceptual framework of the INTRAGOV Network



Source: PRODESP

³ For detailed and downloadable documentation on INTRAGOV Network contracts and technical provisions, see <http://www.intragov.sp.gov.br/documentos.php>. Accessed June 25, 2016.

Figure 7: INTRAGOV Network topology, two views



Source: <http://www.intragov.sp.gov.br/topologia.php>

Note: See source for legend

Notes: AS = Autonomous System, GESP = Government of the State of São Paulo, UPI = Internet Service Unit, VPN = Virtual Private Network, PTT = Internet Exchange, SEFAZ = Secretariat of Finance, FDE = Education Development Foundation, PM = Military Police, USP = University of São Paulo, Intelig (Telecommunications company providing redundancy services).

The topology of the INTRAGOV Network comprises three structures as follows:

1. IP Network Backbone: INTRAGOV Network resource responsible for Multimedia Communication Service (*Serviços de Comunicação Multimídia - SCM*, where information, whether data, voice or video, is transported from one government unit to another government unit through private IP addressing. It is an MPLS-based network (Multiprotocol Label Switching), composed of multiple Virtual Private Networks (VPNs) that cater to the corporate network's signatory bodies, with the possibility of implementing QoS (Quality of Service). Available SCM nominal capacities ranging from 64 Kbps to 40 Gpbs.
2. UPI (Internet Provider Unit): a feature added to the IP Backbone Network to provide the Internet access service (IAS) to the contracting units this optional service. This type of service cannot publish content on the Internet, but you can surf the Internet from computers that use private IP.
3. AS-GESP (Autonomous System of the São Paulo State Government): a feature added to the IP Backbone Network to provide Internet Traffic Service (ITS) to the contracting units this optional service. In addition to browsing, this type of service also allows the publication of content on the Internet from computers that use public IP.

The INTRAGOV network is managed from the Management Provider Unit (*Unidade Provedora de Gerenciamento – UPG*), located in the PRODESP data center in Taboão da Serra. Under the INTRAGOV IV contract there is a division of labor between PRODESP and Telefônica (Table 2).

Table 2: Division of labor between Network Administration and Network Operator

<p>WEB Portals - Management / Administration</p> <ul style="list-style-type: none"> • Developed and maintained by Telefônica • Permission for the issuing and monitoring of service requests, opening and monitoring of incidents, analysis of performance of links and issuing of reports • Control of the government database shared with PRODESP
<p>Operational Management and Support System</p> <ul style="list-style-type: none"> • Developed and maintained by PRODESP • Provides and enhances all existing functions on Web portals and adds new ones, like the full control of the government database, control of billing services, "Network Health" with service level agreements (SLA) and service level management (SLM)

Source: PRODESP

The division of responsibilities between PRODESP and Signatory Organizations (*Órgãos/Entidades Signatários – OES*) receiving INTRAGOV Network services are summarized in Table 2. As of June 2016 there were 119 signatories, including state secretariats, state agencies, universities, courts, and municipal governments (*prefeituras municipais*).

Table 2: Responsibilities of PRODESP and Signatory Organizations

Responsibilities of PRODESP	Responsibilities of Signatory Organizations (OES)
<ul style="list-style-type: none"> • Assure the contract conditions are fulfilled • Undertake the technical, economic and financial management of the contract • Clarify doubts concerning the contract • Analyze and approve service requests • Evaluate new demands • Monitor network performance • Provide for contractual succession 	<ul style="list-style-type: none"> • Provide the infrastructure necessary in the location where INTRAGOV services are installed • Issue service requests • Issue the “acceptance” when services are delivered or repaired • Certify invoices issued by the Operator • Pay for services provided

Source: PRODESP

A high priority project of the State Government is to guarantee the safe and high quality links to all 17,000 administrative units in the executive branch of government, 303 installations in prisons, and other judiciary installations, and the 645 *municipios*, link them with the state’s data centers, and provide high speed redundant links between the data centers remaining after integration and consolidation of the existing ones. This would involve expanding and upgrading the existing INTRAGOV Network.

Table 3: INTRAGOV Network Data (June 2016)

Active lines (64 Kbps to 40 Gbps) using IP (v4 and v6)/MPLS technology	17,033
Participating government entities	119
GESP Autonomous System	About 1,000 lines
Internet Transit Providers	> 12
Internet Provider Units (including the PRODESP UP)	> 30
PRODESP UP bandwidth consumption	< 1.0 Gbps
Bandwidth occupied by the GESP Autonomous System	> 11,0 Gbps
Internet Provider Unit users	> 50,000 (200,000 requests per day)
Average incident reports issued per month	< 3,000
Invoices issued per month	> 4,000
Monthly average requests for service analyzed	< 500

Source: PRODESP

An option that could decrease the cost, but increase the quality of service of the Intragov Network is to partner with other entities to create a new network independent of the major telecommunication companies that could cover the entire state or parts of it. If the new network could link all 645 *municipios*, part of the network could be outsourced to a major

telecommunications operator using the same type of reverse auction used to choose the current operator of the entire INTRAGOV Network.

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

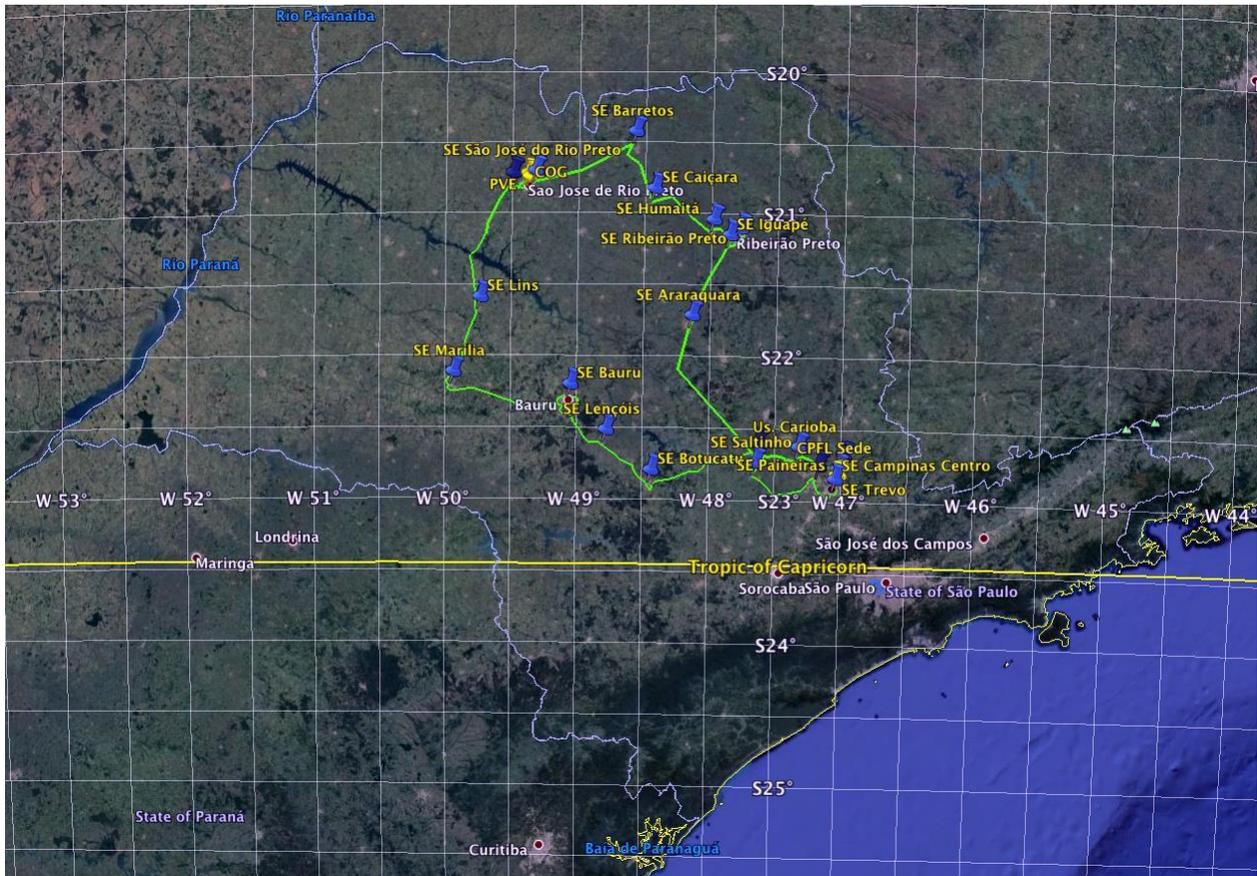
Swaps (*Permutas*) are another way to reduce costs, and are widely used in the telecommunications industry between commercial telecommunications providers, though this fact is not widely known and it is extremely difficult to obtain maps showing each company's network and those parts that are shared or traded with other companies.⁴ Several other Brazilian states, led by Pará and Ceará, have invested in their own fiber networks and engaged in sharing of fiber cables with partners including RNP, Telebras, Petrobras, and federal and state electric power distribution companies. A number of other states have begun or are planning to do the same, among them Bahia, Paraíba, Rio de Janeiro, Rio Grande do Sul, Santa Catarina, Sergipe, and Tocantins.⁵

The characteristics of the best state and municipal networks are:

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

Other states have constructed, or are planning, creating or expanding their own networks (e.g. Pará, Rio Grande do Sul, Santa Catarina, Rio de Janeiro, Bahia, Paraíba and Sergipe). The São Paulo Electric Energy Company (*Companhia Paulista de Força e Luz* – CPFL). CPFL is seeking partners to help build a fiber network based on optical ground (OPGW) cables hung from its high-tension transmission towers. The route of this network is shown in Figure 8.

Figure 8: Route and accesses to the CPFL Ring



Source: CPFL

The DM consultants met with RNP’s Director for Operations and Engineering in May 2016 to discuss the idea of obtaining access to dark fiber to link its São Paulo and Campinas Metropolitan networks and RNP’s national backbone (*Rede Ipê*) to about 50 campi of higher education and research institutions in the interior of the state. RNP is prepared to invest R\$ 2 to 3 million in this network this year and in 2017 and R\$ 4-6 million per year beginning in 2018 when a contract with Telefônica/Vivo expires. RNP suggests building out the OPGW network in segments, attracting more than one partner for each segment.

RNP already has its own metropolitan networks in Campinas and São Carlos that it built in cooperation with CPLF. CPLF provided poles for hanging the cables in return for use of two pairs of fiber. Beyond these, RNP’s first priority is to build a similar fiber network in Sorocaba, after that in São José dos Campos, Santos e Botucatu, all of which have more than one institution to be connected. Currently the connection between them Campinas and São Carlos is by leased links, however, in about 3 years RNP wants to have a fiber pair or right to use spectrum in third party’s

fibers, especially on the routes Campinas-Sorocaba, Campinas-São Carlos and Sorocaba-São Carlos.

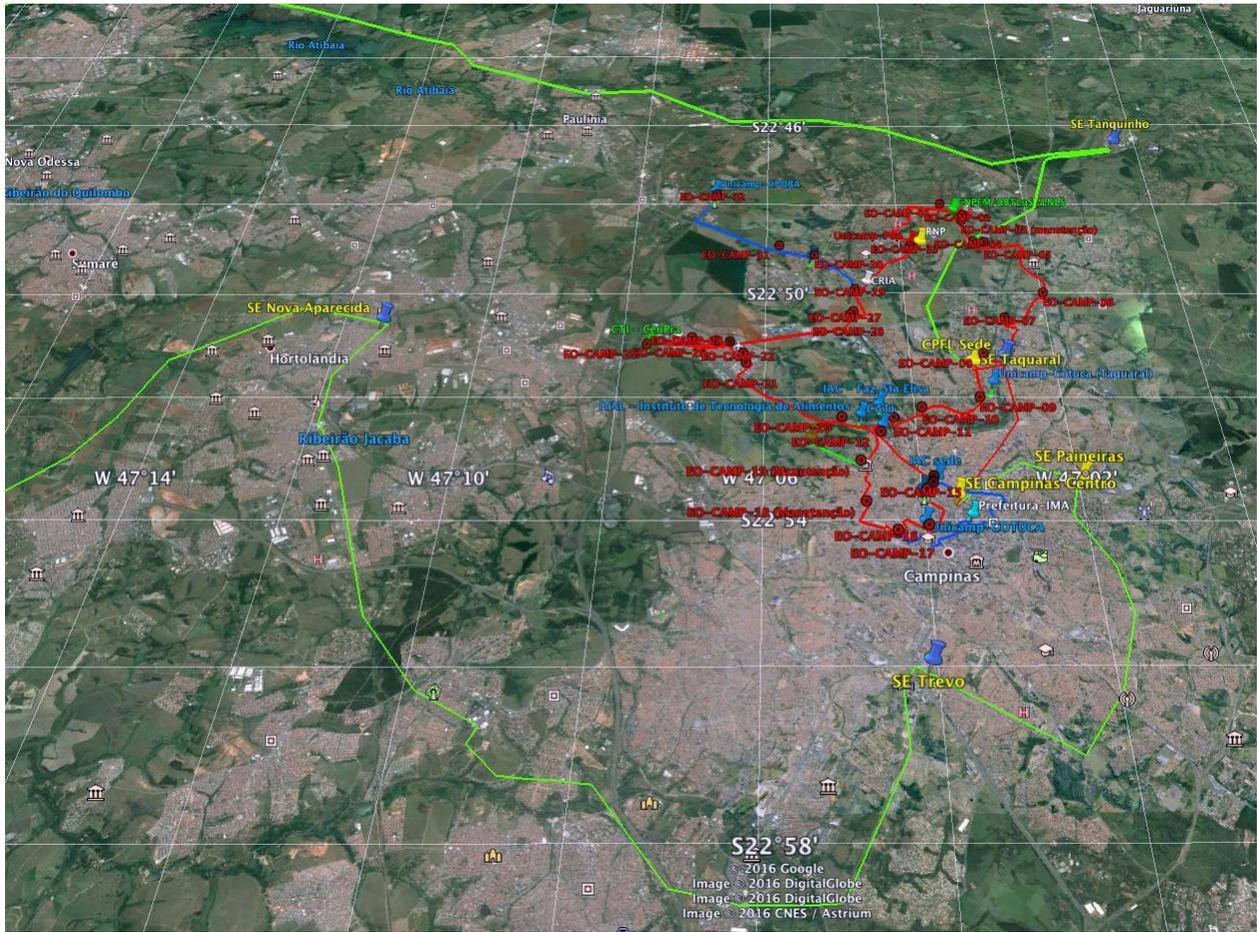
RNP wants to have fiber links to higher education and research institutions in 33 *municípios* in the interior of São Paulo where it currently has only leased connections (Table 2).

Table 2: *Municípios* with institutions RNP seeks to connect with fiber optic links

1. Araraquara
2. Araras
3. Avançado de Matão
4. Avaré
5. Barretos
6. Birigui
7. Boituva
8. Botucatu
9. Bragança Paulista
10. Cachoeira Paulista
11. Campinas
12. Campos do Jordão
13. Capivari
14. Caraguatatuba
15. Catanduva
16. Cubatão
17. Diadema
18. Guarulhos
19. Hortolândia
20. Itapetininga
21. Osasco
22. Piracicaba
23. Presidente Epitácio
24. Registro
25. Salto
26. Santos
27. São Bernardo do Campo
28. São João da Boa Vista
29. São José dos Campos
30. São Roque
31. Sertãozinho
32. Suzano
33. Votuporanga

The RNP investment resources mentioned above would allow construction of one segment per year in 2016 and 2017 and two segments per year in subsequent years. That would allow partners to swap fibers on their segments for fibers on other segments. Such swaps (*permutas*) do not involve financial transactions and hence are tax-free. The São Paulo state government could join such a partnership by either investing in some segments of the network or by leasing dark fibers or capacity in the network. Investment in this network could reduce annual operating costs for connectivity for all partners. The State would only be interested in participating in the CPLF project if it could result in major cost savings. Determining whether such savings could be achieved would be one of the objectives of a USTDA-financed consultancy.

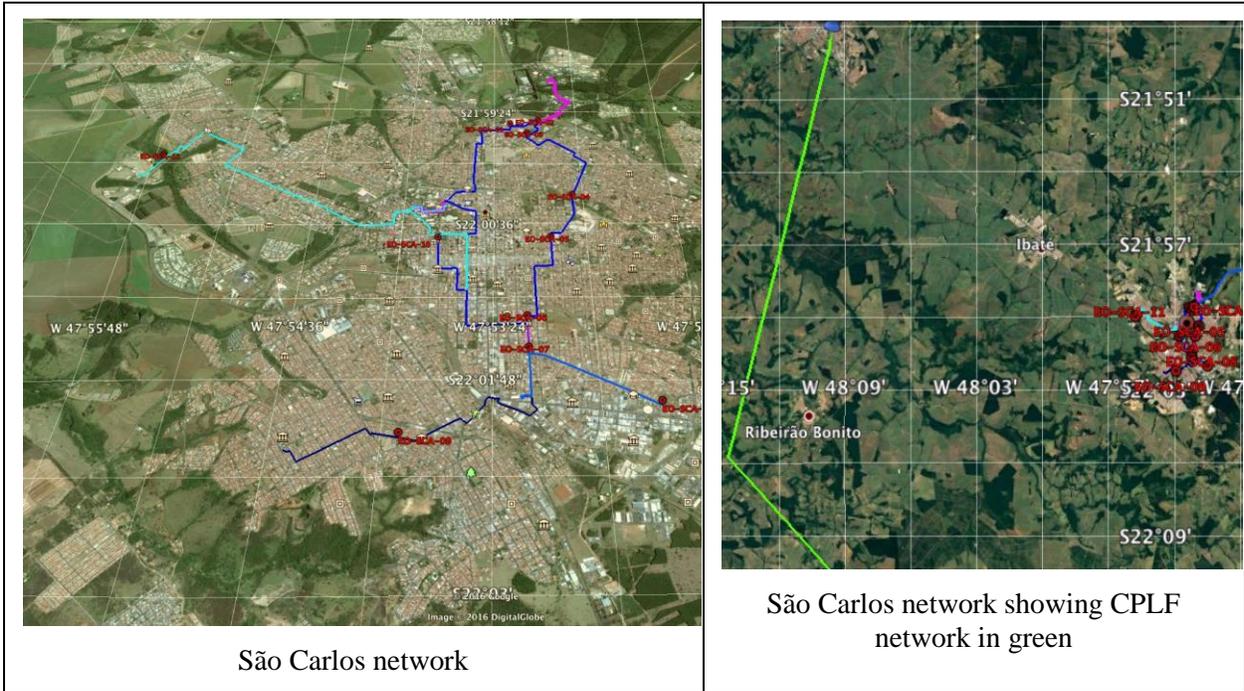
Figure 9: RNP Metropolitan Network in Campinas



Source: RNP

CPLF network in green

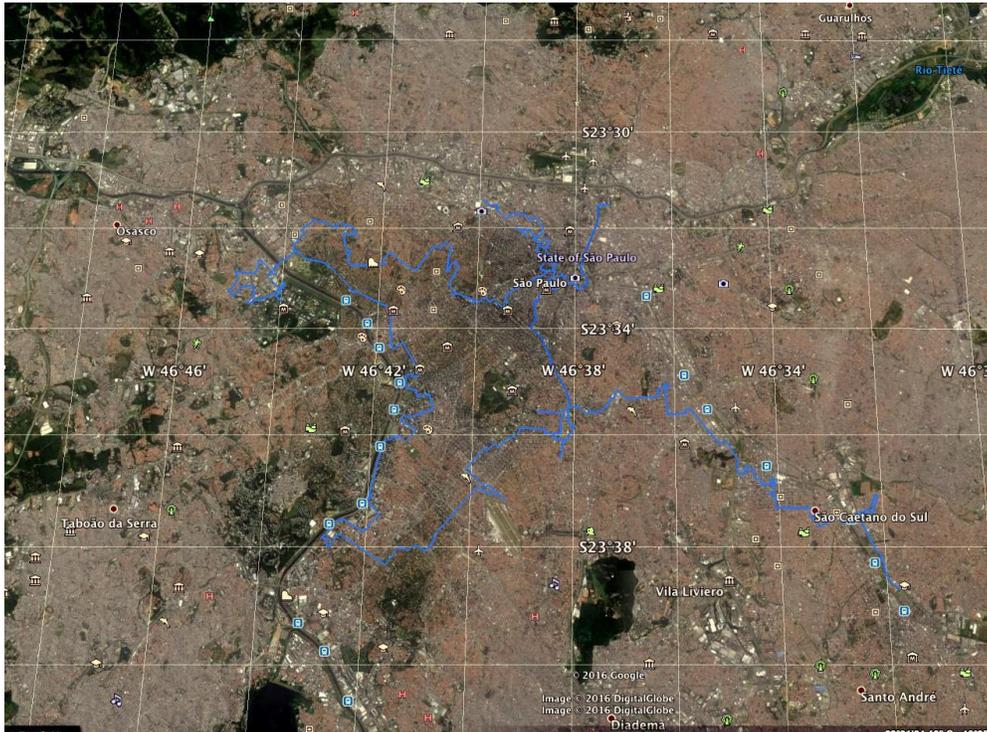
Figure 10: RNP Metropolitan network in São Carlos



Source: RNP

RNP's metropolitan network in São Paulo consists of a single pair of fibers to which it has access for 10 years. Figure 11 shows the RNP metropolitan network (MetroSampa) in São Paulo.

Figure 11: RNP Metropolitan Network in São Paulo (MetroSampa)



Source: RNP

CPLF indicates that number of private sector telecommunications companies (TIM, Claro, Oi, Vivo, Embratel) have also expressed interest in participating in the CPFL project to expand their own networks. Highline, a company similar to American Tower and invests in telecommunications towers, is interested is using CPFL’s towers, another source of CAPEX for the proposed CPLF OPGW network.

III Government commitment

The Secretariat of Government, responsible for the project, was created in January 2015 to coordinate high-impact projects; work and state services that often involve more than one Secretary and / or entity. The project is such a high-impact project. Parts of the project are included implicitly in the latest São Paulo State Multiyear Development Plan (*Plano Plurianual – PPA*) for the years 2016-2019. This rolling plan includes the first year of the government to be elected in October 2018’s mandate, and is the strongest indication of priority.⁶ It declares in several items the necessity to use innovation and technology to improve public administration and citizen services and it can only be provided having a good ICT infrastructure.

Table 3: Estimated purchases of US software and hardware for the data center consolidation project

Area	Supplier options (examples)	Total for All Data Centers	Software	Hardware	Cloud Services
Power System, UPS units, power generator units	APC, EATON	R\$ 950,000		R\$ 950,000	
Network infrastructure (e.g. Switch core like Cisco WSC6509-V-E0)	Cisco	R\$ 2,550,000		R\$ 2,550,000	
Network Management Software (e.g. Cisco R-PII2-LF-500 and modulator for 500 devices)	Cisco, HP	R\$ 4,220,000	R\$ 4,220,000		
Redundant Database - High Availability, Active Replica (e.g. Oracle Enterprise Edition 56 Proc & other Options com support BCA)	Oracle, Microsoft	R\$ 34,000,000	R\$ 34,000,000		
Virtual machine software (e.g. VMware, 68 vSphere, 02 vCenter, 08 Bundles Horizon – 800 desktops)	Microsoft, Vmware	R\$ 8,876,000	R\$ 8,876,000		
Operational software (e.g. Windows Datacenter, RedHat Enterprise)	Microsoft, American Linux distributors	R\$ 3,200,000	R\$ 3,200,000		
Servers (e.g. HP C7000 w/ 32 boards HP BL460c, DELL VRTX Full)	HP, Dell, Oracle	R\$ 2,000,000		R\$ 2,000,000	
Storage	HP, Dell EMC, Oracle	R\$ 15,200,000		R\$ 15,200,000	
Backup systems (eg. VERITAS 100TB)	HP, Dell EMC, Oracle	R\$ 10,500,000		R\$ 10,500,000	
Datacenter management software	CA, BMC, IBM	R\$ 6,200,000	R\$ 6,200,000		

Cloud computing services	Amazon, Microsoft	R\$ 5,000,000			R\$ 5,000,000
Security Systems and Software	Fortinet, Symantec	R\$ 4,300,000	R\$ 4,300,000		
Application platform Software	IBM, Oracle	R\$ 15,400,000	R\$ 15,400,000		
TOTAL PER SITE IN REALS		R\$ 112,396,000	R\$ 76,196,000	R\$ 31,200,000	R\$ 5,000,000
TOTAL IN USD		\$35,123,750	\$23,811,250	\$9,750,000	\$1,562,500
GRAND TOTAL R\$ -	R\$ 112,396,000				
GRAND TOTAL US\$	\$35,123,750				

Annex 2- 25

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.

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).

IV. Preliminary development impact review

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

Development Impact Measures should be viable, realistic and quantifiable. During the initial stages of project definition, we evaluated the development impact from the attached list. At least one realistic and quantifiable Development Impact Measure is selected for each USTDA activity. In close consultation with the proposed project sponsor, a baseline measurement is established for

each indicator, which is used to compare future outcomes. The baseline is also used to set an anticipated timeline and determine how the information will be measured and collected once a project moves to implementation. This baseline information is incorporated into the Terms of Reference, which provides reporting guidance to the contractor performing the USTDA activity.

We selected to following indicators:

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

Sector Outcome	Category	Indicator	Description	Anticipated
Telecom	Infrastructure Development and Efficiency Gains	Improved Output through Advanced Technology	New technologies introduced, resulting in an increase of efficiency, capacity, or government output	Y

For the Data center the main indicator is

All	Infrastructure Development and Efficiency Gains	Improved Data Management and Security	Capacity added, security gained and reliability improved through implementation of data centers, cloud computing systems, or other storage infrastructure	Y
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As designed, the datacenter project component is unlikely to result in any new legislation or regulations, though it should promote competition among potential suppliers. The project to build and lease a statewide fiber optic network could promote competition and reduce prices for the massive increase in connectivity needed the data center project to achieve its objectives as regards cloud computing and enhanced eGovernment services in such areas as telemedicine, education, and public safety.

V. Qualifications of Professionals IN SÃO PAULO STATE'S GOVERNMENT DATACENTERS GOVERNANCE AND INTEGRATION PROJECT

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

Team Leader

- At least fifteen (15) years' experience in the ICT industry
- Strong background in at least one of major areas of the feasibility study (Datacenters, hybrid fiber optic and wireless broadband networks, Definition of SLAs, economic and financial project analysis)
- Both a US and an international perspective on the ICT industry, with the international perspective preferably gained through on-the-ground project work, ideally in the area of datacenters and/or broadband networks
- Management, organizational and cross-cultural skills and perspective to structure, oversee and carry out the Feasibility Study effectively
- Ability to communicate findings effectively and to liaise appropriately within the PRODESP framework and with other stakeholders, including the Secretariat of Finance, other public sector entities and potential private sector partners
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Strong Portuguese language skills, written and spoken is required

Senior Data Center Electrical Engineer

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

- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Portuguese language skills is desirable

Junior Data Center Electrical Engineer

- At least an undergraduate degree in electrical engineering or related discipline
- At least five (5) years' experience in the telecom/ICT industry, including hands-on experience with datacenter design and implementation
- Knowledge of configuration management, problem management, change management, help desk, distribution and control of software, managing of service levels (SLM), capacity management, contingency planning, availability management, and cost management – as applied to datacenters
- Expertise in the economic and financial analysis of projects and feasibility studies involving rapid technological change, including total cost of operations (TCO) and return on investment (ROI) analysis
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role
- Excellent written and verbal communication skills, including technical writing
- Excellent ability to clearly explain advanced technical issues in manner that is easily understood
- Strong interpersonal and customer service skills
- Strong sense of personal responsibility and accountability for delivering high quality work
- Ability to work well both independently and on teams
- Portuguese language skills is desirable

Senior Wireless Engineer

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

Senior Fiber Optic Network Electrical Engineer

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

Data center Security Expert

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

Junior ICT/Network Engineer

- At least an undergraduate degree in electrical engineering or a related discipline
- At least five (5) years' experience in the ICT industry including hands-on experience with the design, operation and maintenance of fiber optic networks and wireless extensions of such networks
- Experience in defining and monitoring service level agreements (SLAs) for ICTs.
- Expertise in the economic and financial analysis of projects and feasibility studies involving rapid technological change, including total cost of operations (TCO) and return on investment (ROI) analysis
- Detail-oriented and able to prioritize
- Experience serving in technical consultative role

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

Brazilian Environmental Expert

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

ICT Strategist & Regulatory Specialist

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

Senior Economist

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

Brazilian Lawyer Specializing in Brazilian legislation and regulation (regulamentação)

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

Project Coordinator/Local Manager

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

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

ADDITIONAL COMMENTS

Successful execution of the feasibility study presupposes that a) the U.S. Firm shall establish a

close working relationship with PRODESP; and b), that the team is prepared to spend the necessary amount of time on-site in-country).

XIV. Suggested Evaluation Criteria

The selection of the U.S. firm for both of the studies be based on the following criteria:

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

TERMS OF REFERENCE

Objective

The objective of these terms of reference is to set forth the terms and specifications for the performance of a technical assistance (the “TA”) in connection with the planned (i) consolidation and upgrade of the state data centers; and (ii) expansion of the state broadband network; in each case for the Brazilian State of São Paulo (the “Project”). The Grantee is the Companhia de Processamento de Dados do Estado de São (“PRODESP”). References to the “State” or to “São Paulo” refer to the Brazilian State of São Paulo.

PRODESP is the São Paulo State IT Company and is the operator of the largest data center in the State’s existing data center system. CTIC is a public entity within the São Paulo State Secretariat and is responsible for the planning and coordination of ICT resources and infrastructure for the state, and will therefore be a key stakeholder in the Project. PRODESP shall coordinate as needed with CTIC in order to facilitate the TA.

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

TASK 1: DATA COLLECTION

The U.S. Firm selected by PRODESP to perform the TA (the “US Firm”) shall research past and current state and federal government initiatives in the planning, financing, construction, and operation of municipal, state-wide and national broadband networks and datacenters (reviewing at least four Brazilian and four international case studies), including security and emergency arrangements. In analyzing each of these Brazilian and international examples, the U.S. Firm shall identify, analyze and detail the best practices in technology, finance, construction and operation. The U.S. Firm shall also analyze and detail the demands on these networks of typical e-Government activities, including:

- internal administration;
- tax collection;
- operation of citizen service centers;
- distance education;
- telemedicine;
- cloud computing, and
- big data analysis.

The U.S. Firm shall identify and analyze four Brazilian government broadband networks involving both fiber and wireless technologies and identify four international case studies drawing on these case studies and a review of the relevant literature on state-of-the art hybrid (fiber/wireless) networks. The U.S. Firm shall devote particular attention to business models that include infrastructure sharing under different leasing, exchange of rights for use of infrastructure, including fiber optic cables, towers, poles and ducts.

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

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

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

DATACENTER

The U.S. Firm shall travel to São Paulo to review the State's existing datacenter system, meet with PRODESP and the key stakeholders in the Project. The U.S. Firm shall conduct a needs/requirements analysis at each State agency that, as indicated by PRODESP, is an existing or potential stakeholder or end-user with regard to the Project, and shall analyze each agency's existing data storage arrangement(s) and/or facilities, connectivity arrangements and budget allocations for datacenters and data communications (including traditional and voice over internet protocol - VOIP telephony). The U.S. Firm's analysis shall also include recommendations on the optimal methods for providing backup services and other public or private cloud services for the State's data center system. The U.S. Firm shall confirm and elaborate with PRODESP the basic objectives for the data center consolidation and upgrade, which include the need to meet the growing demand for information and communications technology in connection with the Government of São Paulo's eGovernment program (broadband network management, applications, services, and portals) with agility, flexibility and efficiency under the strategic management of PRODESP.

The U.S. Firm shall:

- Meet with PRODESP and other major stakeholders (with guidance from PRODESP) to develop an assessment of their needs, priorities, and expectations;
- Visit the PRODESP and the Secretariat of Finance (SEFAZ) data centers, and at least two additional São Paulo state data centers;
- Collect data through a survey of smaller data centers and server rooms with the help of PRODESP and conduct a needs and requirement analysis for the planned São Paulo datacenter integration and consolidation;
- Conduct basic cost/benefit analyses to help PRODESP to determine the appropriate scale of the new datacenter and potential backup facilities for all the data centers in the State data center system, considering the six largest potential client secretariats/agencies of the State of São Paulo who are not already using the PRODESP data center;
- Conduct a security analysis, both physical and electronic, of all datacenters expected to remain in the São Paulo data center system and its backup facilities to determine the best course of action to take to ensure the security and privacy of the information contained in the datacenters;
- Quantify the benefits in unit cost reduction and improved quality for datacenter services (using standard telecommunications network metrics) that can be achieved with the proposed consolidated and integrated data center;

- Analyze at least three options for operation of the existing PRODESP data center (i.e., options for data storage, mix of usage of cloud versus local data center, etc.) that would best suit the goals of PRODESP for the State data center system, and provide detailed recommendations in terms of the strengths and weaknesses of each option (the U.S. Firm shall then use this analysis to inform the work under Task 3);
- Inventory of Requirements for Supporting Critical and Non-Critical State Applications;
- Estimate and project Data Center Power Supply Requirements and Cost;
- Specify and project Data Center Cooling Requirements and Cost;
- Specify Standby Power Requirements and Fire Safety requirements;
- Specify Guidelines for Selecting Data Center Construction Contractors; and
- Estimate future demand for integrated state data center services of (a) the São Paulo state government secretariats and agencies and (b) municipalities in the state of São Paulo.

BROADBAND NETWORK

The U.S. Firm shall travel to São Paulo to review the current State broadband network contractual arrangements whereby the State of São Paulo outsources connectivity requirements to commercial telecommunications firms; meet with PRODESP and the key stakeholders in the Project: CTIC, the Secretariats of Finance, Education, and Health; Military Police, Civil Police, DETRAN, and other Secretariats and government agencies; and conduct a needs/requirements analysis for the expansion of the hybrid broadband network. The U.S. Firm shall also analyze the needs and capabilities of potential partners in the upgraded hybrid network, including CPLS Energia, AES Eletropaulo, Telebras, the National Education and Research Network (RNP), the Ministry of Education and Culture (MEC), The Ministry of Science, Technology, Innovation and Communications, and private telecommunications companies (e.g. Oi, Vivo, Embratel, Claro) and local internet service providers. The U.S. Firm shall also assess the interest of such potential partners and conditions under which they would be willing to partner with PRODESP to operate the expanded network under a concession or PPP. The expanded network should reach all 185 municipalities in the State of São Paulo, with preference for a fiber optic connection where economically viable, but allowing some wireless extensions for small municipalities.

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

The U.S. Firm shall:

- Meet with PRODESP and major state government stakeholders (with guidance from PRODESP) to develop an assessment of their needs, priorities, and expectations;
- Recommend strategies which would help PRODESP get municipal governments in the state to become clients of the hybrid broadband network;
- Conduct basic cost/benefit analyses for the expansion of the hybrid broadband network, taking into consideration the needs of its prospective clients; and

- Quantify the benefits in unit cost reduction and improved quality (using standard telecommunications network metrics) for broadband communications that can be achieved with the state-owned hybrid network compared with continued contracting with commercial operators (Embratel and Telefonica/Vivo).

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

TASK 3: DIMENSIONING AND ALTERNATE SCENARIOS

DATA CENTER

Based on the findings in Task 2, the U.S. Firm shall project the collective needs for the State data center system over the next five years and estimate the size and scope of data center requirements. Then the U.S. Firm shall develop two alternate scenarios for the data center system for the State of São Paulo:

- a) Expansion of one of the existing data centers; and
- b) Construction of a new state-owned data center (Tier III).

In consultations with PRODESP, the U.S. Firm shall recommend the optimum strategy for the integration of the existing data centers detailing the strengths and weaknesses of each strategy, and recommend a redundancy strategy utilizing the current storage capacity. Based on the strengths and weaknesses of each scenario and in consultation with the U.S. Firm, PRODESP shall decide on the scenario the U.S. Firm shall then analyze for the remainder of the Tasks below.

BROADBAND NETWORK

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

- a) Expansion and upgrading of the existing arrangements for outsourcing connectivity requirements;
- b) Building a statewide broadband network of its own in partnership with other companies and entities requiring or owning telecommunications facilities; and
- c) Some combination of options a) and b).

In consultations with PRODESP, the U.S. Firm shall recommend the optimum strategy for expanding and updating the needs for broadband connectivity, detailing the strengths and

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

Deliverable #3: The U.S. Firm shall prepare a report on all work done under this Task, including summarizing the alternative strategies studied and recommendations for the optimum strategies for both data center integration and consolidation and the development of the broadband network.

TASK 4: ROLES AND RESPONSIBILITIES

DATACENTER

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

- Will PRODESP continue to operate the principal data center (and any new backup data center) with its own personnel?
- Could the operation of any new data center be conducted by a private sector company under policies set by PRODESP with the support of an interagency committee?
- Can greater use be made of outsourcing to cloud service providers such as Microsoft, Google and Amazon to save on costs, freeing up resources for investment in the broadband network or other PRODESP priorities?
- What will be the role of the secretariats and agencies with applications stored in the datacenter?
- How will performance of the datacenter be measured?
- If there is a private partner, how should it be remunerated?
- Assess the favorability of alternative structures and what role PRODESP and CTIC will play in each alternative structure, including the following: (i) CTIC or PRODESP serves as the supervisory authority for a private partner operating any of the integrated and consolidated data centers, with PRODESP setting policies both for the partner and for submissions of data from the various state agencies, subject to review by an interagency committee chaired by CTIC; (ii) continuing the present arrangements under which each data center authority both sets policy and operates its data center; and (iii) at least two more options for PRODESP's role, as identified and detailed by the U.S. Firm.

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

BROADBAND NETWORK

The U.S. Firm shall conduct a study of the roles and responsibilities of the various actors involved, including the legal, institutional, structural and service levels for the operation of the

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

- Will the new broadband network be part of the administrative structure of the executive branch of the São Paulo government?
- Who will administer the hybrid broadband network?
- What will be the role of the secretariats and agencies that will use the network?
- How will performance of the broadband network be measured?
- If there is a private partner, how should it be remunerated?
- What should be the role of CTIC and PRODESP once the new network is operational?

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

Based on the strengths and weaknesses of each option and in consultation with the U.S. Firm, PRODESP shall decide on the business model for the operation and maintenance of the network that the U.S. Firm shall then analyze under the remaining Tasks set forth below.

Deliverable #4: The U.S. Firm shall prepare a report on all work performed under this Task, including a report of the roles and responsibilities for the management and operation of the datacenter and the broadband network.

TASK 5: DEVELOP FUNCTIONAL SPECIFICATIONS, ARCHITECTURE, AND DESIGN

DATACENTER

The U.S. Firm shall:

- Analyze the findings from Tasks 3 and 4 and develop specifications regarding the architecture and design of the datacenter and any needed facilities and/or software to execute the integration and consolidation of existing state data centers;
- Develop precise and detailed estimates of data center design including building security, air conditioning, power provision, uninterruptable power supply, storage, processing, and fire prevention, equipment needs and capacity, and resulting capital expenditure and operating costs;
- Design an optimum solution for the integration of all data centers, so that each one is able to implement redundancy and to utilize idle machines to process tasks from another data center;
- Develop technical specifications for all main components of the proposed data center as follows:
 - Storage facilities and electronics;
 - Location and housing space;

- Electric power supply;
- Air conditioning requirement;
- Back-up power generators;
- Fire protection equipment; and
- Other peripheral requirements.

These technical specifications shall be sufficient to be used in the bidding documents that will be prepared by the state's local procurement experts; and

- Propose and draft service level agreement (SLAs) for the new integrated and consolidated datacenter system.

BROADBAND NETWORK

The U.S. Firm shall:

- Analyze the findings from Tasks 3 and 4 and develop specifications regarding the architecture and design of the hybrid broadband network;
- Assess the opportunities for partnerships with CPFL, RNP, commercial telecommunications companies and any other entities having or seeking dark fiber or spectrum in lit fiber;
- Develop precise and detailed engineering estimates of network designs, equipment needs and capacity, and resulting capital expenditure and operating costs;
- Propose and draft service level agreement (SLAs) to specify degrees of redundancy, maximum response times to incidents, percentage of “up time” and other technical metrics for the statewide hybrid broadband network; and

Deliverable #5: The U.S. Firm shall prepare a report on all work performed under this Task, including the datacenter and hybrid broadband network designs, functional specifications and architecture.

TASK 6: ECONOMIC AND FINANCIAL ANALYSIS

The U.S. Firm shall conduct an overall cost evaluation with a projected useful life of 10 years for both the data center and broadband network components of the Project. The analysis shall identify total capital expenditures, operating costs, and maintenance expenses, and shall be apportioned as initial investment or annual outlays as the case might be. The discount rate to be used in the calculations shall be agreed upon with PRODESP prior to undertaking this task.

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

- Quantify the benefits in unit cost reduction and improved service quality and reliability (using standard telecommunications network metrics) for the data center and broadband connectivity services that could be achieved with the new hybrid broadband network as compared with the current connectivity arrangements;

- Assess the technical, economic, financial, and organizational aspects of the broadband network and data center consolidation;
- Calculate the Net Present Value and evaluate Total Cost of Ownership of the São Paulo state data centers and broadband network;
- Develop Implementation Finance Plans for the São Paulo state data centers and broadband network;
- Prepare risk analysis, rate return analysis, and analysis of total cost of operation for each technological option presented during the technical assistance;
- Conduct sensitivity analysis for the main factors affecting the success of the Project components, including commercial risk, technology obsolescence, and competitive forces; and
- Prepare a detailed operational model.

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

TASK 7: PRELIMINARY ENVIRONMENTAL ASSESSMENT

The U.S. Firm shall:

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

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

TASK 8: DEVELOPMENTAL IMPACT ANALYSIS

The U.S. Firm shall identify and assess the developmental outcomes that would be expected if the Project is implemented in accordance with the recommendations of the TA.

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

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

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

Sector	Category	Indicator	Description	Anticipated Outcome
Telecom	Infrastructure Development and Efficiency Gains	Improved Output through Advanced Technology	New technologies introduced, resulting in an increase of efficiency, capacity, or government output	Y

For the Data center the main indicator is

All	Infrastructure Development and Efficiency Gains	Improved Data Management and Security	Capacity added, security gained and reliability improved through implementation of data centers, cloud computing systems, or other storage infrastructure	Y
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The U.S. Firm shall update the indicators chosen and anticipated measurable outcomes, based on the recommendations resulting from the technical assistance. The U.S. Firm shall then incorporate the baseline analysis and adjust the findings, as needed, to explain how the proposed activity will directly impact development in Brazil. The U.S. Firm shall work closely with the Project sponsor as well as USTDA personnel at this stage to ensure that the final report clearly displays the anticipated outcomes that will be achieved when the Project is implemented. These updates are used in future evaluation efforts to monitor progress and expected timeframes when the development impact will be realized.

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

TASK 9: ESTABLISH OPERATIONAL AND ADMINISTRATIVE REQUIREMENTS

In consultations PRODESP, the U.S. Firm shall recommend the organizational structure, personnel requirements, and support resources that would be required to effectively manage a consolidated data center and broadband network. The U.S. Firm shall:

- Review the current organization and define new the corporate governance structures for each of the Project components;
 - Identify problems that may arise due to administrative changes in the São Paulo State Government that could affect the relationship between the Government and PRODESP, and what obstacles may arise from consolidating smaller data centers or servers into PRODESP's data center, particularly for entities not yet using PRODESP's services;
 - Define the qualifications, respective roles and relationships of the staff;
 - Identify the support resources needed for effective management;
 - Define training programs for professional development and a regular training schedule;
- and
- Clearly define any outsourcing contract objectives (scope, service levels, metrics, requirements, etc.).

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

TASK 10: TERMS OF USE

The U.S. Firm shall define policies that will regulate the use by São Paulo state secretariats, agencies, and other state and municipal entities. These policies shall be prepared in a format that can be used in a decree(s) or regulation(s) to be issued by the Governor of the State of São Paulo. The objective is to ensure that all PRODESP client entities in the state can use the consolidated data center and broadband network with the same level of trust and governability.

Deliverable #10: The U.S. Firm shall prepare a report of all the work performed and findings under Task 10.

TASK 11: PROJECT PLANNING AND IMPLEMENTATION

The U.S. Firm shall develop a deployment plan that will guide the relevant authorities throughout the implementation of the Project. The plan shall include specific recommendations on the steps that PRODESP and CTIC should undertake, as well as timing of these, to ensure that all aspects of the Project will take place in an expeditious and effective manner. The document shall include a bar chart depicting every activity required for the successful implementation of the Project and assess and determine what the critical goals and success factors are for Project implementation, and shall identify relevant risks and mitigants to achieve these goals/success factors. The analysis shall address the following goals/success factors:

- The government shares with any private sector partners the benefits of productivity increases arising from technological change, and not just the costs;
- Continual monitoring of the contractual conditions in relation to the market is carried out – provisions for this need to be incorporated in the contract itself;
- Contract objectives for any PPP, concession, Build Operate Transfer (BOT) agreement or other legal arrangement for the relationship between public and private entities involved (scope, service levels, metrics, length of contract, renewability, terms for renewability,

requirements, etc.) are clearly specified;

- Top government managers necessary to achieve efficient Project implementation are involved and supportive of the Project;
- Priority is obtained for any payments to private sector partners for strategic and critical activities outsourced;
- Potential difficulties the São Paulo state government may encounter during project implementation and how these challenges can be mitigated;
- Any new regulations that need to be enacted or whose enactment may be detrimental to the Project;
- Penalties for noncompliance with contract conditions are established and applied if violations are detected;
- A clear process is defined for exiting from the contract and transition to one or more other private sector partners with operating responsibilities for the Project or sharing infrastructure of the hybrid broadband network; and
- Other critical success factors inherent in any outsourcing for ICT services and means to achieve them defined.

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

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

Deliverable #11: The U.S. Firm shall prepare a report of all the work performed and findings under Task 11, including a Project Impact Report and a Project Implementation Report.

TASK 12: PRESENTATION OF THE DRAFT FINAL REPORT

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

- Create an accompanying PowerPoint presentation; and

- Identify any additional suggestions or recommendations derived from PRODESP's responses to the presentation.

Deliverable #12: The U.S. Firm shall travel to São Paulo to present the draft Final Report and PowerPoint Presentation.

TASK 13: FINAL REPORT

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

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