Definitional Mission to Evaluate ICT Projects in Brazil: Volume 4: Pernambuco

(Volumes 1, 2, 3, 5 & 6 Issued Separately)

Final Report

Submitted by
Hellerstein & Associates

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

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I. EXECUTIVE SUMMARY

Grantee: The Pernambuco State Information Technology Agency (ATI)

Activity Budget: $736,930.

U.S. Export Potential: Fiber optic cables; optical electronics; wireless equipment such as antennas, transmitters, and receivers; systems and application software, Servers, Switches, Storage, virtualization software, other data center equipment, and cloud storage services; total approximately US$73 million.

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

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

Accordingly, ATI aims to propose and provide integrated solutions of means, methods and skills, making intensive and appropriate use of information technology; channeling efforts to improve the services provided by the state public administration; and preserving the management, control and the integrity of strategic state information. ATI is responsible for technical coordination of distributed data processing units called Sectoral Informatics Centers (*Núcleos Setoriais de Informática* – NSIs) in state secretariats. All NSI staff are ATI employees.

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

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

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 Definitional Mission (DM) for USTDA requires development of detailed terms of reference (TOR) for activities recommended by the consultants, detailed consultant qualifications, and

a detailed Project budget, with final approval of the activities by USTDA. This Final Report contains a summary of the DM process and findings. The DM Contractor's recommendations, the TOR, consulting team qualifications, and budget for the project are presented here.

II. PROJECT DESCRIPTION

A. Introduction

Brazil

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

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

Brazil is the largest country in Latin America, with an estimated population of 206,3 million in August 2016, it is also the most populous. According to the World Bank, in 2014 Brazil's economy was the seventh largest in the world. Per capital income was US$11,790 in 2014. The five largest cities are São Paulo, Rio de Janeiro, Salvador, Fortaleza, and Belo Horizonte. There are 29 cities of over 500,000 people, and 5,570 municipalities. With almost 30 million people in the rural areas, provision of affordable broadband to this group, which has the lowest average income levels, presents a particularly severe problem.

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

To help improve broadband coverage and reduce the cost of broadband access, the government launched a major broadband infrastructure development initiative in 2010, setting ambitious targets to triple broadband uptake by 2014. The National Broadband Plan (*Plano Nacional de Banda Larga* – PNBL) aimed to ensure that broadband access is available to low-income households, especially in areas that have

so far been poorly served. Many States created strategic plans and are implementing the projects in these plans. Most state Governors understand that they need to modernize their government secretariats and agencies, and support them with a modern information infrastructure so they can become transparent and nimble, focused on producing excellent public services in essential areas, such as public safety, education, health, and welfare. These states are creating public and private partnerships to help achieve these goals. For example, the Rio de Janeiro Government states that Government's role should be as an articulator, motivator and facilitator by creating conversations with public and private entities in their effort to modernize the Government and create a 21st century public administration.

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

Despite receiving considerably less investment resources than announced on various occasions by government official (that can be considered a sign of less than urgent priority for the PNBL), Telebras has gradually created a national network of fiber optic cables, in large part through public-public and public-private partnerships that involve leasing or exchanging existing dark fiber. As of 2016, the Telebras network includes 28,000 km of fiber. In 2011 Telebras established long-term rental contracts for use of fiber pairs some 16,000 km in the optical ground wire (OPGW) cables of electric power companies that are run by Eletronet, a company that is owned by Eletrobras and AES, an American company. Telebras also leased some 2,200 km of fiber from Petrobras. Another 2,200 km were obtained in an exchange of use of fiber with a private operator, TIM, in 2013. These arrangements allowed expansion of Telebras trunk lines in rings that provide redundant links in case of failure at any point in the system. Telebras has also invested in its own fiber optic links to provide high capacity redundant links to the six cities where the Confederations Cup soccer matches were played in 2013 & to the 12 cities that hosted the World Cup matches in 2014.

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

The growth of the Telebras network has increased competition and thereby led to lower prices offered by private providers. Telebras says it has not cut the wholesale prices it charges as far as it could and still cover costs so as not to drive the private operators, needed for meeting Internet penetration goals, out of the market. The federal government encourages private operators to expand digital inclusion of populations in underserved markets. Telebras is also investing in a Brazilian geostationary satellite providing military X band and civilian KA band communications covering all of Brazil's territory. The

satellite is scheduled to be launched in late 2016 and enter service in the first quarter of 2017. Telebras also has plans for submarine fiber optic cables to Africa, Europe, and the United States to reduce costs for Internet connectivity. It is unclear whether the necessary resources will be forthcoming to undertake these investments.

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

Another strategy to support the PNBL is requiring coverage of rural areas when auctions are held for mobile spectrum allocation. Operators bidding on 450 MHz frequencies were required to provide voice and data services in rural areas and remote regions as well as free access to rural public schools. Winning bidders were required to offer these services on a commercial basis within a radius of 30 km from the municipal seat (capital) in all *municípios*[1] by the end of 2015, thus covering 91% of the rural population. They also had to provide free broadband connections to all the public schools in these areas, thus serving 96% of public schools. Winners were determined according to the lowest price on commercial connections. In 2012 federal law 12,715 provided a full exemptions from federal taxation for telecommunications services offered on this frequency and for small satellite antennas as well as for network equipment, terminals, and transceivers for these services.

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

Prior to the establishment of the PNBL, a large number of municipal and state-supported efforts to improve access to the Internet were already underway, including the use of tax incentives and provision of low-cost, or even free broadband services in public access facilities (telecenters) and schools. These efforts are now accelerating as implementation of the PNBL proceeds. For example, the state of Sao Paulo has exempted broadband from the state value-added, and developed a network of 850 telecenters with more than 3 million registered users supported by 1,211 supervisors in 600 municipalities.

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

In 2005 RNP began a program to build fast metropolitan fiber optic networks in Brazil's major cities in association with a variety of partners. This program is called Redecomep, and as of December 2015 had 36 metropolitan networks in operation with some 3,650 km of fiber optic cables. Redecomep achieved

[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.

this by partnering with electric power companies, state and municipal governments and other entities that provided rights or way, ducts or poles in return for access to fibers in these cables.

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

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

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

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

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

- The state or *município* takes advantage of dark fiber allocated to it in the state capital's Redecomep;
- Partnerships are established with RNP; municipalities, state and federal public enterprises, private telecoms, and Telebras to extend the network's reach and share costs of operation and maintenance;
- Complementary fiber and wireless networks are built to fill in gaps and provide capillarity (urban as well as rural);

- Maintenance and operation are outsourced to private firms; and
- States or *municípios*
- lease dark fiber in their networks to private operators to generate additional revenue, helping to cover operating and maintenance costs.

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

The state of Pernambuco

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

Figure 1: Political Map of Brazil

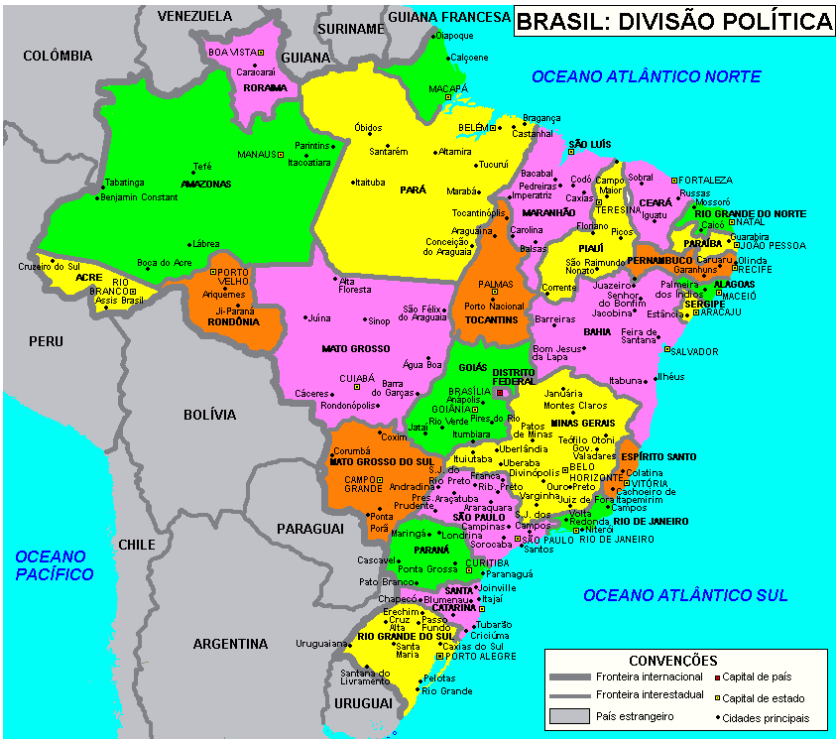

Figure 2: Map of Pernambuco

Figure 3: Archipelago of Fernando de Noronha

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

Pernambuco's GDP in 2013 Brazil's eighth largest, and its per capita GDP US$6,048, about 58% of the national average. The state's geographical regions include a narrow well-watered coastal zone (*zona da mata*) with extensive sugar cane plantations, a high semi-arid inland plateau (*sertão*) subject to periodic droughts and used mainly for extensive grazing of livestock, and an intermediate zone formed by the terraces and slopes between the two with moderate rainfall (*agreste*) where smaller farms predominate.

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

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

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

ATI

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

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Accordingly, ATI aims to propose and provide integrated solutions of means, methods and skills, making intensive and appropriate use of information technology; channeling efforts to improve the services provided by the state public administration; and preserving the management, control and the integrity of strategic state information. ATI is responsible for technical coordination of distributed data processing units called Sectoral Informatics Centers (*Núcleos Setoriais de Informática* – NSIs) in state secretariats. All NSI staff are ATI employees.

The Multi-Year Plan (*Plano Plurianual* – PPA) for the period 2016-2019[2], approved by the state legislature on 21 December 2015,

B. THE PROJECT

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

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

plans to:

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

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

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

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

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

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

The U.S. firm would then help ATI implement a proof of concept for the new cloud computing based data center system architecture. ATI has a plan for upgrading the datacenter equipment to a state-of-the-art facility capable of serving forecast demand over the next ten years. It has a modern vault room constructed by Aceco located on its premises. It was inaugurated in 2015 (Figure 6). Much of this equipment is either obsolete or of insufficient capacity to handle expected demand, including cloud services to be made possible by the statewide Broadband PPP project that will provide reliable high-speed connectivity to state installations in both in Recife and the interior of the state.

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

H&A visited the four largest state data centers belonging to ATI, the Secretariat of Finance, the

Secretariat of Education (SEE/PE), and the Department Transportation (DETRAN) and held discussions with their managers.

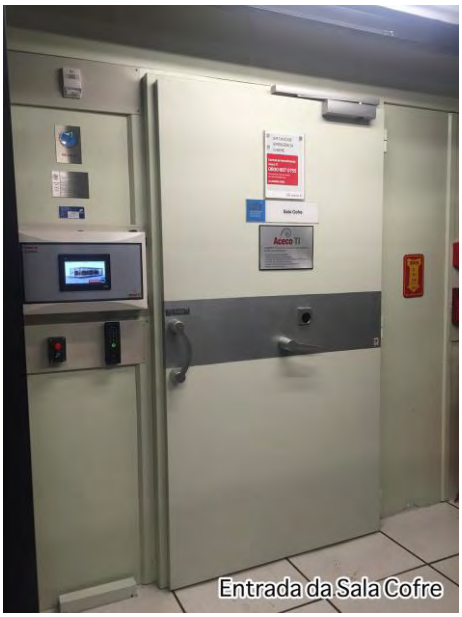
The ATI data center. This data center serves 3,830 "multidigital clients" (*Pontos Clientes Multidigital* – PCMs) – 1,396 in the Recife Metropolitan Area, 2,114 in the interior of the state, 54 temporary PCMs, and 266 special PCMs with dedicated data links – and 40,000 fixed VoIP (Voice over Internet Protocol) voice stations (*Pontos de Voz Fixo* - PVF) using VoIP technology with links with up to 155 Mbps. For these purposes, ATI has 700 servers in its data center, providing more than 200 services to client government agencies in the state and to the population of Pernambuco. The Corporate Internet connects the entire network with 2.5 Gbps bandwidth. ATI's Data Center offers physical servers, virtual servers (APP, DATA and OS) and virtual resources (vCPU, vRAM and Storage), providing:

- Pre - Cloud Computing Environment;
- 100% virtual infrastructure;
- High availability system; and
- Redundant infrastructure.

Figure 4 includes photographs of major elements of the ATI data center.

Figure 4: ATI Data Center

Entrance to safe room



Entrance to vault room

Safe room

Vault room

IBM mainframe

Fire control system

Servers and Storage

Storage

Network connections rack

Fiber optics connections

ATI data center equipment summary:

The current configuration of the vault room and its subsystems has a total constructed are of 125 m^2, composed of the vault room with 75 m2, a safe room with 50 m^2, and a UPS room with 50 m^2. These rooms include the equipment and software shown in Tables 1-4.

Table 1: Vault room – Description of Resources

Quantity	Description
01	Biometric access control VAULT F9 -
01	Early fire detection system
01	Blocking key Digisensor -
01	Manual General Electric actuator
01	Audiovisual siren
01	CHEMETRON Micro XLT control panel
06	Conventional fire detector
02	Fire extinguishing gas cylinder CHEMETRON FM 200 VN3296
01	Aceco central control ABNT NBR 15247 certified
04	Energy distribution panel
04	IP GERP C DOME IP 2MP cameras
01	Management server CFTV
01	Temperature and humidity sensor
01	Temperature and humidity sensor - climate control
01	Rittal Netwatch processing unit
01	Liquid presence sensor
01	Stratos Micra 25 smoke detector

75m^2	Aceco elevated floor
200	Furukawa CAT 6A 10Gbps logical points
01	CMC monitoring system
06	Emerson HCE 33 23KW condenser unit

Source: ATI

Table 2: Safe Room – Description of resources

Quantity	Description
01	Hersteller armored entry door
01	VAULT F9 biometric access control
01	IP GERP C DOME IP 2MP camera
50m2	Aceco elevated floor
02	Evaporation unit (Model for central air conditioning, 15RT
02	Electrical distribution panels
200	Furukawa CAT 6A 10Gbps logical points

Source: ATI

Table 3: UPS Room – Description of Resources

Quantity	Description
02	120kVA UPS
02	120kVA battery array
01	160kVA UPS
01	160kVA battery array
01	200kVA UPS
01	200kVA Battery array
01	STEMAC 230kVA generator
01	STEMAC 560kVA generator
02	STEMAC 430kVA generator

Source: ATI

Table 4: IT equipment: Rack Blade Servers (Total Capacity 3.78TB RAM; 3.2THz CPU), Storage, Mainframe and other

Quantity	Description
01	HP c7000 – 16 blades
01	DELL M1000e – 13 blades M620

01	DELL M1000e – 3 blades M520
01	DELL M1000e – 14 blades M520
01	DELL M1000e – 12 blades DXM520
01	DELL M1000e – 12 blades DXM520
01	IBM 86773XU – 12 blades HS20
05	Supermicro rack servers
04	Dell R715 DE rack servers
02	IBM 3650 M4 rack servers
01	EMC VNX 5200 storage, 35TB
03	EMC VNX 5300 storage, 415 TB
01	HP EVA 8100 storage, 18TB
01	DotHill DH3730 storage, 5TB
02	EMC VPLEX V2 appliances
02	Fortinet 3040B Firewall
02	Fortinet 300C Firewall
02	Black Diamond 8800 core switch
02	Dell Force10 core switch
01	IBM z890 mainframe
01	IBM DS8000 storage, 18TB

Source: ATI

There are more than 1.000 virtual machines, with Linux and Windows operating systems, Postgress SQL database, SQL Server, MySQL, ADABAS and Oracle.

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

- Agility;
- Elasticity;
- Automation;
- Sharing;
- Scalability;
- Economic viability;
- Monitoring;
- Accounting by use;

- Standardization;
- Capacity Planning;
- Management;
- Direct Processing Power for users;
- Innovation;
- Development of Open Data solutions;
- Transparency;
- Self Service;
- Backup;
- Multimedia;
- Integration and
- Control, among others.

ATI estimates a total cost for it's data center upgrade of R$40 million (about US$13.3 million), of which hardware R$15 million, software R$15 million, and services R$10 million. Hellerstein & Associate's estimates are slightly higher: R$45 million or about US$14 million.

The Secretariat of Finance (SEFAZ/PE) has a substantial data center and in June, 2016 was in the final stages of construction of a new Aceco vault room with enough space to house a backup of the ATI data center (Figure 7). Whether this opportunity should be taken advantage of, whether it should be a full active-active backup of the ATI data center, and what kind of equipment and software should be installed, should one the answer be yes, is one of the issues for which ATI seeks USTDA-funded technical assistance in addressing. Another possibility that should be considered is cloud backup using one of the commercial services like Microsoft's Azure, Amazon Web Services or Google Cloud Platform.

Figure 7: The SEFAZ/PE data center

Entrance to existing SEFAZ/PE data center	*Biometric entry controlSEFAZ/BA data center*
 *Storage SEFAZ/PE data center*	 *Fire control SEFAZ/PE data center*
 *SEFAZ-PE equipment*	 *SEFAZ-PE IBM equipment*

SEFAZ-PE Equipment

SEFAZ-PE UPS cabinets

The equipment and software of the SEFAZ/PE data center is shown in Table 5.

Table 5: SEFAZ/PE Data Center

Quantity	Description
02	IBM P750 RISK servers
03	HP C700 blade chassis, 48 blades
08	DELL rack servers
01	IBM V700; 90TB
01	HP EVA440; 25TB
01	DB2 e MS-SQL software
01	Aceco vault room 25m^2 (like those of ATI and SEE)
02	120kVA generator
02	120kVA UPS (Redundant, parallel active)

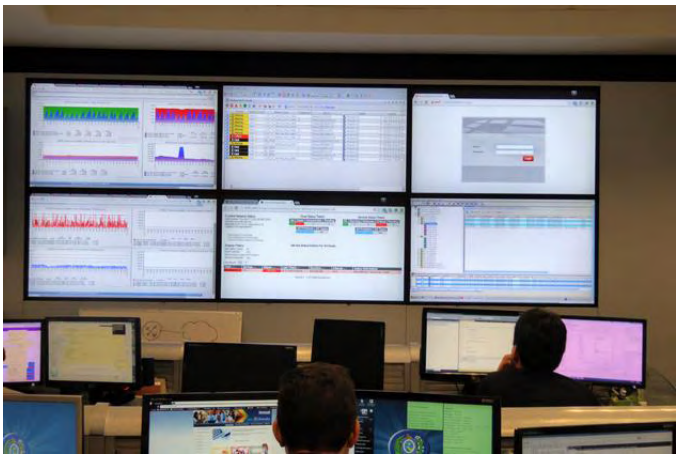
Source: ATI

The Secretariat of Education (SEE/PE) data center

The SEE/PE data center has a modern Aceco-built safe room and has modern generators and other electrical equipment. The H&A consultant was not able to visit the safe room. A full list of its hardware is included in Annex I. Figure 8 shows some photos of this data center's control room and electrical equipment.

Figure 8: SEE/PE data center

SEE/PE data center Aceco branded



SEE/PE Control Room

SEE/PE generators

SEE/PE generators close-up

SEE/PE UPS Cabinet

SEE/PE equipment

The DETRAN/PE data center

The least secure and up-to-date data center visited is that of DETRAN/PE. Figure 9 provides some photos from this data center.

Figure 9: DETRAN-PE data center

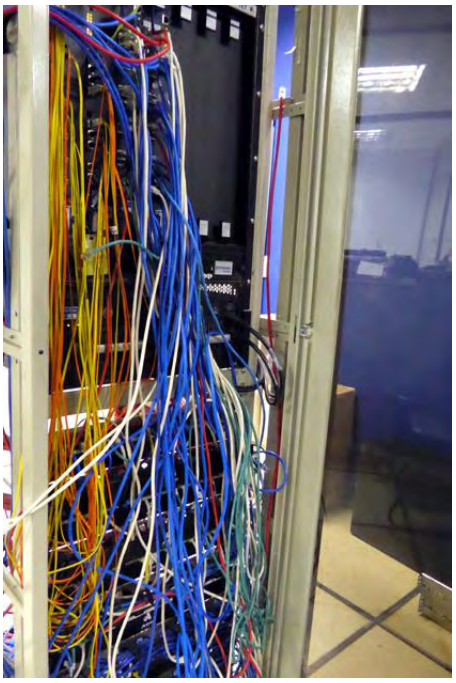
Storage equipment

IBM storage

Sun Storagetek SL500

Sun StorEdge 6910

Racks



Cables back side of rack

Optical distribution equipment

Sun storage equipment

UPS cabinet

Closeup of UPS equipment

Table 6: Equipment of the DETRAN/PE data center

Quantity	Description
02	SunFire V880
01	Sun T3-1
01	Sun T5120
01	IBM Blade Center – 6 Blades (HS22 e HS23)
01	IBM storage, 25TB
01	6910 storage, 1TB
01	StorEdge 6140 storage, 24TB

Source: ATI

The State Corporate Network Project (*Infovia Digital da Pernambuco Projeto Rede Corporativa* – IDBPE-Global)

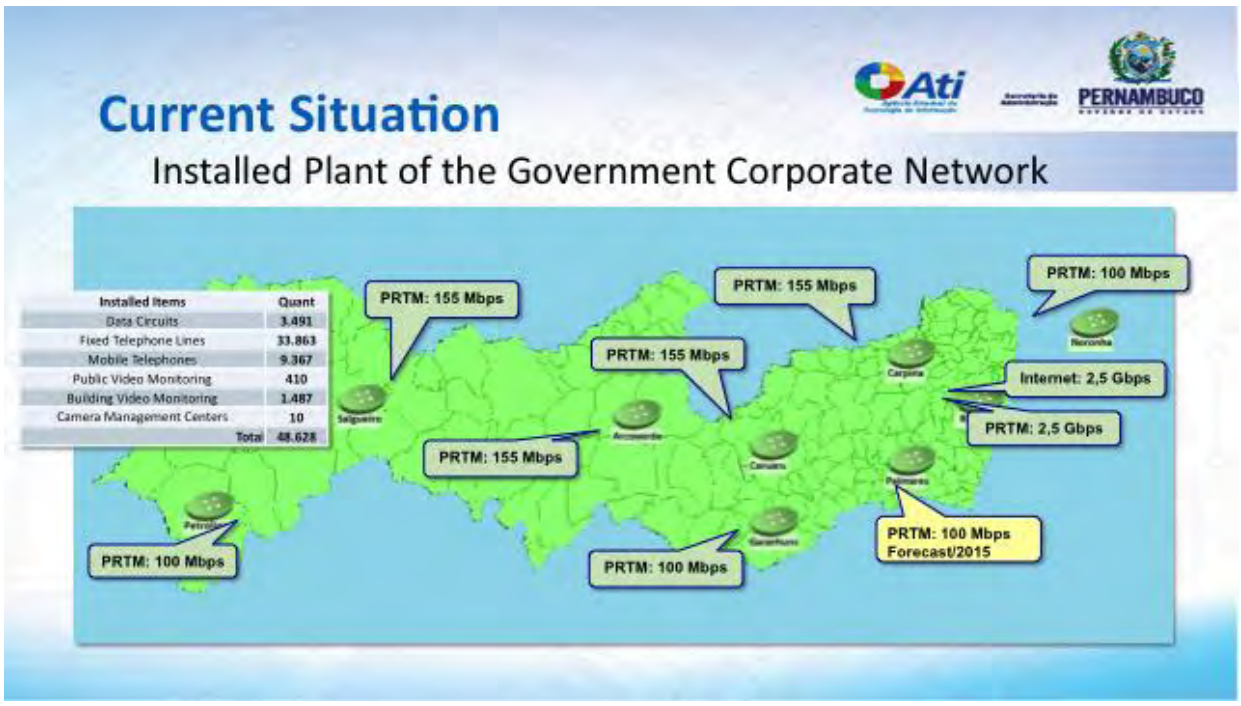
The PE-Global project would provide connectivity, through designing and implementing its own broadband network to interconnect all units of the state government located in the Recife Metropolitan Region (RMR) to meet their demands for ICT services. This new corporate network would update existing leased physical and logical broadband network infrastructure, increasing speed and agility in responding to demands for service, modernizing the technological base of government, reducing OPEX and optimizing the use IT resources.

Figures 10 and 11 depict the state of ATI's network in 2016

Figure 10: Network management

Source: ATI Gerência de Redes e Conectividade

Figure 11: Installed plant



Source: ATI Gerência de Redes e Conectividade

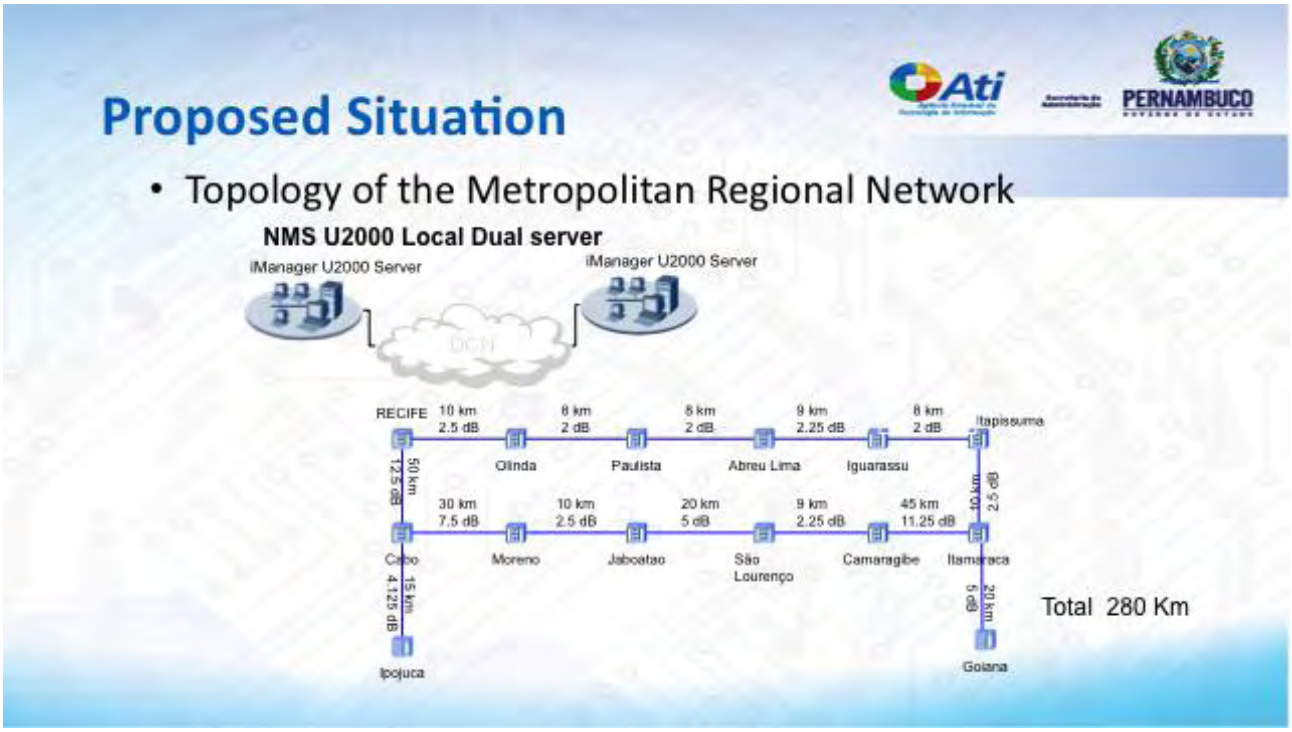
The major links in the existing Government Corporate Network are listed below (PRTM is same as a point of presence plus central VOIP connections with the public network .

- Recife: PRTM -> 4,0 Gbps e INTERNET -> 2,2 Gbps;
- Carpina: PRTM -> 310 Mbps;
- Palmares: PRTM -> 200 Mbps;
- Caruaru: PRTM -> 310 Mbps;
- Garanhuns: PRTM -> 200 Mbps;
- Arcoverde: PRTM -> 310 Gbps;
- Salgueiro: PRTM -> 310 Gbps;
- Petrolina: PRTM -> 200 Mbps; e
- Fernando de Noronha: PRTM -> 155 Mbps.

The current network is outsourced to a consortium, PE-Conectado, led by Oi. The PE-Conectado contract was estimated in 2012 to cost R$1.3 for a five-year period.

Figures 12-14 depict ATI's proposed topology, new applications to be supported, and technical requirements for the PE-Global project.

Figure 12: Proposed Topology for the Recife Metropolitan Area

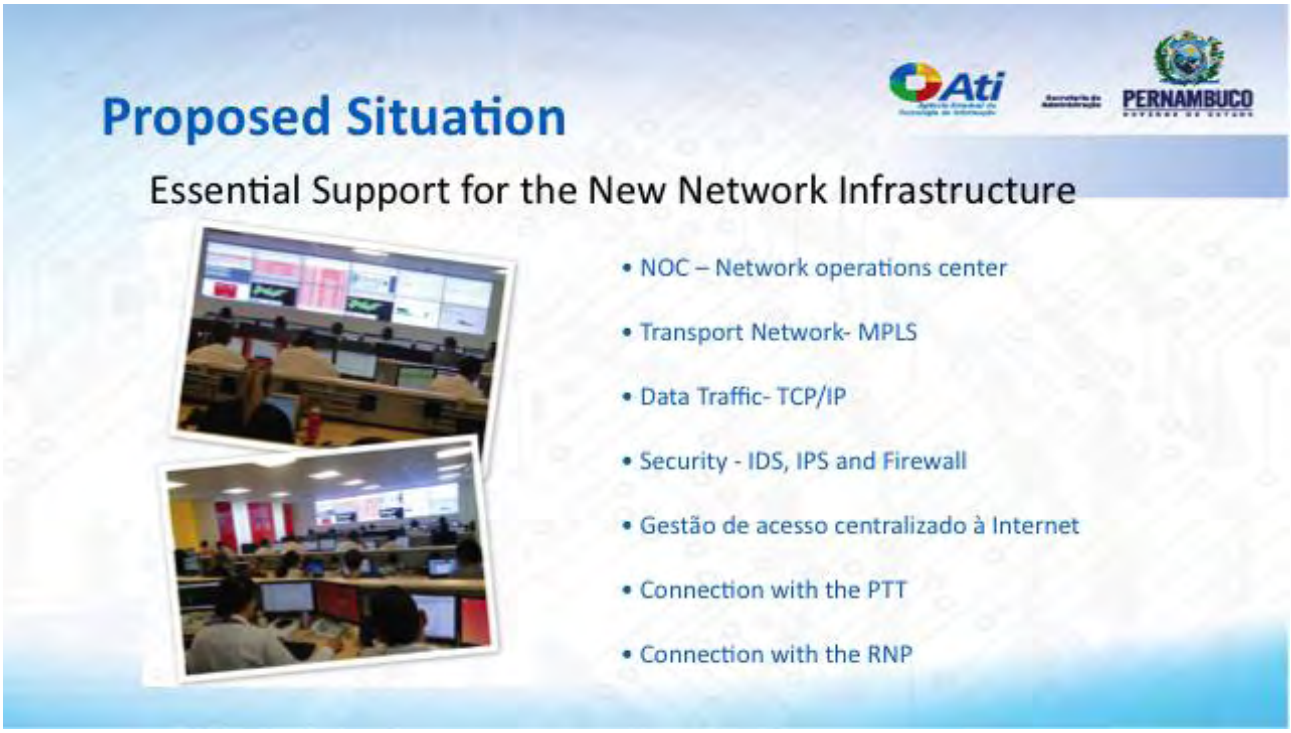


Source: ATI Gerência de Redes e Conectividade

Figure 13: Possibilities for Innovation

Source: ATI Gerência de Redes e Conectividade

Figure 14: Required Network Infrastructure



Source: ATI Gerência de Redes e Conectividade

Table 7: Suggested Routes for PE-Global Fiber Backbone

Segments	**km**
Swaps with telecommunications operators	
ATEL Telecom PNZ-PAF-SAL-CAU	870
OPPS Telecom Paulo Afonso/BA - Caruaru	530
Subtotal swaps with telcos	*1,400*
New deployment	
Salgueiro/PE - Araripina/PE	190
Ouricuri - Petrolina/PE	290
Serra Talhada - Arcoverde/PE	280
Rota Floresta - Arcoverde/PE	190
Petrolândia - Garanhuns	260
Caruaru - Recife/PE	140
Garanhuns/PE- Recife/PE	290
Recife - Goiana/PE Ring	190
Subtotal new deployment	*1830*
Grand total PE-Global	**3,230**

Source: RNP

Figure 15: Map of Proposed PE-Global

Source: RNP

Once the project is implemented, it will be possible to develop an integrated governance system to link all departments and public agencies, provide greater speed and efficiency in the delivery of public services, thereby reducing costs to the state through the use of an efficient multiservice communications infrastructure.

The population will gain access to broadband Internet connectivity, allowing every citizen to have free access through public telecenters and schools. At the municipal level, priority will be given to the poorest strata of the population, the *quilambolas* (settlements established at the end of the 19th century by freed slaves), indigenous communities, and agrarian reform settlements.

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

A hybrid fiber and wireless data network should reach all Pernambuco's 185 *municípios,* providing efficient and low-cost telecommunications service. Then each point of presence (POP) will require at least a minimal ICT infrastructure allowing use of this network.

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

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

information and training facilities.

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

Swaps (*Permutas*) are another way to reduce costs, and are widely used in the telecommunications industry between commercial telecommunications operators, though this fact is not widely known and it is extremely difficult to obtain maps showing each company's network and those parts that are shared or traded with other companies.[3] Several other Brazilian states, led by Pará and Ceará have invested in their own fiber networks and engaged in sharing of fiber cables with partners including RNP, Telebras, Petrobras, and federal and state electric power distribution companies. A number of other states have begun or are planning to do the same, among them Rio de Janeiro, Rio Grande do Sul, Santa Catarina, Sergipe, Tocantins, Bahia, and Paraíba.[4]

Potential partners for building ATI's broadband network

The first logical partner for ATI is the National Education and Research Network (*Rede Nacional de Ensino e Pesquisa* – RNP). ATI is already a partner in the Redecomep metropolitan networks program. In addition today RNPhas 140 km of its own fiber in partnership with the Secretariat of Social Protection (*Secretaria de Proteção Social*) that interconnects nine government units for the transmission of data from 237 video monitoring cameras.

Figure 16 shows the Recife metropolitan network (Rede Ícone), one of the RNP's Redecomep networks, in which the Pernambuco state government has at least two pairs, initially dark fiber, that has been lit by ATI and will serve as the starting point for the state broadband network. Figure 16 includes extensions deployed by ATI to reach government buildings in the Recife metropolitan region The RNP has another fiber network in Petrolina in the northwest southwest corner of the state on the São Francisco, Rede VASF (Figure 17). It also extends to Juazeiro, a city on the other side of the São Francisco River, in the State of Bahia. The RNP is interested in connecting the two metropolitan networks and also research and higher education institutions in the interior of the state. Table 1 shows a list of those institutions and their locations. There are 22 campi in 21 of the 185 *municípios* not already served by metropolitan networks (Table 7). As of May 2016, RNP expects to have resources on the order of R$1.6 million (about US$450 thousand) to invest in Pernambuco, and is eager to be a partner in the Pernambuco broadband network.

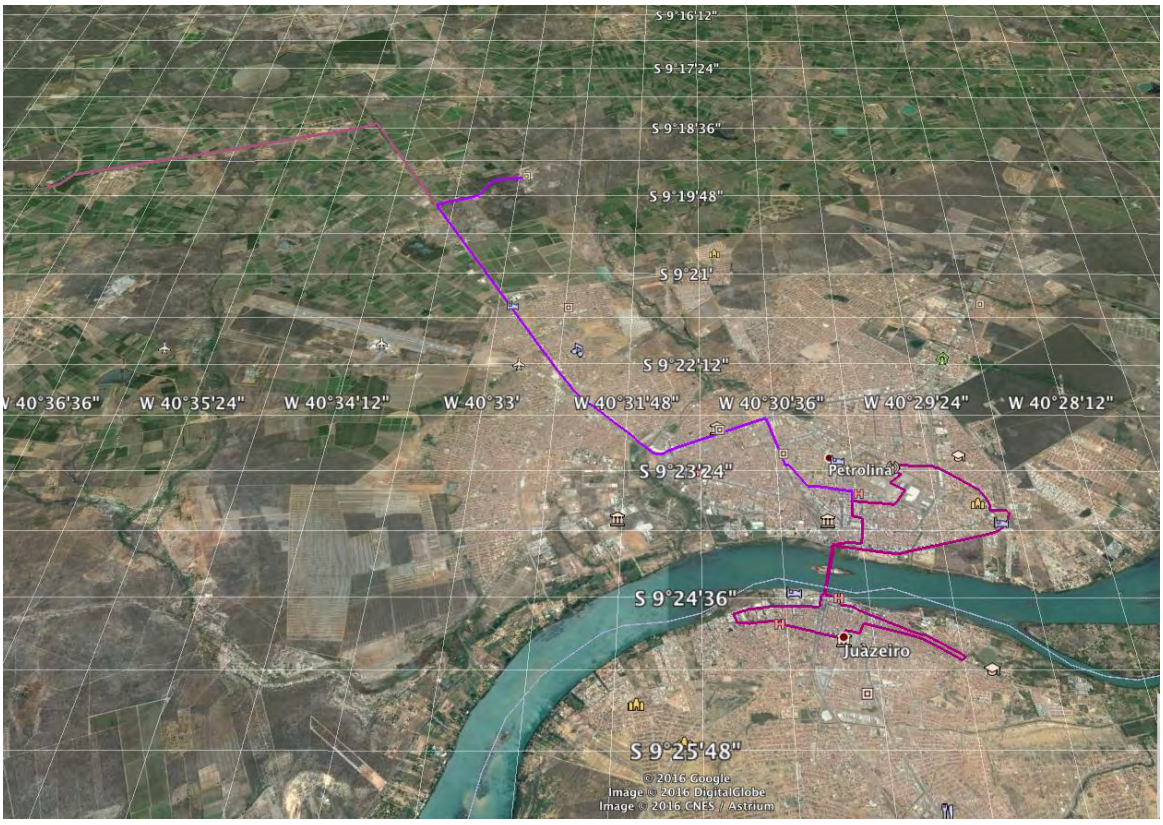
[3] See Knight, Peter T. (May, 2014) *The Internet in Brazil: Origins, Strategy, Development, and Governance*. Bloomington, IN: Author House, especially Chapter 1, "The Strategic Importance of the Internet for Brazil's Development" for further analysis. A Portuguese language version of the book is also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

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

Figure 16: Existing Recife Metropolitan Network (Rede Ícone)

Source: ATI

Figure 17: The RNP's VASF Network in Petrolina, Pernambuco and Juazeiro Bahia



Source: RNP

As part of its *Veredas Novas* program to "interiorize" its network, RNP is interested in connecting the two metropolitan networks and also research and higher education institutions in Recife, and the interior of the state not already connected by RNP fiber. Table 8 shows a list of those institutions and their locations.

Table 8: Research and higher education institutions RNP seeks to connect in Pernambuco

Organization	Institution	Município
Universidade Federal de Pernambuco (UFPE)	***Subotal 2***	
UFPE	Campus Centro Acadêmico de Vitória	Vitória de Santo Antão
UFPE	Campus do Agreste	Caruaru
Universidade Federa Rural de Pernambuco (UFPRE)	***Subtotal 4***	
UFPRE	Campus de Serra Talhada	Serra Talhada
UFPRE	Campus de Santo Agostinho	Cabo de Santo Agostinho
UFPRE	Campus de Garanhuns	Garanhuns
UFPRE	Colégio Agrícola Dom Agostinho Ikas	São Lourenço da Mata

INSTITUTO FEDERAL DE EDUCACAO, CIENCIA E TECNOLOGIA BAIANOInstituto Federal de Pernambuco (IFPE)	***Subotal 11***	
IFPE	Campus Afogados da Ingazeira	Afogados da Ingazeira
IFPE	Campus Barrreiros	Barreiros
IFPE	Campus Belo Jardim	Belo Jardim
IFPE	Campus Cabo de Santo Agostinho	Cabo de Santo Agostinho
IFPE	Campus Caruaru	Caruaru
IFPE	Campus Garanhuns	Garanhuns
IFPE	Campus Ipojuca	Ipojuca
IFPE	Campus Jaboatão dos Guararapes	Guararapes
IFPE	Campus Palmares	Palmares
IFPE	Campus Pesqueira	Pesqueira
IFPE	Campus Vitória de Santo Antão	Santo Antão
Instituto Federal de Educação, Ciência e Tecnologia do Sertão Pernambucano (IF SERTÃO-PE) and IFECT	***Subtotal 6***	
IF SERTÃO PE	Campus Floresta	Floresta
IF SERTÃO PE	Campus Ouricuri	Ouricuri
IF SERTÃO PE	Campus Petrolina Zona Rural	Petrolina
IF SERTÃO PE	Campus Salgueiro	Salgueiro
IF SERTÃO PE	Campus Santa Maria da Boa Vista	Santa Maria da Boa Vista
IFECT	Campus Serra Talhada	Serra Talhada
Universidadede Pernambuco (UPE)	***Subtotal 15***	
ESEF - Escola Superior de Educação Física	Campus de Recife	Recife
FCAP - Faculdade de Ciências da Administração de Pernambuco	Campus de Recife	Recife

FCM - Faculdade de Ciências Médicas de Pernambuco	Campus de Recife	Recife
FENSG - Faculdade de Enfermagem Nossa Senhora das Graças	Campus de Recife	Recife
FOP - Faculdade de Odontologia de Pernambuco	Campus de Recife	Recife
ICB - Instituto de Ciências Biológicas	Campus de Recife	Recife
POLI - Escola Politécnica de Pernambuco	Campus de Recife	Recife
CISAM - Centro Integrado de Saúde Amaury de Medeiros	Campus de Recife	Recife
HUOC - Hospital Universitário Oswaldo Cruz	Campus de Recife	Recife
PROCAPE - Pronto Socorro Cardiológico de Pernambuco	Campus de Recife	Recife
FOP - Faculdade de Odontologia de Pernambuco	Campus Camaragibe	Camaragibe
FACITEC - Faculdade de Ciências e Tecnologia de Caruaru	Campus Caruaru	Caruaru
FACETEG - Faculdade de Ciências, Educação e Tecnologia de Garanhuns	Campus Garanhuns	Garanhuns
FFPNM - Faculdade de Formação de Professores de Nazaré da Mata	Campus Mata Norte	Mata Norte
FFPP - Faculdade de Formação de Professores de Petrolina	Campus Petrolina	Petrolina
Total without connections to Rede Ícone and VASF	**27**	**23**

Source: RNP

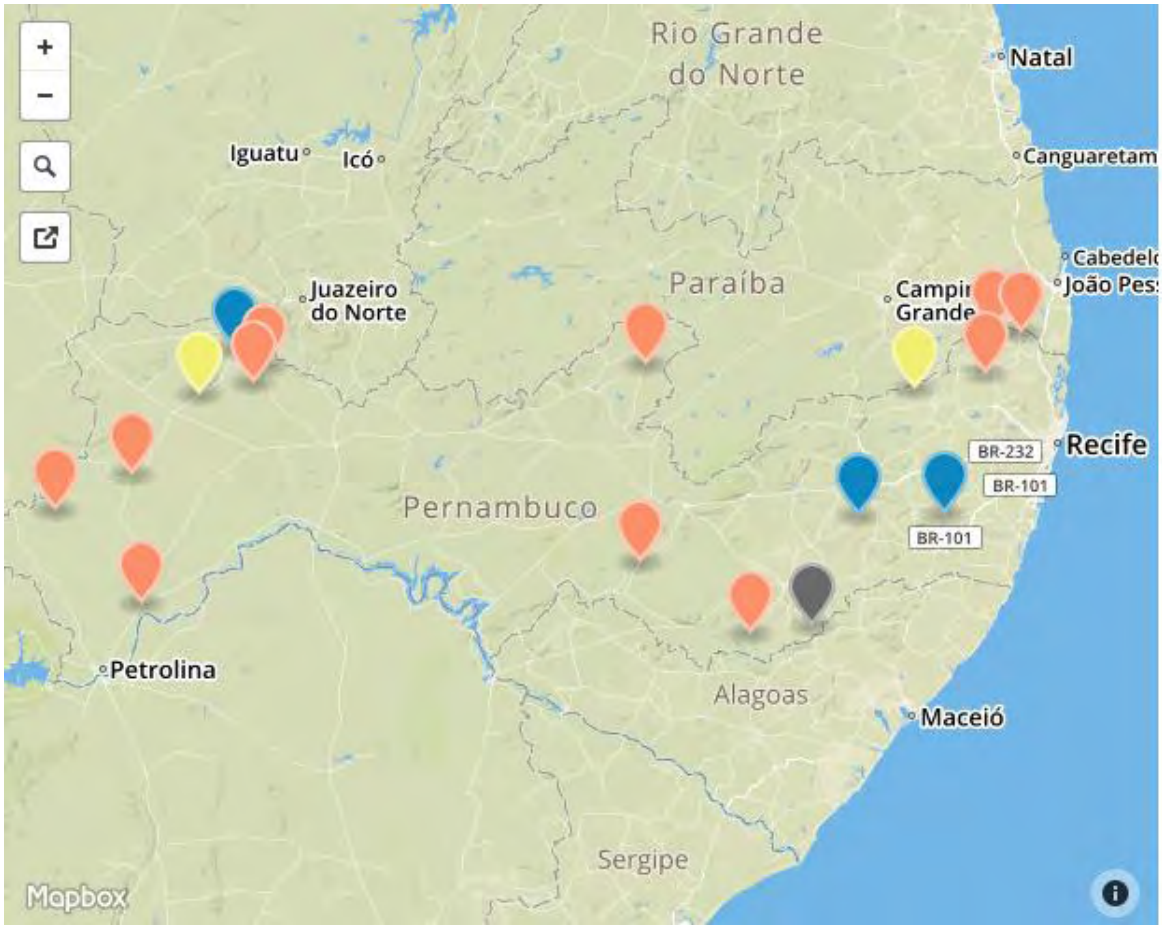
RNP can convert its annual OPEX per institution of R$120,000 into CAPEX to invest in the ATI network. Thus establishing a partnership with RNP could result in a contribution of R$2.6 million (About US$740,000) for the 22 institutions not yet covered by one of the two RNP metropolitan networks in return for a pair of fiber.

The Pernambuco Electric Power Company (*Companhia Energética de Pernambuco* - CELPE) would be a good partner for ATI, as it already is participating in Rede Ícone and Rede VASF, allowing free use of its transmission poles in return for at least two pairs of fiber. This partnership with CELPE could be

extended throughout the state.

ATI can also work with existing federal government programs such as the My Smart City (*Minha Cidade Inteligente*) program of the new Ministry of Science, Technology, Innovation and Communications (the successor program of the Ministry of Communications Digital Cities program). Under the Digital Cities Program 17 *municípios* in Pernambuco were selected to receive local fiber optic networks. Their locations within the state are shown in Figure 18 and Table 9 provide a list of these *municípios*). As of September 2016 ATI is not aware of any having been completed, but if the new government goes ahead with the planned Smart Brazil (*Brasil Inteligente*) program, it is likely partner for ATI to reach government units in these *municípios*. Three *municípios* (Itambé, Recife and São Bento do Una) have expressed interest in the My Digital City (*Minha Cidade Inteligente*) program as per the tender document (edital) number 214/2016/SEI/MEC:

Figure 18: *Municípios* selected for the former Ministry of Communications Digital Cities program



Source: http://blogdoelvis.ne10.uol.com.br/index.php/cidades-digitais-em-pernambuco-ainda-nao-saiu-do-papel/, Accessed August 17, 2016.

Table 9: *Municípios* selected to participate in the *Cidades Digitais* program

Município
Altino
Bodocó
Bom Conselho
Camutanga

Cortês
Casinha
Dormentes
Exu
Granito
Itambé
Lagoa Grande
Machados
Moreilândia
Santa Cruz
Tupanatinga
Tuparetama
Vicência

Source: http://blogdoelvis.ne10.uol.com.br/index.php/cidades-digitais-em-pernambuco-ainda-nao-saiu-do-papel/, Accessed August 17, 2016.

Additional partners identified by RNP include two telecommunications companies, ATEL Telecom and OPS Telecom. As shown in Table

In sum, ATI seeks USTDA funding for an international consultancy to conduct a full feasibility study for the expansion of the state broadband network.

ATI estimates the cost of the PE-Global corporate network subproject at R$53.5 million (about US$15 million), R$17.5 million for the 14 *municípios* of the Recife Metropolitan Region and R$35 million for the 171 *municípios* in the interior of the state, including the State District of Fernando de Noronha. The smaller and more distant ones could be reached by radio links, as has been done in other states, including Ceará and Pará, reducing costs. But Hellerstein & Associates estimate a much higher cost (R$199 million or about US$60 million), even with excluding the cost of the two segments for which RNP envisions a swap of fiber with telecommunications operators. If additional fiber swaps and/or reductions in the length of the fiber and/or wireless networks are contemplated, or a phased deployment, these figures would be reduced.

III. GOVERNMENT COMMITMENT

Each organ or entity of the executive branch has in its plan within the 2016-2019 Multiyear Plan (*Plano Plurianual* - PPA) an activity and sub action with its forecast of expenses:

Activity: Operationalizing Access Digital Network Corporate Government
Sub action: Corporate Digital Network Maintenance government.

IV. POSSIBLE SOURCES OF PROJECT FINANCING

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

Domestic sources of finance include The National Bank for Economic and Social Development (BNDES) or direct financing of the State of Pernambuco budget. Another source of finance could be through suppliers of equipment.

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

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

The Inter-American Development Bank (IADB) is another potential source of international funding, under conditions similar to the World Bank. A fourth potential international source is supplier's credits from firms interested in providing equipment and/or software. New loans from the World Bank or IADB would most likely be ruled out given the time it takes to receive federal government priority, appraise, approve and make them effective, though they cannot be ruled out, possibly in the context of a public administration reform loan. Another option would be to include the projects in a World Bank or IADB project already under preparation.

For both the data center and the network, H&A ascertained that one option is to convert a capital expense into a current expense via a contract with a private enterprise or consortium of private enterprises. These companies then finance the project from their own or borrowed funds. Interviews were conducted with representatives of several US enterprises that might be interested in this kind of arrangement, at least for the data center: Cisco, EMC, IBM, Google (through a Google Partner, RW3 Tecnologia), Oracle, and IBM.

V. POTENTIAL FOR US EXPORTS AND FOREIGN COMPETITION

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

The cost of the hybrid fiber/wireless network could be on the order of R$318 million (about US$98 million), the datacenter project about R$147 million (US$42 million). The export potential for US producers of hardware, software and services would be US$68 million for the broadband network and US$38 million for the data center upgrade and containerized backup, for a total of U$106 million in exports estimated (Table 10). Full detail of the breakdown of these estimate are in the Appendix.

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

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

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

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

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

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

VI. FOREIGN COMPETITION AND MARKET ENTRY ISSUES

Potential foreign competitors could include

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

VII. PRELIMINARY DEVELOPMENT IMPACT REVIEW

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

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

contractor performing the USTDA activity. Here are some examples of indicators and baseline data. ATI selected to following indicators as their main development impact: Telecommunications/ Infrastructure Development and Efficiency Gains/Improved Data Management and Security

Sector	Category	Indicator	Definition	Measure
Telecommunications	Infrastructure Development and Efficiency Gains	Improved Digital Communication Access	Number of people affected by expansion in telecommunications infrastructure to both metropolitan and rural areas including Broadband, Wireless, Voice, and Data (particularly of note if reaching populations without prior access to internet, telephone, etc.)	Number of individuals
Telecommunications	Infrastructure Development and Efficiency Gains	Improved Data Management and Security	Capacity added, security/redundancy gained or reliability improved through implementation of data centers, cloud computing systems, or other storage infrastructure	Y/N

VIII. EVALUATION STRATEGY

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

(1) The proposed project implementation timeline

(2) How the project will be developed (Engineering, Procurement and Construction, Turnkey, Build-Own-Transfer, Build-Own-Operate, etc.)

(3) Any potential difficulties STSC/SG/SP might encounter during project implementation and how can these challenges be mitigated

Benchmarks to help USTDA evaluate success of project

- Financing for project is obtained. The amount from each source should be specified.
- Issue of RFPs for purchase of software and equipment with international competitive bidding, in months from date finance approved. This is a complex process in Brazil and sometimes takes months. The faster it is accomplished, the better managed is the state and the executing agencies.
- Bids received and winners selected. Metric: the percentage of total won by US firms
- Purchases completed. Metric; time in months from selection of winning bids.

- Percentage of total software and equipment purchased provided by US firms
- Construction and equipping initiated. Metric: time in months from purchase of equipment.
- Construction and equipping completed. Metric: time in months from the initiation of construction.
- Full planned network and datacenters in operation. Metric: time in months from completion of construction. Includes time for installing software and testing.
- Percent of state datacenter operations not previously integrated into the ATI data center that now use the ATI datacenter (principal and backup). The higher the better.
- Number of partners sharing costs of statewide network and extent of cost reduction compared with ATI undertaking all investments and operational costs itself. Divide into capital and current costs.

Proposed project implementation timeline

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

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

Likelihood of development

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

Potential difficulties

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

Other entities needed to approve project

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

IX. ENVIRONMENTAL IMPACT

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

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

ATI considers that there is no need for a detailed study on climate resilience because they cannot identify potential climate impacts that will be caused by implementation of this project since it does not involve the construction of buildings or structures that may change the environment. To reduce emissions of greenhouse gases ATI wants the design of the data center to follow Green Data Center model through adoption of devices with this type of certificate, solar energy use, etc, which maximizes energy efficiency, bringing savings and contributing to reducing CO2 (it should be considered that most of the energy generated in Brazil comes from green sources such as hydroelectric power, solar, wind, nuclear and some thermo-electric plants burning mostly natural gas.

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

X. IMPACT ON US LABOR

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

XI. JUSTIFICATIONS & RECOMMENDATIONS

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

The project also has a social objective. The population will gain access to broadband Internet connectivity, allowing every citizen to have free access to the Internet, educational opportunities, and e-government services through public telecenters and schools. At the municipal level, priority will be given to the poorest strata of the population, the *quilambolas* (settlements established at the end of the 19th century by freed slaves), and indigenous communities.

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

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

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

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

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

Team Leader

- At least fifteen (15) years' experience in the ICT industry
- Strong background in at least one of major areas of the feasibility study (Datacenters, hybrid fiber optic and wireless broadband networks, integrated e-Government systems, Definition of SLAs, economic and financial project analysis)
- Both a US and an international perspective on the ICT industry, with the international perspective preferably gained through on-the-ground project work, ideally in the area of datacenters, broadband networks and integrated e-Government systems

- Management, organizational and cross-cultural skills and perspective to structure, oversee and carry out the Feasibility Study effectively
- Ability to communicate findings effectively and to liaise appropriately within the SECTI/BA and ATI frameworks 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

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

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

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

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

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

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

Senior Economist

- At least a master's degree in economics, 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

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

Brazilian Lawyer Specializing in Brazilian legislation and regulation (<u>regulamentação</u>)

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

Project Coordinator/Local Manager

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

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

XIII. SUGGESTED EVALUATION CRITERIA

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

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

ANNEX I SSE/PE DATA CENTER EQUIPMENT AND SOFTWARE

The current vault room and its subsystems have an area of 156 m^2 composed of the vault room with 36 m^2, a safe room with 50 m^2, an UPS room with 20 m^2 e and a generator room with 50 m^2. Each of these rooms has the following equipment.

Table 1; Description of the equipment in the safe room, vault room, UPS room, and generator room

Quantity	Safe room resources	Manufacturer	Brand/Model/Serial No.	Capacity
1	Armored door	Hersteller	Sommer	-
1	Biometric access control	VAULT	F9	-
1	Technical corridor	-	-	-
1	IP Camera	GERP	C DOME IP 2MP D&N POE/WDR/IR L MOT 3A9	Full HD 1080p (1920*1080)
6	Lighting fixtures	-	-	-
24	Florescent lamps	OSRAM	F16W/840	F16W
50m^2	Elevated floor	Aceco	Aceco Floor tile CC1000	Resistance to concentrated load 545KG / Resistance to uniformly distributed load 1.479KG / Resistance to maximum secure load 1,635K
1	Evaporator Unit (Modelo Split)	Hitachi	Scroll Utopia	60.000BTUs
1	Condenser Unit (Modelo Split)	Hitachi	Scroll Utopia	60.000BTUs
3	Evaporator Unit (Central Air Conditioning)	Carrier	38CCD060235MC	60.000BTUs
3	Condenser Unit (Central Air Conditioning)	Carrier	38CCD060235MC	60.000BTUs
3	Electric panel	Cemar	Legrand (short circuit capacity 10KA)	short circuit capacity 10KA
1	Fire extinguisher ABC (Expiration date Jan/15)	Resil	ABC	6 Kg
50m^2	Ceiling	-	-	-
176	Logical points	Furukawa	CAT 6A	10Gbps

Quantity	Vault Room– Description of resources	Manufacturer	Brand/Model/Serial No.	Capacity
1	Biometric access control	VAULT	F9	-
1	Armored door	Hersteller	Sommer	1
1	Early fire detection system	Stratos	Micra 25	-

-	Fire extinguishing system	-	-	-
1	Blocking key	Digisensor	Digisensor	-
1	Manual activator	General Electric	General Electric	-
1	Audiovisual siren	-	-	-
1	Control panel	CHEMETRON	Micro XLT	-
4	Conventional fire detection	-	-	-
1	Gas cylinder FM 200	CHEMETRON	FM 200 VN3296 (N/S AA539795)	114,42 Kg
1	Control Panel	Aceco	Aceco	-
1	Certification ABNT NBR 15247 S60 Type B	-	-	-
1	Automatic control panel	FOCKINK	PV_001007840	-
1	Redundant Multimediator	-	-	-
1	Electric panel	Aceco TI	QDiX	-
1	Electric panel	Aceco TI	QDiY	-
16	Lighting fixtures	-	-	-
16	Fluorescent lamps	OSRAM	L36W/840	L36W
2	Equal energy bar	-	-	-
3	IP cameras	GERP	C DOME IP 2MP D&N POE/WDR/IR L MOT 3A9	Full HD 1080p (1920*1080)
1	Management server CFTV	Wretch	Wretch CN29BX403V	-
1	Keyboard	Microsoft	Wired 600	-
1	Mouse	Microsoft	Wired 600	-
1	Switch	HP	V1910-24G-PoE	24G-PoE
-	Remote monitoring and supervision system	-	-	-
1	Temperature and humidity sensors	Rittal	Netwatch	-
1	Temperature and humidity sensors– climate control	Rittal	Netwatch	-
1	Processing unit	Rittal	Netwatch	-
1	Liquid presence sensor	-	-	-
3	I/O unit	-	-	-
1	Smoke detector	Stratos	Micra 25	-
36m^2	Elevated Floor	Aceco	Aceco Floor tiling CC1000	Resistance to concentrated load 545KG / Resistance to uniformly distributed load 1.479KG / Resistance to maximum secure load 1,635KG
-	Cabling CAT 6A	-	-	-
120	Logical points	Furukawa	CAT 6A	10Gbps
1	CMC Monitoring system	Rittal	Processing Unit II	-
4	Condenser unit	Emerson	HCE 33	23KW

2	Evaporator units	Emerson	Hidross S23 UA - Liebert	23KW

Quantity	**UPS Room – Description of resources**	**Manufacturer**	**Brand/Model/Serial No.**	**Capacity**
4	Battery bank	EATON	9390-80	80Kva
80	Batteries (40 in each bank) with 12 Ah capacity - each battery)	EATON	PWHR12200W4FR	-
1	UPS 40 kVA	EATON	9365-40	40Kva
-	ATS	-	-	-
1	QD-01	VEPAN	003/12	-
1	QD-02	VEPAN	004/12	-
1	QD-AR-01	VEPAN	005/12	-
1	QD-AR-02	VEPAN	006/12	-
2	QD-X	VEPAN	007/12	-
2	QD-Y	VEPAN	008/12	-
1	ATS-01	GE	1612107-9	-
1	ATS-02	GE	1611319-3	-
1	ATS-03	GE	1613453-3	-
1	QD-UTIL	VEPAN	002/12	-
1	QD- see (Climate control)	ACECO TI	7001-02-4899	-
1	CMC - Monitoring system	Rittal	Processing Unit II	-
1	Smoke detector	Stratos	Micra 100	-
1	Humidity and temperature sensors	Rittal	Netwatch	-
20m^2	Elevated floor	Aceco	AcecoFloor Placa CC1000	Resistance to concentrated load 545KG / Resistance to uniformly distributed load 1,479KG / Resistance to maximum secure load 1,635KG
3	Camera IP (Internal)	GERP	C DOME IP 2MP D&N POE/WDR/IR L MOT 3A9	Full HD 1080p (1920*1080)
3	Lighting fixtures	-	-	-
6	Fluorescent lamps	Slimfluor	-	-
1	Armored door	Metálika	P120 – 1F	-
1	Biometric access control	VAULT	F9	-
2	Evaporator unit	Carrier	42BQA048510	60.000BTUs

	Split air conditioning system -			
2	Condenser unit - Split air conditioning system	Carrier	38CCC048535MC	60.000BTUs
1	Fire extinguisher, expires Jan/15)		ABC	6 Kg

Quantity	**Generator room – description of resources**	**Manufacturer**	**Brand/Model/Serial No.**	**Capacity**
2	Generators 260 Kvat 380V/220V and power de 260 kVA)	CUMMINS	C200 D6	260Kva 380V/220V power 260 kVA)
2	Armored doors	-	-	-
1	Biometric access control	VAULT	F9	-
2	Daily fuel tanks - 250 liter capacity (one tank per generator)	CUMMINS	C200 D6	250 litrers (one tank per generator)
2	Principal reserve fuel tanks - 250 liter capacity	MetalPress Metais	2065 / 2066	250 liters
2	QTA	ABB	ARTV	-
-	Acoustic separation	-	-	-
6	Lighting fixtures	-	-	-
12	Fluorescent lamps	Sylvânia	-	-
1	Camera IP (Internal)	GERP	C DOME IP 2MP D&N POE/WDR/IR L MOT 3A9	Full HD 1080p (1920*1080)
1	Camera IP (External)	GERP	BULLET IP 2MP POE/WDR/IR L MOT 3A9	Full HD 1080p (1920*1080)
1	Fire extinguisher B C Type PP20	IMaster	PP20	20 Kg
1	Reservoir for discard of diesel oil	-	-	-

This solution supports the following assets:

Equipment	Resources
Storage IBM DS 4300	12TB of total storage abiility
Storage EMC VNX 5400	100 TB de capacidade total de armazenamento
Blade Center DELL	10 Blade servers in a virtual cluster VMware vSphere 5.5
Blade Center IBM HS22	11 servidores lâminas
	09 Blades in a virtual cluster VMware vSphere 4.1
	02 Blades dedicated to backing up the TSM TSM Server
Blade Center IBM LS20	Blade dedicated to the vCenter server in the vSphere 4.1 environment
	01 Blade dedicated to the file backup server
Tape Library	Tape Library Dell TL 4000
	Tape Library IBM TS 3200
07 Servidores Rack Dell Modelo R710	04 Dedicate to (Hyper-V) virtualization
	35 Implemented virtual machines
	01 Dedicated to Siepe
	01 Dedicated for specific use of large-scale applicationsi in ATI
	01 Dedicated to SIEPEcontingencies
Solução de vídeo conferência composta por:	01 (one) MCU (*Multipoint Control Unit*)
	01 (pme) Streaming server
	02 links of 2Mbps (each)
	01 link of 1Mbps (to attend the VC of the Secretary's rooom)
Links de Comunicação da SEE	01 (one) link of 100Mbps para DATA
	02 (two) links 10Mbps (each) for VOICE
Ativos de Rede	84 network asserts (switchs) distributed in the following manner:
	01 nucleus (N7 - Enterasys)
	03 for distribution
	80 border (headquarters of, GRE and Annexes)
	02 Fortinet 620B (bandwidth control, contente filter, wireless network mnagement for schools, etc.)
	01 FortiAnalyzer (Management of Logs and reports)
	01 FortiManager (Management of the Fortinet platform)
	01 equipment for IDS Enterasys Dragon
	01 equipment for IPS Enterasys Dragon

Annex I

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) upgrade of the state data center; (ii) expansion of the state broadband network; and (iii) improvement of e-Government services; in each case for the Brazilian State of Pernambuco (the "Project"). The Grantee is the Pemambuco State Information Technology Agency ("ATI").

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. For illustrative purposes, it is estimated that the U.S. Firm will travel to Recife for the approximate number of visits as follows:

- Three trips to Recife for the Team Leader;
- Two trips each for the senior wireless/fiber optic engineers;
- Two trips for the senior data center engineer;
- Two trips for the junior data center engineer;
- Two trips for the junior **JCT** and network engineer;
- One trip for the security expert; and
- One trip each for the JCT specialist/economist.

TASK l: DATA COLLECTION

The U.S. Firm selected by AT[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, dataccnters, and e-Government systems (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. Finn 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 perfonned under Task l, including the case studies, and best practices identified and recommended for Pernambuco's data centers, hybrid broadband networks. and integrated e-Govemment systems.

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

The US finn shall familiarize themselves with the Brazilian governmental public budget finance and project analysis via Internet research and any documents provided by *A* TI.

DATACENTER

The U.S. Finn shall travel to Recife, Pemambuco to review the current datacenter situation; meet with ATI and the key stakeholders in the Project: the Secretariats of Finance, Education. and Health; Military Police. Civil Police, DETRAN, other Secretariats and government agencies, and the state judiciary (Tribunal de Justic;a)) and conduct a needs/requirements analysis for the planned upgrade of the ATI datacenter, its proposed backup datacenter in the new Secretariat of Finance (SEFAZ/PE) data center safe room. The analysis should include recommendations on the optimal methods for providing backup services and other public or private cloud services for the entire data center system. The basic objectives of the expansion of the data center are to meet the growing demand for information and communications technology in connection with the Government of Pemambuco's eGovernment program (broadband network management, applications, services, and portals) with agility, flexibility and efficiency under the strategic management of ATI.

The U.S. Firm shall:

- Meet with ATI and other m jor stakeholders (with guidance from *A* TI) to develop an assessment of their needs, priorities, and expectations;
- Visit the four largest datacenters in ATI and the Secretariat of Finance, the Secretariat of Education and DETRAN and conduct a needs and requirement analysis for the planned expansion of the ATJ datacenter system and backup datacenters, including cloud services;
- Conduct basic cost/benefit analyses to help ATI to determine the appropriate scale of the new datacenter and potential backup facilities for all the data centers in the ATI system, considering the six largest potential client secretariats/agencies of the

State of Pernambuco (Finance, Education, Health, Public Safety, Transportation (DETRAN), and the state judiciary;

- Conduct a security analysis, both physical and electronic, of all datacenters expected to remain in the ATI data center system and its backup facilities to be located in the SEFAZ/PE safe room and 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 centralized and integrated data center;
- Analyze at least three options for operation of the data center (i.e., options for data storage, mix of usage of cloud versus local data center, etc.) that would best suit Pernambuco;
- Inventory of Requirements for Supporting Critical <)nd 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 Pernambuco state government secretariats and agencies and (b) municipalities in the state of Pernambuco.

HYBRID BROADBAND NETWORK

The U.S. Finn shall travel to Recife, Pernambuco to review the current hybrid broadband network situation; meeL with ATI and the key stakeholders in the project: 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 The Sao Francisco Hydro Power Company (CHESF), the main state electrical energy distribution company (COELPE), 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 ATI to operate the expanded network under a concession or PPP. The expanded network should reach all 185 municipalities in the State of Pemambuco, with preference for a fiber optic connection where economically viable, but allowing some wireless extensions for small municipalities.

The basic objectives are to meet the growing demand for broadband connectivity to support the State of Pemambuco's e-Government program (broadband network management, applications, services, and portals) and promote digital inclusion of the population with agility, flexibility and efficiency under the strategic management of the state.

The U.S. Firm shall:

- Meet with ATI and major state government stakeholders (with guidance from ATI) to develop an assessment of their needs, priorities, and expectations;
- Recommend strategies which would help ATl 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 (Oi, Claro, Embratel, and Vivo).

Deliverable #2: The U.S. Fim1 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 reniainder of these Terms of Reference.

TASK3: DIMENSIONING AND ALTERNATE SCENARIOS FOR BROADBAND NETWORK

DATA HOSTING

Based on the findings in Task 2, the U.S. firn1 shall project the collective needs for data hosting 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 data hosting in the State of Pernambuco:

a) Expansion of one of the existing data centers; and

b) Construction of a new state-owned data center (Tier III).

In consultations with ATI. 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. Fim1, AT! shall decide on the scenario that should be analyzed for the remainder of the Tasks below.

BROADBAND NETWORK

Based on the findings in Task 2. the U.S. fim1 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 Pernambuco:

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 ATI. 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. Finn, ATl shall decide on the scenario that should be analyzed 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 ATI continue to operate the data center (and the proposed backup in SEFAZ) with its own personnel?
- Could the operation of the new data center and its backup data center be conducted by a private sector company under policies set by ATI with the support of an interagency committee?
- What will be the role of the secretariats and agencies with applications stored in the datacenter?
- How will performance of the datacenter be measured?
- If there is a private partner, how should it be remunerated?

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

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. finn shall:

- Analyze the findings from Task 3 and 4 and develop specifications regarding the architecture and design of the datacenter and backup data center;
- Develop precise and detailed estimates of data center design including building security, air conditioning. power provision, uninterruptable power supply, storage, processing, and fire prevention, equipment needs and capacity. and resulting capital expenditure and operating costs;
- Propose and draft service level agreement (SLAs) for the upgraded centralized datacenters; and
- Prepare a list of prospective US-based sources of supply for the datacenters and cloud services. The business name, point of contact, address. telephone and e-mail address shall be included for each commercial source.

BROADBAND NETWORK

The U.S. firm shall:

- Analyze the findings from Task 3 and 4 and develop specifications regarding the architecture and design of the hybrid broadband network;
- Develop precise and detailed engineering estimates of network designs. equipment needs and capacity, and resulting capital expenditure and operating costs;
- 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
- Prepare a list of prospective US-based sources of supply for the network. The business name, point of contact, address, telephone and e-mail address shall be included for each commercial source.

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.

TASK6: ECONOMIC AND FINANCIAL ANALYSIS

The U.S. firm shall conduct an overall cost evaluation with a projected useful life of 1 O 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 shal I be agreed upon with ATI 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 their supporting legal, economic and financial rationales. As a basis for these reports, the U.S. Fim1 shall perform the following assessments and analysis, which shall be detailed in one or both of the reports:

- Quantify the benefits in unit cost reduction and improved quality (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 upgrade.
- Calculate the Net Present Value and evaluate Total Cost of Ownership of the ATI data centers and broadband network;
- Develop Implementation Finance Plans for the ATI 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 stmcture and their supporting legal, economic and financial rationales.

TASK 7: **PRELIMINARY ENVIRONMENTAL ASSESSMENT**

The.U.S. firm shall:

- Conduct, in consultation with the Pernambuco 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;
- Discuss how any potentially significant negative impacts can be minimized; and

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

TASKS: 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 tirneline 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 Digital Communication Access	Number of people affected by expansion in telecommunications infrastructure to both metropolitan and rural areas including Broadband, Wireless, Voice, and Data (particularly of note if reaching populations without prior access to internet, telephone, etc.)	Number of individuals should become available in 2020

For the Data center the main indicator is

- A clear process is defined for exiting from the contract and transition to one or more other private sector partners with operating responsibilities for either of the projects 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 ATI 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 State datacenter and hybrid broadband network. The Project Implementation Repo1t shall also describe how to structure any service contract or infrastructure sharing atTangements to incorporate the evolving scope of the Project.

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

TASK 10: PRESENTATION OF THE DRAFT FINAL REPORT

Upon concluding all tasks listed above, the U.S. firm shall travel to Recife, Pemambuco to formally present to A**Tl** the findings and recommendations and a near final version of the report. ATI 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 ATl's responses to the presentation.

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

TASK 11: FINAL REPORT

The U.S. Firm shall prepare and deliver to ATI 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 ATI. The U.S. Firm shall provide one copy of the Final Report in Portuguese to ATI. The Final Report shall be prepared and delivered to USTDA, in English, in accordance with Clause I 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 ATI 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 ATI with the appropriate information, recommendations and guidelines. ,