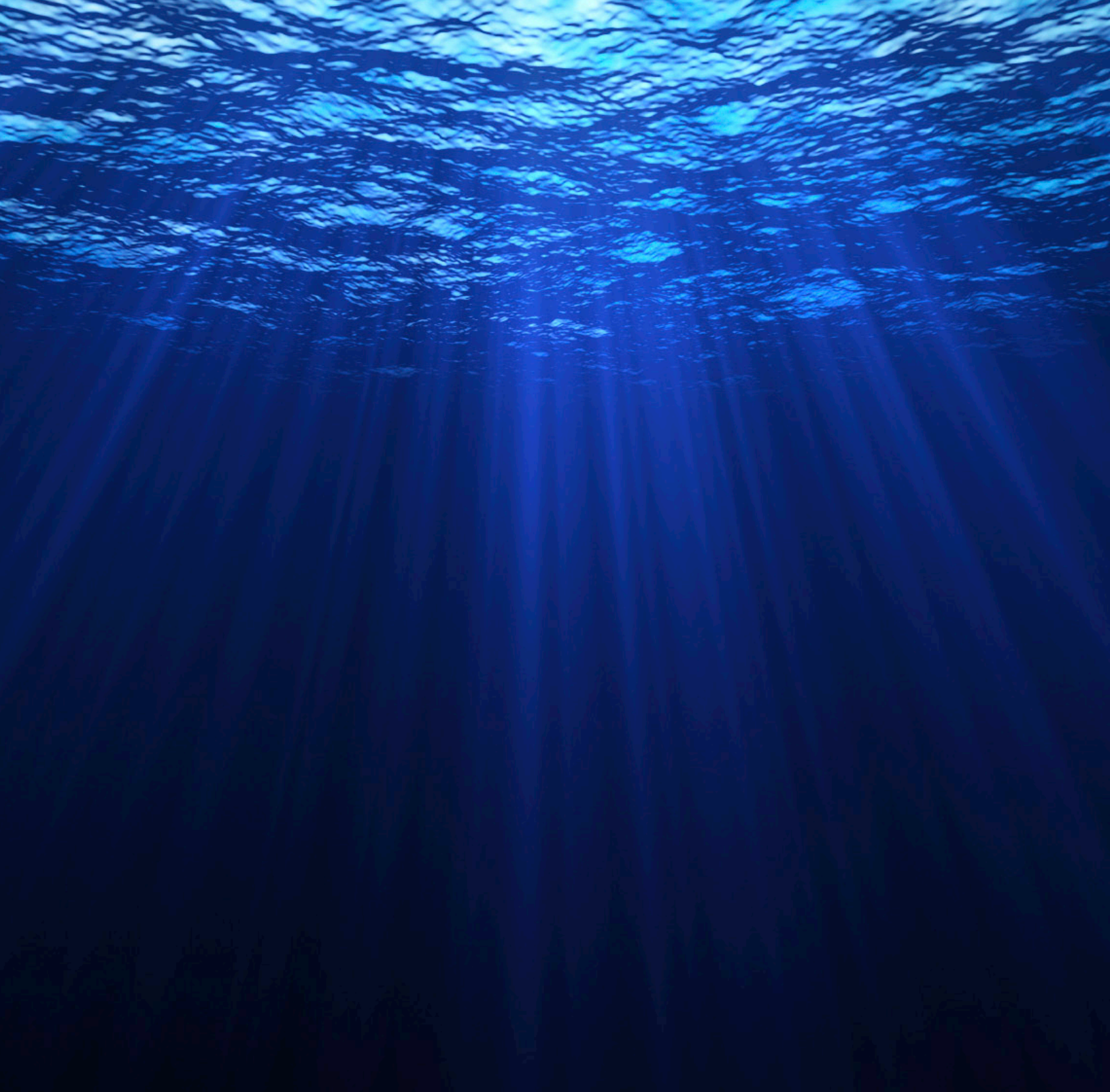
# Puerto Rico Broadband Strategic Plan

May 2012



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PRBT
PR Broadband Taskforce

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# Executive Summary

In today's global economy, broadband, or high-speed Internet, is an essential infrastructure asset for social inclusion, economic competitiveness, and sustainability. Policy makers around the world have recognized this and are working to close the digital divide by promoting access to high-speed broadband infrastructure, universal adoption of the technology across all segments of society, and increased utilization across key strategic sectors, such as education, healthcare, and the provision of government services. Broadband is the great infrastructure challenge of our time, and ensuring universal access, adoption, and utilization is essential to maintain a vibrant and competitive economy and society.

The impact of broadband technology is perhaps nowhere more acute than in an island economy such as Puerto Rico. As Puerto Rico makes gradual recovery from the current economic downturn, a robust, ubiquitous, fast broadband infrastructure is essential to attract foreign direct investment that will generate the jobs and opportunities needed to sustain Puerto Rico's competitiveness; it is essential for companies to efficiently interact with their business peers and reach existing customers and new markets; it is essential to ensure that professionals have access to remote jobs and training opportunities previously beyond their reach; and it is essential to ensure that students can access educational resources beyond the confines of their schools, universities, or neighborhoods.

Broadband will ensure that students in Puerto Rico's schools and universities have the same access to distance learning opportunities as those on the U.S. mainland. Through telemedicine, enabled by very fast broadband, patients will receive better quality of healthcare and access to doctors worldwide, and healthcare practitioners can provide services in remote areas where healthcare providers are scarce at a fraction of current costs. Broadband is also essential to ensure that both the Puerto Rico Government and local jurisdictions can deliver better and more cost-effective government services to Puerto Rico citizens and ensure that law enforcement officials and first responders have the necessary technology to effectively protect our communities.

Broadband enables all this and much more. To make these goals a reality we must work to ensure a robust, fast, ubiquitous network, universally adopted and used across all segments and sectors of society.

Understanding this challenge, the Puerto Rico Broadband Taskforce (PRBT) was formed in 2011 with two key objectives: to ascertain the size and scope of the digital divide in Puerto Rico and identify strategies to close it and, armed with such strategic recommendations, to steer public and private stakeholders across Puerto Rico and the U.S. to action. The PRBT is a non-governmental, public-private partnership conceived by the Chief Information Officer of Puerto Rico, the President of the Telecommunications Regulatory Board, and the Internet Society of Puerto Rico, that joined forces to establish a non-partisan committee that includes key stakeholders in the broadband ecosystem.

The PRBT is composed of 12 members including, along with its founding members, representatives from the broadband provider community, information and communication technology providers, K-12 education stakeholders, the higher-education community, healthcare professionals, local government, grassroots community groups working to address the digital divide in their communities, and private sector groups for whom broadband is an essential investment asset. Connect Puerto Rico, a subsidiary of Connected Nation, a not-for-profit working across the U.S. to help bridge the digital divide, worked with the PRBT in this effort by conducting research and supporting development of this plan.

The first goal of the PRBT was the completion of a Broadband Strategic Plan. The PRBT adopted a holistic approach in this Strategic Plan, addressing both demand- and supply-side challenges with three inter-related policy goals:

- **Access** - Ensuring subsequent waves of investment in infrastructure deployment to meet the increasing demand for broadband capacity by all citizens, businesses, government, and community anchor institutions.
- **Adoption** – Ensuring universal adoption and penetration of broadband services – either mobile or fixed - by all citizens, and businesses.
- **Utilization** – Ensuring that all communities – particularly community anchor institutions such as schools, hospitals, and clinics – are increasingly using broadband technology to pursue economic opportunity and sustainability, improve government services, and leverage educational and e-Health resources.

The Strategic Plan adopts a series of goals for each of these areas and recommendations for actionable strategies designed to achieve them. A comprehensive list of these goals and recommendations can be found following this Executive Summary.

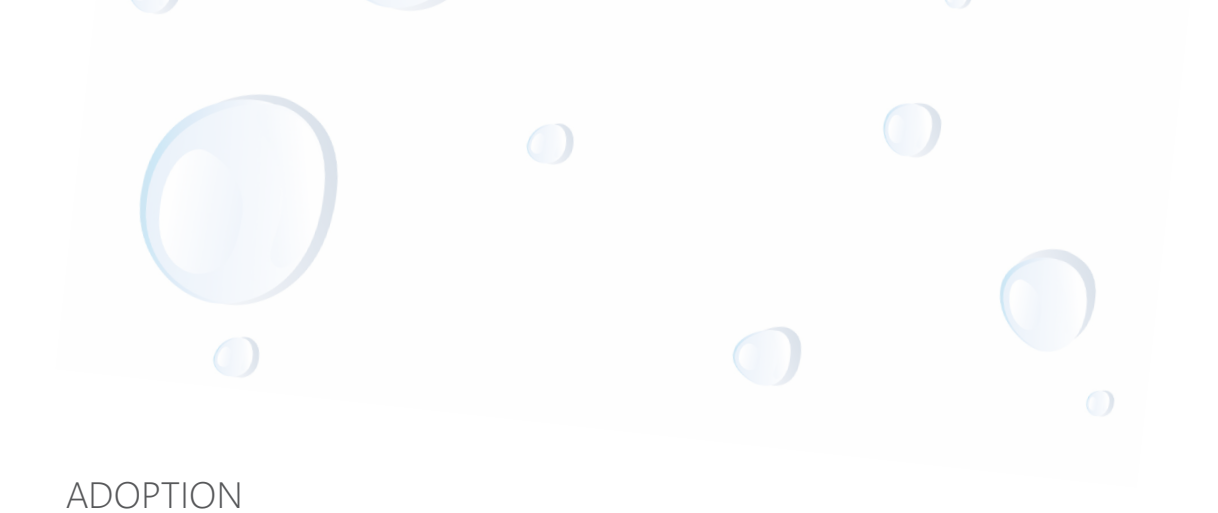
The first step in this process was a thorough assessment of the size and scope of the digital divide across Puerto Rico. To accomplish this, the Office of the CIO of Puerto Rico, armed with American Recovery and Reinvestment Act funding obtained through the Department of Commerce for this purpose, commissioned an ongoing mapping initiative to develop an inventory of available broadband infrastructure across the island, as well as research to survey and analyze adoption and usage trends across the residential and business sectors in Puerto Rico. By focusing on both the supply, or infrastructure gap, and demand, or adoption and usage gap, this research has revealed the scope and nature of the digital divide across Puerto Rico.

## ACCESS

According to Connect Puerto Rico's broadband inventory, by June 2011, 86% of households across Puerto Rico had access to broadband from at least one fixed broadband provider at speeds of at least 768 Kbps download (DL)/200 Kbps upload (UL). This implies that approximately 14% of households, typically located in more rural parts of the island, remain without any form of fixed broadband service. In contrast, the Department of Commerce's National Broadband Map indicates that, in total, 95% of U.S. households are served by broadband at these speeds. This dire lag of broadband infrastructure investment remains a critical barrier to advancing Puerto Rico's economic competitiveness.

The broadband gap in Puerto Rico at higher capacity speeds is even more acute. By June 2011, only 57% of Puerto Rico households had access to broadband at speeds of 3 Mbps DL/768 Kbps UL, and only 32% of households had access to broadband at speeds of 10 Mbps DL/768 Kbps UL. Such speeds and more are necessary to sustain many services increasingly demanded by business and residential customers, such as two-way video conferencing. This capacity lag is an acute danger for the economic and social future of Puerto Rico. This investment lag is driven by lagging demand for the service, resulting in lower expected revenues, high cost of build-out, and high cost of operation maintenance. All of these factors affect business plans and slow investment. To help overcome this gap, this Strategic Plan set a series of infrastructure and capacity goals across both urban and rural areas of Puerto Rico. At the most basic level, the Strategic Plan sets a goal of 98% of all households served by broadband at actual speeds of at least 4 Mbps DL/1 Mbps UL by 2015. A comprehensive list of all capacity goals follows this Executive Summary.

For these capacity goals to be reached, we must promote competition and continued investment in infrastructure. Thus, this Strategic Plan also assesses the key barriers to investment and recommends a series of strategies to improve profitability and encourage build-out. Recommendations fall into three categories: i) stimulate lagging demand to improve the business case for broadband deployment; ii) lower unnecessarily high costs associated with broadband build-out and maintenance, including streamlining construction permitting or pole attachment processes; iii) streamline the regulatory process and continue promoting fair competition and market entry. The Strategic Plan also assesses the role of Federal programs impacting the Puerto Rico broadband market and recommends close collaboration of Puerto Rico stakeholders with the Federal Communications Commission to jointly work to address the acute digital divide on the island.



## ADOPTION

Residential survey research conducted by Connect Puerto Rico reveals an acute lag in broadband adoption across the island. Although 86% of Puerto Rican households have access to broadband, in 2010, only 31% subscribed, implying an adoption gap in Puerto Rico of 55%; in other words, more than one-half of Puerto Ricans have basic broadband service available but are choosing not to subscribe. In comparison, data collected in 2010 by the National Telecommunications and Information Administration indicated that 68% of U.S. households subscribed to broadband service. The mobile broadband adoption gap is also acute, as only 27% of Puerto Rico residents reported accessing mobile broadband service in 2010; which is significantly lower than the 59% U.S. average.

Across Puerto Rico, broadband non-adopters are generally people of low-income, senior citizens, and/or people with less education. These trends mirror demographic patterns across the U.S., however, the adoption gap in Puerto Rico for each of these groups is more acute. While across Puerto Rico broadband adoption is 31%, the broadband adoption rate is 5% among adults 65 and older; 7% among residents without a high school diploma; and 15% among households with annual incomes below $15,000. The top barriers to broadband adoption in Puerto Rico include: relevance of the online experience to non-adopters (a lack of value proposition); affordability of the broadband service and access technology; and lack of computer ownership and digital literacy (or knowledge of how to use the technology).

The PRBT believes that it is imperative to address barriers to broadband adoption. Failure to do so would increase the gap between the haves and have-nots across Puerto Rico, creating an Internet underclass at risk of being left behind, resulting in a longstanding, significant, and detrimental social impact. Furthermore, for our collective economy, a broadband adoption gap would limit Puerto Rico's ability to develop sustainable economic models that fully leverage our unique position as an insular bridge between the U.S. and the Caribbean and Latin America and beyond. Moreover, because of the economies of scale and density of broadband networks, particularly high-capacity fiber optic networks, low levels of broadband adoption and use increases the cost per-subscriber for providers, weakening the business case for continued deployment in broadband capacity and infrastructure.

This Strategic Plan sets aggressive goals for rapid expansion of broadband adoption across Puerto Rico, including residential home broadband adoption of at least 50% by 2013 and at least 70% by 2015. To meet this challenge, a series of recommendations are proposed including: aggressive expansion of digital literacy programs targeted to vulnerable communities, particularly those of lower income; such efforts should be conducted in partnership with existing non-profit institutions already working to bridge the digital divide and leverage the K-12 system; promotion of mobile broadband as a lower cost and technically easier to use technology that can serve as an effective point of entry into the online, digital world by non-users; aggressive expansion of public computing centers across the island and expansion of digital literacy programs in these centers; a public-private partnership to develop targeted awareness campaigns regarding the benefits of the online interaction for both personal use and small business enterprises; and strategies to address the affordability challenge and to expand computer or other end-user device and subscription penetration across Puerto Rico.

## UTILIZATION – EDUCATION AND e-HEALTH

Promoting access and adoption of broadband service is a key objective of the Strategic Plan. The job would be incomplete, however, if we failed to address the utilization challenge. An effective broadband strategy needs to ensure the growth of broadband-enabled technology and solutions across key business sectors, in particular, the Education and Healthcare sectors.

Online educational resources for teachers and students are already transforming the way children learn and teachers teach, empowering schools with a plethora of resources previously unattainable. However, this transformation needs proper steering and coordination to ensure that students and teachers have appropriate online educational content, appropriate content standards and means to protect students from online risks, and new curricula adapted to these new resources. Furthermore, teachers need to be trained to ensure that they not only know how to use a computer and can access this new wealth of information, but also understand how to leverage those resources to effectively steer their pupils along their educational development. Importantly, to enable all this, educational institutions need to have extremely fast (hundreds of megabits per second or more) broadband available to accommodate simultaneous use of online resources by teachers, administrators, and their students.

This Strategic Plan sets ambitious goals for broadband capacity and use across the K-16 system in Puerto Rico, including capacity of at least 100 Mbps by 2015 and 1 Giga bit per second by 2020. Data from the Puerto Rico Department of Education reveals a maximum contracted capacity across Puerto Rico public schools of 1.5 Mbps in 2011, indicating a vast gap to meet the established education capacity goals by the due dates.

To address this gap, the Strategic Plan recommends strategies to expand broadband capacity to all K-16 institutions by removing cost drivers and helping to improve the business case for broadband capacity deployment across the island. Recognizing the importance of investment in education, the Government of Puerto Rico has launched an aggressive plan to modernize the island's public schools through the 21st Century Initiative. To complement these efforts, this Strategic Plan includes a series of recommendations that build upon the work already underway; establishing that, first and foremost, it is imperative that there is a true public-private partnership to accomplish these goals. The transformational process underway will take time and will necessitate collaboration from the educator community, multiple private organizations, including many private corporations that are working to provide a vision for a new educational paradigm that has technology at its core, and the public sector. Key strategies to accelerate this process include: an aggressive expansion of resources to train teachers on how to effectively leverage online resources to teach their students in and out of the classroom, develop plans to achieve a computer-per-teacher and device-per-pupil goal, and launch pilot programs to assess the efficacy of online education modules.

A similar transformational process triggered by broadband is taking place in the healthcare service provision sector. Broadband-enabled applications such as online patient records, telemedicine, remote diagnosis, and real-time digital imagery are empowering healthcare service providers in ways that will directly impact the quality of service and lives of patients, positively affect national health statistics, and lower the cost of healthcare provision. To ensure that this vision becomes a reality, healthcare providers need to have access to very fast broadband able to sustain two-way high-definition video imagery in real time. This Strategic Plan sets appropriate broadband capacity goals to meet this challenge, including 100 Mbps connectivity across all large healthcare institutions by 2015, and 1 Giga bit per second by 2020.

Further, the Strategic Plan recommends policies that build on the work already underway by stakeholders in the Healthcare sector, including medical practitioners, clinics, hospitals, major payers, and the public sector who are working together to overcome barriers to the expansion of e-Health strategies. Such policies include overcoming legal and logistical challenges to achieve an effective Health Information Records system across Puerto Rico that meets U.S. standards; and rapid expansion of broadband adoption and usage across the Puerto Rico medical and nursing community.

In short, this Strategic Plan lays out a series of recommendations to help us achieve a twenty-first century infrastructure that will contribute to the revitalization of the Puerto Rico economy, promote foreign direct investment, and offer new economic and social opportunities to all Puerto Ricans regardless of where they live and work or what their education and income levels are. Many of the recommendations proposed by the PRBT are immediately actionable, while others will require further analysis and assessment. In all cases, a cooperative effort between the private and public sectors, including multiple government agencies in Puerto Rico and at the federal level, is essential to achieve success. While the challenge is great, it cannot be avoided. A broadband policy that neglects to ensure that national, regional, and local government processes evolve to an online world, or that doesn't guarantee that educational processes adapt to leverage online resources to empower educators and their pupils, or fails to address the multiple complexities of online healthcare service and patient records, will be ineffective and incomplete.

This process will not happen overnight and will require waves of reform, coordination, and adjustment across multiple agencies and functions of government, and the private sector. As such, this Broadband Strategic Plan – the first one of its kind for Puerto Rico – should be understood as the beginning of a dialogue and action plan, not the end.

## Broadband Strategic Goals for Puerto Rico

### ACCESS

All urban areas across Puerto Rico should have available ubiquitous broadband infrastructure able to provide service at speeds, and quality of service, comparable to that available in any city in the Western Hemisphere. All citizens across Puerto Rico, in both urban and rural areas, should have available ubiquitous broadband service meeting a minimum speed standard. Similarly, mobile broadband technology should continue expanding and ensure rapid expansion of next generation services across the island. Such service should be accessible to all residential, commercial, and/or government customers.

**Fixed Broadband Capacity Goals:**

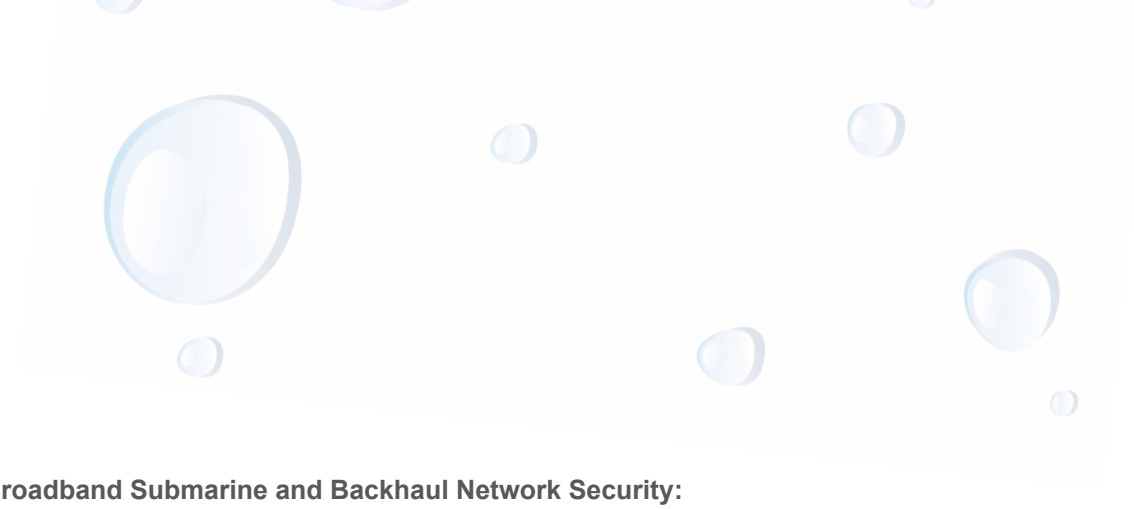
- By 2015, 98% of all households should have broadband available at actual minimum speeds of 4 Mbps download (DL)/1 Mbps upload (UL) at affordable prices to allow for at-home web 2.0 service offerings such as one-way video streaming applications and two-way video conference and collaboration applications.
- By 2015, all urban locations and 50% of all rural and remote areas should have access to broadband actual speeds of at least 10 Mbps DL/3 Mbps UL at affordable prices; 70% of urban locations should have access to at least 25 Mbps DL/10 Mbps UL, and 50% of urban locations should have access to at least 50 Mbps DL/10 Mbps UL.
- By 2015, across the island the average capacity available across all fixed broadband service offerings, provided through wireline or fixed-wireless networks, should be no less than 6 Mbps download speeds.
- By 2020, at least 85% of all customers should have access to at least 100 Mbps DL/50 Mbps UL.
- By 2015, average latency for IP traffic which originates and terminates in Puerto Rico should be no greater than 20 milliseconds; average latency for IP traffic which originates in Puerto Rico and terminates in the southeast coast of the U.S. mainland should be no greater than 90 milliseconds.

**Mobile Broadband Capacity Goals:**

- Mobile broadband offerings at next generation speeds will be available across at least 98% of the island's geography where the population resides by 2015. Expansion of smart phone penetration and tablet end-user devices will be promoted.

**Connectivity Across Community Anchor Institutions:**

- By 2015, higher education, K-12 schools, and healthcare institutions across all urban and rural areas should have access to 100 Mbps DL/25 Mbps UL speeds to sustain virtual community learning and telemedicine.
- By 2020, higher education, K-12 schools, and healthcare institutions across all urban and rural areas should have access to 1 Gbps speeds to sustain virtual community learning and telemedicine.



**Broadband Submarine and Backhaul Network Security:**

- Puerto Rico broadband providers and local and national government officials will work together to derive a plan to improve the security, robustness, and redundancy of the backhaul broadband infrastructure across the island. Particular emphasis will focus on the security standards of alternative submarine cables, and strategies to encourage the underground construction of backhaul infrastructure across the island.
- A more robust backhaul and underwater cable infrastructure will support the expansion of Puerto Rico as a telecommunications and data hub for the Hemisphere.

**Competition across the Broadband Service Market:**

- By 2015, 98% of Puerto Ricans will have at least three competitive broadband offerings available.

## ADOPTION

All Puerto Ricans, regardless of income, race, gender, age or location, should have access and the willingness to partake and benefit from the online opportunities available through broadband.

- By 2013, residential home broadband adoption across Puerto Rico should be at least 50% and by 2015 at least 70%.
- By 2015, adoption of broadband by all business with more than 4 employees.
- By 2015, 90% of the Puerto Rico population should have access to a broadband enabled computer or other mobile devices, either at home, work or via personal connection.

## EDUCATION

- All K-16 institutions will have sufficient broadband capacity available to sustain always-on learning opportunities in every school, teacher's and administrator's office, classroom, and on each student's desk and backpack.
  - To enable this vision, every K-16 institution should have access to 100 Mbps speed by 2015 and 1 Gbps speed by 2020.
- All students will have the means to access always-on online learning opportunities in and outside of the classroom. To enable this vision, all students will need to have wireless devices that are fast, robust, and safe and that can support the student's learning experience beyond the classroom.
- A technology curriculum will be developed for every stage of the K-16 learning experience that is adjusted to the changing technology environment and ensures students are developing the necessary IT-literacy skills to fully leverage online resources in a safe environment.
- Continued development of a teaching work force that has the necessary skills to fully leverage broadband and IT technology in and outside of the classroom.

## e-HEALTH

All Puerto Rican healthcare providers and patients should have access to broadband that meets the capacity, latency, and quality of service specifications necessary to utilize healthcare information technology and provide telemedicine services effectively.

- By 2015, create a nationwide e-care network that will ensure interconnectivity between all stakeholders, including patients, healthcare providers, and payers – public and private.
- By 2015, ensure broadband network capacity available to healthcare providers:
  - 4 Mbps to all healthcare providers
  - 10 Mbps to nursing homes and rural healthcare providers
  - 25 Mbps to clinics and large physician practices (5-25 physicians)
  - 100 Mbps to hospitals
- By 2020, ensure 1 Gbps to academic and large medical centers

# STRATEGIC RECOMMENDATIONS TO EXPAND BROADBAND ACROSS PUERTO RICO

## ACCESS

- Puerto Rico should continue to collect and analyze data on broadband infrastructure availability, capacity, and competition over the next decade to assess progress in meeting the Strategic Plan's goals.
- Puerto Rico's public and private broadband stakeholders should work collaboratively with the FCC to ensure fair and effective allocation of subsidies to unserved areas in Puerto Rico. In particular, models determining the size of subsidies needed to achieve sustainable broadband business plans across Puerto Rico should be based on the economic realities of Puerto Rico, including levels of broadband demand half those expected elsewhere across the U.S.
- All broadband providers should collaborate with Connect Puerto Rico to ensure that broadband inventory data collected under the SBI grant program and used by the FCC to determine the Connect America Fund transition is comprehensive and accurate.
- Public and private broadband stakeholders in Puerto Rico should work collaboratively to reform the Puerto Rico Service Fund (PRUSF) to support the deployment of broadband in unserved areas and ensure that the PRUSF complements the FCC's new Connect America Fund program.
- To encourage sustainable investment in network build-out, Puerto Rico must aggressively implement strategies to promote broadband adoption across vulnerable populations, whether residing in rural or urban areas.
- Streamline the regulatory process to promote network investment and increase competition in the broadband sector.
- The legislative and executive branches, as well as the Junta Reglamentadora de Telecomunicaciones, should work to ensure that government assets critical to the broadband market are effectively contributing to the expansion of the market in a fair and competitively neutral way. The Government and regulatory agency should be vigilant of anti-competitive activity blocking market expansion and increased capital investment in broadband capacity across Puerto Rico.
- Promote island-wide and municipal planning and coordination of construction projects.
- Continue streamlining the construction permit process and Right of Way (RoW) approvals process in order to ensure lower costs of infrastructure build-out and processing timeframes.
- Institute legislation that will encourage "Dig Once" policies for all future transportation and civil engineering construction projects.

- Institute legislation that ensures competitively neutral access to colocation infrastructure in public buildings.
- Reduce uncertainty of future costs by encouraging implementation of tax and fee policies by state and municipal government aimed to attract investment and encourage broadband network build-out.
- Establish low and uniform pole attachment rental rates and efficient processes.
- To achieve this goal, establish the formation of a taskforce to evaluate pole attachment costs across the island and work to improve efficiency of pole attachment processes.
- Promote local network interconnection and peering to lower the cost of backhaul traffic in Puerto Rico.
- Create minimum service level requirements for broadband providers serving local government agencies and entities.
- Institute Legislation to amend Act No. 73 of May 28, 2008, to include companies which operate and deploy broadband networks in Puerto Rico.
- Institute legislation for the establishment of public-private partnerships (PPP) for the exclusive purpose of designing, building, and operating a fully-passive fiber optic network to the premise in currently unserved areas for wholesale use by any *bona fide* telecommunications or broadband provider.
- Continue implementing policies aimed to stabilize the price of energy across the island.
- Improve law enforcement efforts to reduce the theft of broadband network infrastructure and reduce service theft.
- Incentivize deployment of fiber networks, thereby reducing reliance on copper networks targeted by thieves.
- Improve the enforcement of existing excavation laws to reduce damages to infrastructure assets and end-user service interruptions.

## ADOPTION

- Expand public computing capacity, digital literacy, and workforce development programs leveraging existing community resources, support from national non-profit organizations, and public institutions such as the University of Puerto Rico campuses.
- Aggressively promote mobile broadband usage, especially among low income and vulnerable populations, as an effective lower-cost and easier to access introduction to online resources.
- Leverage existing online digital literacy curricula.
- Launch targeted public-private awareness campaign promoting the benefits of online resources across vulnerable populations.
- Promote telework across Puerto Rico by revising labor laws and policies hindering its growth, and setting in motion plans to expand teleworking practices through the Puerto Rico government.

- Leverage the presence and value of eGovernment services.
- Accelerate ICT access and use in the K-12 classroom.
- The private sector in partnership with public agencies including the Public Housing Authority, the Special Communities Administration, the Department of Labor, Economic Development and the Department of Family Affairs should work to establish programs offering basic entry broadband service at discounted prices to the most vulnerable citizens in Puerto Rico.
- Work collaboratively with federal agencies to promote broadband adoption among low income populations.

## EDUCATION

- Promote a collaborative effort across government agencies and private stakeholders.
- Leverage the demand for broadband across education institutions to promote competition and investment in broadband services.
- Develop plans to achieve a computer-per-teacher and device-per-pupil goal.
- Ensure K-16 institutions have appropriate legal and procedural frameworks to perform effective network management.
- Expand resources to train the teacher to ensure they are able to fully leverage ICT solutions in the classroom.
- Launch pilot programs to assess the efficacy of online education modules.

## e-HEALTH

- Continue to promote build-out of very high-speed Internet to all healthcare institutions and practitioner's offices.
- Continue ongoing efforts to document information regarding broadband service capacity used by healthcare providers across Puerto Rico.
- Reinforce public-private partnerships to overcome governmental barriers to Health IT expansion

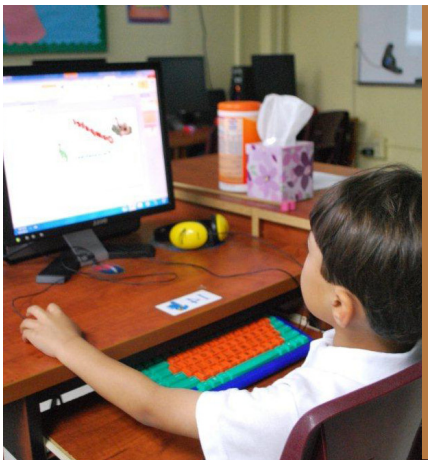
# Chapter I: Puerto Rico Broadband Taskforce

The Puerto Rico Broadband Taskforce (PRBT) was formed with the conviction that broadband is a key driver of economic growth, competitiveness, and sustainability, as well as the general improvement of the quality of life of the people of Puerto Rico. The PRBT was also formed with the sobering acknowledgement that broadband adoption in Puerto Rico is lagging behind the U.S. and other similar jurisdictions and that lag will remain a tremendous hindrance to effectively competing in the twenty-first century economy unless a comprehensive plan and deliberate intervention is aggressively pursued. The PRBT was formed with the understanding that overcoming these challenges will require the direct, cooperative engagement of the private, public, and not-for-profit sectors.

The primary goal of the PRBT has been to design and facilitate the implementation of a pragmatic and actionable Broadband Strategic Plan that effectively minimizes the digital divide in Puerto Rico by promoting adoption of broadband and Information Technology (IT) and stimulating investment opportunities in ever-increasing broadband capacity infrastructure across the island.

The PRBT efforts are focused in attaining the following six general goals:

1. Based on data collected by Connect Puerto Rico, identify critical priority areas across the island's geography and demographic communities where broadband is lagging.
2. To define, design, and develop an **integrated development plan** for Puerto Rico to secure the necessary funding sources to meet the plan's goals. This may include, among others: grants, donations (cash or in-kind), fundraising activities, and other sustainability strategies.
3. To increase citizen **awareness on the benefits and utility of broadband access** for Puerto Rico through volunteerism and outreach activities aimed at maximizing broadband adoption.
4. To **increase digital literacy** through **training and technical assistance** in order to attain the skill set that allows successful implementation of the development plan and increased adoption of broadband in Puerto Rico.
5. To develop **support systems** to attain the plan's objectives and enable strategies to instill broadband adoption and use as an island-wide, high-priority endeavor.
6. To identify **barriers to broadband build-out and long term investment** across the island and build consensus to address them.



## The primary goal of the Puerto Rico Broadband Taskforce is to close the digital divide in Puerto Rico.

The goal of the PRBT is to identify and implement actionable strategies to promote investment in broadband infrastructure and capacity where it is lacking, and to expand broadband adoption and usage amongst digitally disconnected communities across Puerto Rico. To achieve all these goals, the PRBT has actively engaged support from public and private sector stakeholders. There is an important group of overlapping stakeholders in Puerto Rico as it relates to broadband access and adoption, from both demand and supply sides. These groups have worthy, recognizable, and visible achievements; however, they have been largely scattered. Harnessing the diversity of interests presented by each group requires PRBT to be composed of key stakeholders that represent the interests of all stakeholder groups within the Puerto Rico broadband ecosystem. The PRBT is composed of 12 members representing various sectors of the broadband ecosystem in Puerto Rico including the Office of Chief Information Officer, the Telecommunication Regulatory Board, the Internet Society of Puerto Rico, broadband providers, information and communication technology providers, K-12 and higher education, healthcare, local government, grassroots community groups, and private sector groups.

Connect Puerto Rico has supported the Puerto Rico Broadband Taskforce in the preparation of this Strategic Plan by providing research and analysis consulting services. Connect Puerto Rico is a subsidiary of Connected Nation, Inc., a non-profit corporation working with the Office of the Chief Information Officer of Puerto Rico to conduct comprehensive research and analysis of the broadband landscape in Puerto Rico as part of the State Broadband Initiative (SBI) federal grant program managed by the Department of Commerce under the National Telecommunications and Information Administration, and funded through the American Recovery and Reinvestment Act. The Puerto Rico Broadband Strategic Plan is a body of work that represents the core consensus held by PRBT members listed as follows and their participating stakeholder groups:

The PRBT is a public-private partnership comprised of government representatives and multiple private and not-for-profit stakeholders.

## Members of the Puerto Rico Broadband Taskforce

Chairman of the PRBT
**Juan E. Rodríguez de Hostos**
Chief Information Officer
Government of Puerto Rico

Secretary of the PRBT
**Eduardo Díaz**
President
The Internet Society of Puerto Rico

Representative of Local Community Institutions and NGOs Committee
**Beatriz Arroyo**
Coordinadora / Voluntaria

Representative of the Broadband Provider Committee
**Karen Larson**
Senior Vice President
Critical Hub Networks, Inc.

Representative of the Private Sector Committee
**Rodolfo F. Mangual Ramos**
Executive Director
Professional College of Engineers and Land Surveyors of Puerto Rico

Representative of the Municipal Consortia Committee
**Nelson Perea**
Executive Director
Puerto Rico Technoeconomic Corridor

Vicechair of the PRBT
**Lcda. Sandra Torres**
President
Junta Reglamentadora de Telecomunicaciones de Puerto Rico

Representative of Higher Education Committee
**Luis Acosta Benítez**
President
Automeca Technical College

Representative of the Healthcare Stakeholder Committee
**Arthur Fernández del Valle**
Director Planificación y Análisis Financiero
Centro Cardiovascular de Puerto Rico y del Caribe (CCPRC)

Representative of the Content Provider Committee
**James Lynn**
Graphic Designer / Multimedia Artist

Representative of the IT Stakeholder Committee
**Paul Maldonado**
Account Manager
Cisco Systems, Inc.

Representative of K-16 Stakeholder Committee
**Dr. Juan N. Varona Echendía**
Rector
Universidad de Puerto Rico en Cayey

## Members of the Puerto Rico Broadband Taskforce Working Committees

### BROADBAND PROVIDERS

Aeronet Wireless Broadband Corp.
Atenas Internet
AT&T Mobility Puerto Rico, Inc.
AWV Communications, Inc.
Ayustar Corporation
Choice Cable TV – Puerto Rico
Cibuconet Inc.
Claro – Puerto Rico Telephone Company, Inc.
Columbus Networks Puerto Rico, Inc.
Caribe.Net – Critical Hub Networks, Inc.
Culebra Wireless Net
INTECO – Iniciativa Tecnológica Centro Oriental, Inc.
IP Solutions, Inc.
Liberty Cablevision of Puerto Rico, Ltd.
Neptuno Networks, Inc.
Nustream Communications
Onelink Communications – San Juan Cable, LLC
Open Mobile – PR Wireless, Inc.
Optivon, Inc.
Orizon Wireless, Corp.
OSNet Wireless
PREPA Networks, LLC
Puerto Rico Webmasters
Sprint Nextel Corporation
Telefónica Empresas – Telefónica Larga Distancia de Puerto Rico, Inc.
T-Mobile USA, Inc.
VPNet, Inc.
Wi-Fi Services Caribbean, Inc.
WinPR, Inc.
Worldnet Telecommunications, Inc.
Xairnet Corp.
Xecure Communications, Corp.
Zellilus Telecommunications

### CONTENT PROVIDERS

TNet Networks, Inc.
The iOS Post
infografica.net
dgtallikä
mrtechpr.com – Mr.Tech
envivoyonline.com
lachicagamer.com
Qiibo
esmandau.com
Fundación Nacional para la Cultura Popular
Red EducaPR
EnVivoPR
El Nuevo Dia
Primera Hora
WAPA TV and WAPA America in the U.S.
Mi Puerto Rico Verde
dianeris.com
CaribeNews.net
YoSoyMami.com
jameslynn.com
Radio Isla 1320
NotiCel.com
agrochic.com
turelacionista.com
Consultaconjcb.com
mipodcast.tv
Orcheed
GTA Internet Marketing
Oficina para el Financiamiento Socioeconómico y Autogestión (OFSA)

**EDUCATION**

Department of Education of Puerto Rico
University of Puerto Rico
Automeca Technical College
National University College
Flamboyan Foundation

**HEALTHCARE**

Puerto Rico Health Information Network (PRHIN)

**INFORMATION TECHNOLOGY STAKEHOLDERS**

Cisco Systems, Inc.
IBM Corporation
Intel Corporation
Microsoft Corporation
Hewlett-Packard Company
Building Industry Consulting Service International (BICSI)
Chamber of Commerce – IT & Technology Commission

**MUNICIPAL CONSORTIA**

Iniciativa Tecnológica Del Norte (INTENOR), Inc.
Desarrollo Integral del Sur (DISUR), Inc.
Iniciativa Tecnológica Del Noreste (INTENE), Inc.
Iniciativa Tecnológica Centro Oriental (INTECO)
Puerto Rico TechnoEconomic Corridor (PRTEC)

**NGOs**

Aspira
The Internet Society of Puerto Rico
Boys and Girls Clubs of Puerto Rico

**PRIVATE SECTOR**

Professional Colleges of Engineers and Surveyors
Coalición del Sector Privado, de Puerto Rico, Inc.

# Chapter II: Introduction

*"Broadband is a key economic catalyst of our time. Investing in broadband infrastructure capacity and ensuring that all citizens have access and use this technology is a core strategy to ensure economic growth in these tough times. This is especially true in an insular state, such as Puerto Rico; which is why closing the digital gap is a priority of my administration."*[1]

Governor Luis Fortuño, 2011

*"Ensuring America has twenty-first century digital infrastructure — such as high-speed broadband Internet access, fourth-generation (4G) wireless networks, new health care information technology and a modernized electrical grid — is critical to our long-term prosperity and competitiveness. The President is committed to ensuring America has a thriving and growing Internet economy. The Internet has become a global platform for communication, commerce and individual expression, and now promises to support breakthroughs in important national priorities such as health care, education and energy. Additionally, the Internet and information technology can be applied to make government more effective, transparent and accessible to all Americans."*[2]

White House, 2012

*"All over the world, the Internet has become essential to our societies, economies and their growth. For citizens, the Internet is a unique information and education resource and thus can be a helpful tool to promote freedom, democracy and human rights. For business, the Internet has become an essential and irreplaceable tool for the conduct of commerce and development of relations with consumers. The Internet is a driver of innovation, improves efficiency, and thus contributes to growth and employment."*[3]

G8 Declaration, 2011

Leaders across the world recognize the importance of broadband and information and communications technology (ICT) as key drivers of economic opportunity, sustainability, and expansion. Today, high-speed Internet is transforming the way we conduct business in the private and public sectors, the way doctors interact with patients and other healthcare providers, the way teachers approach their students' learning experience, the way citizens communicate with friends, family, search for commercial deals, professional and training opportunities, or simply seek entertainment.

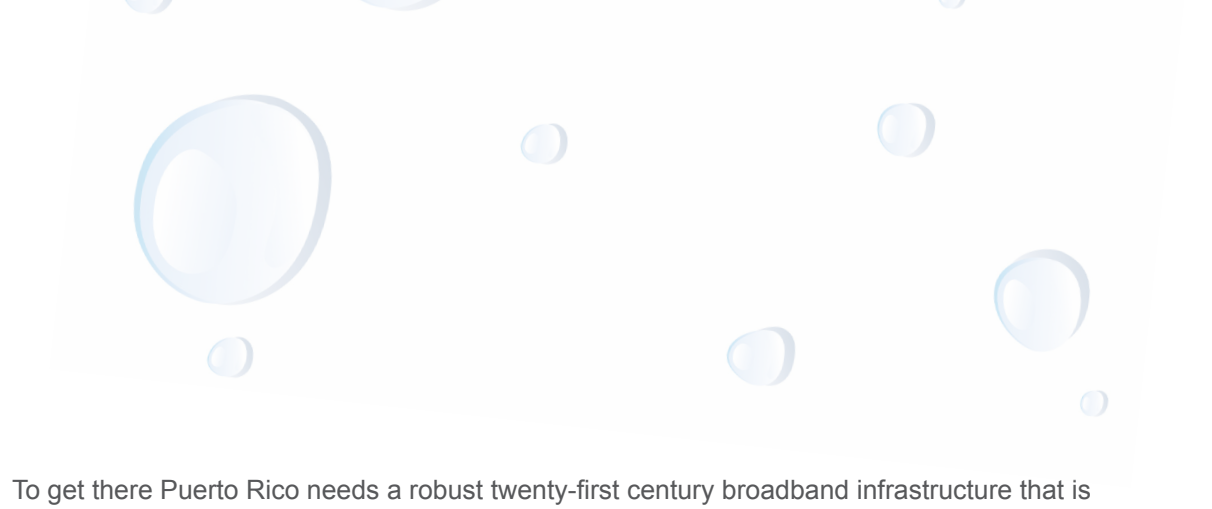
A 10% rise in the market penetration of broadband services in the LAC region increases GDP by 3.2% on average and boosts productivity by 2.6%.

In today's global economy, high-speed Internet is an essential element for economic competitiveness and sustainability. According to a recent Inter-American Development Bank study, "a 10 percent rise in the market penetration of broadband services in the (Latin American and Caribbean) region increases the GDP by 3.2 percent on average and boosts productivity by 2.6 percent."[4] Where broadband is lacking and citizens and business are unable or unwilling to access online resources through a high-speed broadband network, economies will lose competitive ground in the global economy. This is why, as the Federal Communications Commission states, "broadband is the great infrastructure challenge of the early twenty-first century."[5]

As Puerto Rico makes gradual recovery from the economic downturn, the need for a twenty-first century broadband infrastructure is a key factor in achieving economic sustainability. A robust broadband infrastructure is essential to attract foreign direct capital that will generate the jobs and opportunities needed to sustain Puerto Rico's competitiveness. The Government of Puerto Rico recently enacted the Export Services Law that gives substantial incentives for companies to relocate offices and plants to Puerto Rico. The objective of this legislative initiative is to promote foreign investment, particularly targeting companies in industries such as aerospace, manufacturing, and other high-tech industries that will leverage the large number of well-trained, bilingual engineers and other professionals graduating from the University of Puerto Rico system. A strong broadband backbone that will allow these investors to deliver better services to clients in and out of Puerto Rico is an essential asset to ensure the success of this initiative.

With a robust, ubiquitous, and competitive broadband infrastructure, there is nothing that prevents the establishment of Puerto Rico as the central point of innovative broadband-related services and information economy commerce for the Caribbean and the Southern Hemisphere. There is no reason why every municipality in Puerto Rico cannot be "as connected" to the Internet as any city in the Western Hemisphere. Puerto Rico businesses can overcome the distance barrier by interacting with their customers worldwide via broadband-enabled applications such as video conferencing. Students in Puerto Rico's schools and universities can have the same access to distance learning opportunities as those on the U.S. mainland. Through telemedicine, patients in Puerto Rico can receive better quality of healthcare and access to doctors worldwide.

All of this is possible.



To get there Puerto Rico needs a robust twenty-first century broadband infrastructure that is available ubiquitously, with no regard to socio-economic status or geographic location. A robust twenty-first century broadband infrastructure will offer fast broadband retail services aimed at all citizens and households (both fixed and mobile), and ultra-fast wholesale and retail services aimed at the business community, public safety and government facilities, and institutions including schools, libraries, hospitals, clinics, and other community anchor institutions. To achieve this, policy makers need to promote private investment waves to enable ever-increasing broadband infrastructure to meet the capacity demand across all areas.

Yet, such twenty-first century infrastructure will be a means to an end, not an end in itself. The ultimate goal of this Strategic Plan is that all citizens, businesses, and community institutions, will be able to access broadband infrastructure at an effective capacity, adopt the broadband service, and will be empowered to utilize the infrastructure in ways that improve economic efficiency, social welfare, healthcare, education, employment and professional development opportunities, and more.

To achieve these goals, we must broaden our outlook of what constitutes an effective broadband strategy. To develop a holistic broadband strategy that addresses these demand- and supply-side challenges, this Strategic Plan addresses three inter-related policy goals:

- **Access** - Ensuring subsequent waves of investment in infrastructure deployment to meet the increasing demand for capacity access by all citizens, businesses, government, and community anchor institutions.

- **Adoption** – Ensuring universal adoption and penetration of broadband services – either mobile or fixed - by all citizens, and businesses.

- **Utilization** – Ensuring that all communities – particularly community anchor institutions such as schools, hospitals, and clinics – are increasingly using broadband technology to pursue economic opportunity and sustainability, improve government services, and leverage educational and e-Health resources.

## Three inter-related policy goals: access to networks, adoption of broadband, and utilization of broadband solutions across key sectors.

***Access***

A core component of this broadband strategy strives to ensure a competitive market that is able to sustain subsequent waves of investment in the infrastructure build-out that is needed to provide sufficient broadband capacity access to all citizens, businesses, and community anchor institutions. Access to infrastructure – whether mobile or fixed – is still a key challenge across many areas of Puerto Rico. Further, available speed capacity across much of Puerto Rico remains insufficient to support the increasing demand for advanced online applications. Closing this access gap is a key goal of this Strategic Plan. To achieve this goal, the Puerto Rico Broadband Taskforce first endeavored to assess the extent of the access gap. The Taskforce then evaluated key factors affecting investment in broadband infrastructure and proposed multiple recommendations aimed at removing barriers to investment.

Chapter III of this Plan describes the broadband landscape across Puerto Rico and includes a detailed description of available broadband infrastructure across the island at different speed capacities. This information reveals that across Puerto Rico, approximately 14% of households – the majority of which are located in remote areas – have no access to fixed broadband networks. The mapping data also reveals that where capacity does exist, there remains a lag in speed capacity. Across much of Puerto Rico, broadband speed capacity offered by commercial retailers is markedly slow and inadequate to meet the increasing thirst for connectivity speed in the market. Further, retail broadband prices across Puerto Rico are, generally, relatively expensive.

Chapter IV of the Plan proposes broadband capacity goals across Puerto Rico across the coming decade. To ensure that we are on the right path to meet these goals, the chapter assesses key factors that affect broadband infrastructure investment decisions and proposes a series of recommendations aimed to encourage market expansion. In particular, the chapter recommends multiple reforms at the national and local levels aimed to remove barriers to entry into the market and reduce or ameliorate the cost of network build-out and operations. Importantly, Chapter IV also addresses the impact that the Federal broadband policy reform underway in Washington will have for the Puerto Rico broadband market.

***Adoption***

Access alone is not the only broadband challenge facing Puerto Rico. The fastest and most robust network across Puerto Rico would be of limited value if only a portion of its citizens were able to leverage it. Only 31% of Puerto Rico households subscribed to broadband in 2010. This contrasts with much higher rates of adoption across much of the developing world. Across the U.S., for example, 68% of households subscribed to broadband in 2010. Mobile broadband adoption across Puerto Rico is similar; significantly lagging behind other jurisdictions. Other metrics of broadband and ICT usage, such as mobile device, smartphone or computer ownership, similarly reveal a dramatic broadband adoption gap.

The Puerto Rico Broadband Taskforce believes that it is imperative that we address this broadband adoption gap across Puerto Rico. Failure to do so would increase the gap between the haves and have-nots across Puerto Rico and imply that too many Puerto Ricans will not have necessary tools to compete and thrive in the twenty-first century. For our collective economy, a broadband adoption gap will limit Puerto Rico's ability to develop sustainable economic models that fully leverage our unique position as an insular bridge between the mainland U.S. and the Caribbean and Latin America and beyond. Moreover, because of the economies of scale and density of broadband networks, particularly high-capacity fiber optic networks, low levels of broadband adoption and use will increase the cost per-subscriber of those networks. If a community in Puerto Rico does not fully utilize broadband, the per-subscriber cost to serve the citizens, businesses, and institutions that do choose to subscribe will be higher. These higher per-user costs translate into higher prices for the final users. Like in any other market, demand drives supply and thus promoting adoption and utilization of broadband services will improve the business case for network build and capacity investment.

Chapter V of this Broadband Strategic Plan addresses this broadband adoption challenge by first examining the key barriers to broadband adoption and proposing a series of recommendations aimed to address these gaps. Key barriers to broadband adoption include a relevance gap, or lack of knowledge and understanding of the benefits and opportunities that broadband can provide; a lack of digital skills necessary to use a computer and mobile devices and safely navigate the Internet; and affordability of the service and/or the computer or mobile devices necessary to use broadband service. Chapter V proposes a series of recommendations to address these challenges through policies to promote digital literacy and campaigns to build awareness of the benefits of the online interaction for both personal use and small business enterprises; strategies to expand the capacity of public computing centers across the island and to enable the provision of digital literacy education and training programs in these centers; and strategies to address the affordability challenge and to expand computer or other customer device and subscription penetration across Puerto Rico.

***Utilization***

Promoting access and adoption of broadband service is a key objective of the Strategic Plan. The job would be incomplete, however, if we failed to address the utilization challenge. An effective broadband strategy needs to ensure the growth of broadband-enabled technology and solutions across key business sectors, in particular, the Education and Healthcare sectors.

Online educational resources for teachers and students are already transforming the way children learn and teachers teach. Online curricula and resources offer students and teachers a plethora of resources previously unattainable. These resources are already transforming the way we understand educational development. However, this transformation needs proper steering and coordination to ensure that students and teachers have appropriate online educational content, appropriate content standards and means to protect students from online risks, and new curricula adapted to these new resources. Importantly, teachers need to be trained to ensure that they not only know how to use a computer and can access this new wealth of information, but also understand how to leverage those resources to effectively steer their pupils along their educational development.

While these matters might be thought of as outside the realm of broadband policy per se, they cannot be determined separately from a broadband strategy in isolation within the Education sector. This is because broadband policy will ultimately determine whether there remains digital "have" and "have not" students, schools, and communities. Across much of Puerto Rico, existing broadband availability and capacity is inadequate to meet these challenges. Schools across urban and rural areas alike will increasingly need not just broadband, but very fast broadband, perhaps hundreds of megabits or more, that will enable simultaneous access to online service for all classrooms, administrators, teachers, and – crucially – students. Furthermore, teachers and administrators will need to be steered to ensure that they are fully leveraging these resources for the benefit of their students. In short, the educational opportunities that broadband offers present a transformational challenge for the Education sectors that needs to be addressed within the national broadband policy framework.

Addressing the supply-side infrastructure challenge and the demand-side "usage" challenge of transforming curricula and processes in the education system need to go hand in hand, as one factor feeds and depends on the other. There is no need for very fast broadband if schools don't know how to leverage it; and there will be no means to fully leverage online resources and empower students where schools do not have access to very high capacity broadband service. The Puerto Rico Broadband Taskforce has invited members of the educational community, including representatives of the Department of Education, to discuss these matters and contribute to Chapter VI of this Plan, which assess the state of information and communications technology usage across the K-16 educational system and proposes a series of recommendations aimed to promote it.

A similar transformational process triggered by broadband is taking place in the Healthcare service provision sector. Online patient records, telemedicine, and real-time digital imagery are empowering healthcare service providers in ways that – where successful – will directly impact the quality of service and life of patients, positively affect national health statistics, and lower the cost of healthcare provision. Through broadband access and online patient records, healthcare providers will be able to have easier, faster, and more accurate patient history information, enabling faster and more accurate diagnosis. Telemedicine can open the possibility of remote treatment and diagnosis, which can be a partial solution to address the healthcare needs of remote areas, particularly for specialized care and treatment. Online diagnosis and monitoring systems are proving to be an effective means to ensure proper care for chronic patients, such as diabetes patients, that will ultimately result in a healthier population and containment of costs of providing service to chronic patients.

More generally, broadband is an essential tool to empower the Puerto Rico business community to compete in the twenty-first century economy. A reliable, robust broadband is essential to support offshore outsourcing opportunities for Puerto Rico businesses, empower business professionals and the younger generations coming into the labor market to take advantage of offshore workforce development opportunities and directly compete for outsourcing opportunities, or simply enable Puerto Rico coffee growers and other producers to have a direct path to offshore distribution markets and growth opportunities. Ensuring that the infrastructure is available and is being used to support Puerto Rico's economic sustainability is a key goal of this Strategic Plan.

Effective stewardship of these transformational processes, again, will require coordination across various government agencies and the private sector. The Puerto Rico Broadband Taskforce has worked with representatives from the Healthcare sector, including the Puerto Rico Health Information Network, to assess the degree of utilization of broadband-enabled technologies in the Puerto Rico Healthcare sector as well as the challenges preventing utilization, and has proposed multiple recommendations to address these. Chapter VII of this Plan summarizes this work.

## Public-private partnerships are essential to close the digital divide across Puerto Rico.

This Strategic Plan lays out a series of recommendations to help us achieve a twenty-first century infrastructure that will contribute to the revitalization of the Puerto Rico economy, promote foreign direct investment, and offer new economic and social opportunities to all Puerto Ricans regardless of where they live and work or what their education and income levels are. Many of the recommendations proposed by the Puerto Rico Broadband Taskforce are immediately actionable, while others will require further analysis and assessment. In all cases, the Strategic Plan calls for a cooperative effort between the private and public sectors, including multiple government agencies in Puerto Rico and at the federal level. While the challenge is great, it cannot be avoided. A broadband policy that neglects to ensure that national, regional, and local government processes evolve to an online world or that doesn't guarantee that educational processes adapt to leverage online resources to empower educators and their pupils or fails to address the multiple complexities of online healthcare service and patient records will be ineffective and incomplete.

This process will not happen overnight and will require waves of reform, coordination, and adjustment across multiple agencies and functions of government, and the private sector. As such, this Broadband Strategic Plan – the first one of its kind for Puerto Rico – should be understood as the beginning of a dialogue and action plan, not the end. This Strategic Plan will lead to action through the implementation of the multiple actionable strategic recommendations. It is also meant to trigger further dialogue across multiple levels of government and the private sector leading to subsequent review and assessment of Strategic Plans aimed to achieve the access, adoption, and utilization goals defined in this Strategic Plan.

# Endnotes

[1] Fortuño, L. Federal Communications Commission, (2011). *Letter to the Federal Communications Commission*. Retrieved from website: http://apps.fcc.gov/ecfs/document/view?id=7021714838

[2] *White House statement on technology policy*. (2011). Retrieved from http://www.whitehouse.gov/issues/technology

[3] G8, G8 Summit of Deauville, (2011). *Renewed commitment for freedom and democracy*. Retrieved from website: http://www.g20-g8.com/g8-g20/g8/english/live/news/renewed-commitment-for-freedom-and-democracy.1314.html

[4] Inter-American Development Bank, (2012). *Bridging gaps, building opportunity: Broadband as a catalyst for economic growth and social progress in Latin America and the Caribbean*.

[5] Federal Communications Commission. (2010). *National Broadband Plan*, Chapter 1. Retrieved from website: http://download.broadband.gov/plan/national-broadband-plan-chapter-1-introduction.pdf

# Chapter III: Puerto Rico's Broadband Landscape

## A. Introduction

This chapter analyzes the latest data available on the Puerto Rico broadband landscape. This assessment covers the scope, size, and nature of the digital divide across Puerto Rico, focusing on both the demand- and supply-side broadband landscape and gaps across Puerto Rico. This assessment defines the challenge that Puerto Rico is faced with as it pursues policies to ensure digital inclusion for all citizens regardless of where they live, their social or economic status, or any other factors that may be preventing them from benefiting from broadband and the Internet.

The chapter is divided into two sections examining, first, the Puerto Rico broadband network or infrastructure landscape and, second, the broadband adoption or usage across both households and businesses in Puerto Rico. Various data sources are used for this assessment including broadband inventory data collected under the federal State Broadband Initiative (SBI) grant program, managed by the National Telecommunications and Information Administration at the Department of Commerce. The SBI was established to assess the broadband gaps across the U.S. and its territories.[1] Residential and business broadband adoption data is also based on data collected under the SBI grant program through two random digit dial surveys of residential homes and businesses on the island. The purpose of this demand-side research is to better understand the drivers and barriers to technology and broadband adoption and estimate the broadband adoption gap across the territory of Puerto Rico.

## B. Puerto Rico's Broadband Infrastructure

This section analyzes the broadband inventory across Puerto Rico, in order to identify broadband infrastructure gaps at various speeds of connection across the island. It also provides a preliminary assessment of the significance of this digital gap in light of the recent reform by the Federal Communications Commission of the Universal Service Fund.[2] The broadband inventory is based on data collected by Connect Puerto Rico, a non-profit working on behalf of the Office of the Chief Information Officer of the Government of Puerto Rico (OCIO), as part of the State Broadband Initiative (SBI) federal grant program. One of the key goals of the SBI program is the creation of a National Broadband Map to provide granular inventory of the broadband capacity available across the U.S. and its territories, by service speed tier and type of platform. This detailed database can be found at http://broadbandmap.gov/. This federal effort is undertaken in partnership with U.S. states and territories that collect and submit data to the Department of Commerce on a bi-annual basis. The National Broadband Map was first released in February of 2011, is updated twice yearly, and is funded through the American Recovery and Reinvestment Act.[3]

The data collected by Connect Puerto Rico represents the most granular, comprehensive mapping effort to date of the broadband infrastructure across Puerto Rico.

The Puerto Rico broadband inventory data follows the speed tier, granular, and geographic specifications set forth by the NTIA under the SBI program. Connect Puerto Rico is charged with collecting, validating, and aggregating data from multiple broadband providers across the island regarding their service territory by speed and platform. The purpose of this work is to measure the level of broadband service available to Puerto Rico and identify communities and households that remain unserved or underserved by broadband service; information that is essential to estimate the broadband availability gap in the state and understand the scope and scale of providing ubiquitous broadband service to all Puerto Ricans.

The data collected by Connect Puerto Rico represents the most granular, comprehensive mapping effort to date of the broadband infrastructure across the island. The data includes the majority of known broadband providers on the island; however, there are some broadband providers that were unable or unwilling to participate in the program to date.[4]

Connect Puerto Rico welcomes collaboration with all broadband providers in Puerto Rico to achieve a comprehensive, accurate database of the actual inventory across the island. Based on this data collection effort, Connect Puerto Rico has produced the first interactive online map of the broadband inventory across the island, available at http://www.connectpr.org/interactive-map.

The interactive online platform aims to provide granular, transparent information regarding broadband available across each community in Puerto Rico. This information is useful to both consumers seeking competitive broadband offerings, and the provider community. The Connect Puerto Rico maps are an ongoing project and will be updated twice-yearly through the duration of the SBI program. In every iteration of the map, Connect Puerto Rico aims to incorporate new broadband infrastructure build-out, include previously unavailable data, and include corrections to existing data as needed. There is a degree of measurement error inherent in this mapping exercise, which needs to be taken into consideration when analyzing the data. This measurement error will decrease as the maps become active tools for local, national, and federal stakeholders, who will be able to identify areas where the displayed coverage is under- or over-estimated. Connect Puerto Rico welcomes such feedback, to be analyzed in collaboration with broadband providers to correct errors identified in the maps.[5]

The data evaluated in this section represents the known broadband inventory available across the island as of June 30, 2011. This data was submitted by OCIO and Connect Puerto Rico to the Department of Commerce on October 1, 2011. The section first evaluates the broadband landscape available across Puerto Rico by speed tier, technology platform, and demographic density across served and unserved areas; and, second, it evaluates the broadband landscape across Puerto Rico's 78 municipalities by speed tier and technology platform.

## 1. Broadband Availability by Speed Tier

Table III.1 shows estimates of the numbers and percentages of households across Puerto Rico having broadband available at various download speed tiers.[6] Data included in Table III.1 does not include mobile broadband service.

**Table III.1 - Broadband Availability by Fixed Networks Across Puerto Rico - By Speed Tier**

| | Unserved Households | Served Households | Percent Households Served |
|---|---|---|---|
| **Download/Upload Speed Tiers** | **('000)** | **('000)** | |
| At Least 768 Kbps/200 Kbps | 177 | 1,084 | 86% |
| At Least 1.5 Mbps/200 Kbps | 187 | 1,074 | 85% |
| At Least 3 Mbps/768 Kbps | 544 | 717 | 57% |
| At Least 6 Mbps/768 Kbps | 742 | 519 | 41% |
| At Least 6 Mbps/1.5 Mbps | 834 | 427 | 34% |
| At Least 10 Mbps/768 Kbps | 860 | 401 | 32% |
| At Least 25 Mbps/768 Kbps | 1,261 | 0 | 0.00% |
| At Least 50 Mbps/758 Kbps | 1,261 | 0 | 0.00% |
| At Least 100 Mbps/768 Kbps | 1,261 | 0 | 0.00% |
| At Least 1 Gbps/768 Kbps | 1,261 | 0 | 0.00% |

Source:Connect Puerto Rico, June 2011

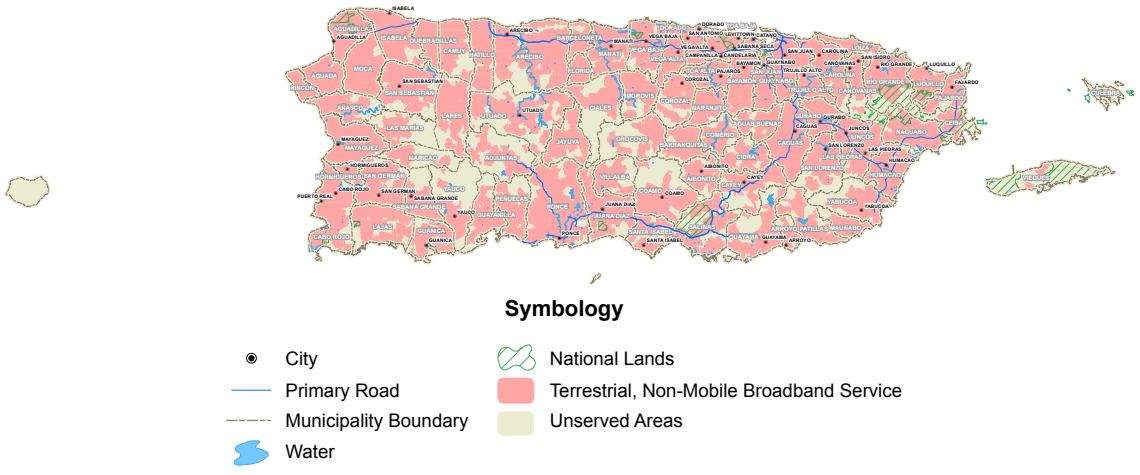
The total number of households in Puerto Rico according to the 2000 U.S. Census was approximately 1.26 million.[7] By June 2011, broadband of speeds of at least 768 Kbps download and at least 200 Kbps upload was available to approximately 86% of all Puerto Rico households.[8] This means that approximately 177,000 Puerto Rico households, or 14%, remain unserved by any form of fixed broadband. This broadband availability gap affecting an estimated 14% of Puerto Rico households is in stark contrast with the national average estimates for unserved areas across the U.S. of 5%.[9] Puerto Rico, therefore, is significantly lagging behind in basic broadband infrastructure build-out.

# An estimated 14% of Puerto Rico households, or approximately 177,000, have no fixed broadband available.

The speed capacity of at least 768 Kbps download and at least 200 Kbps upload is the most basic speed that is classified as broadband by the FCC as of the report's release. This basic broadband speed service is selected by the FCC as the key benchmark to determine what areas across the U.S. will be eligible for funding through Phase I of the newly created Connect America Fund, aimed to subsidize broadband build-out where there is none (for more information on this reform, see Chapter IV below).[10] Based on the new rules of the Connect America Fund for Phase I, areas across Puerto Rico that do not have this basic broadband infrastructure today depicted in Figure III.1 below will be eligible to receive funding beginning in 2012.

Figure III.1 depicts available fixed broadband across Puerto Rico at this basic speed of at least 768 Kbps download/200 Kbps upload. Areas in pink represent areas where fixed broadband is available via cable, DSL, or fixed wireless platforms (this broadband inventory does not include mobile broadband coverage). Areas in beige represent unserved areas that will be eligible for funding under Phase I of the Connect America Program.

Figure III.1 - Broadband Inventory of Advertised Service of At Least 768 Kbps Download/200 Kbps Upload Speeds, June 2011[11]

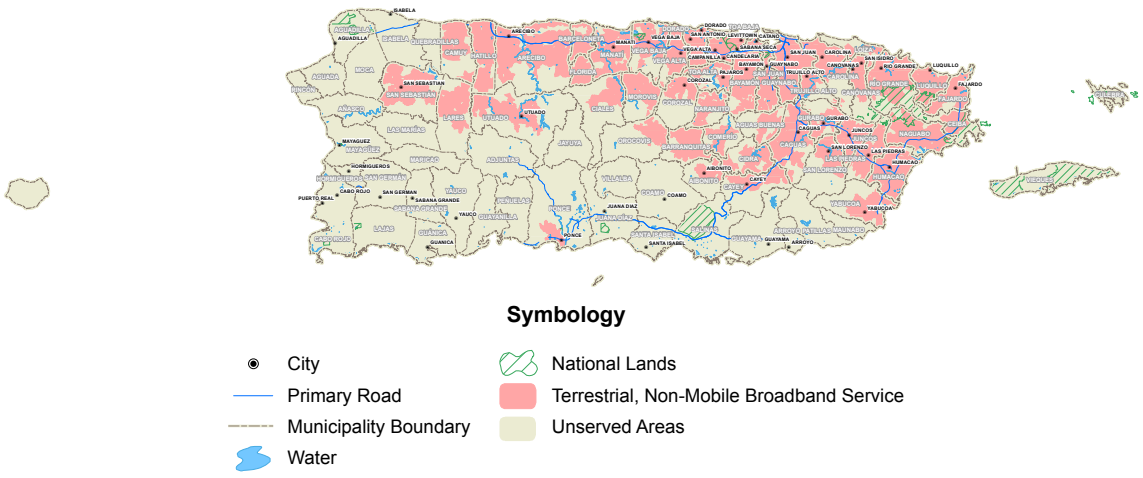



An estimated 57% of households across Puerto Rico have fixed broadband available to at least 3 Mbps download and 768 Kbps upload speeds. This implies that most broadband infrastructure built across Puerto Rico to more than 544,000 households has not been connected to technology that allows for speeds of at least 3 Mbps download / 768 Kbps upload (Figure III.2). This is a significant lag in deployment of capacity at this higher speed tier that demonstrates a second capacity gap across the island. While there is a basic infrastructure gap across parts of the island where approximately 14% of households are located, there is a second, wider gap affecting areas where approximately 43% of all households are located that may have basic broadband, but do not have service at the threshold of 3 Mbps/768 Kbps.

The 4 Mbps download and 1 Mbps upload actual speed capacity is selected by the FCC as the key benchmark under the newly created Connect America Fund to determine what areas across the U.S. and territories will be eligible for funding through Phase II, expected to be implemented in 2013.[12] Figure III.2 approximates the areas across Puerto Rico that would be eligible for Phase II funding of the Connect America Fund as of June 2011.

Note that the infrastructure depicted in Figure III.2 and reported in Table III.1 above, corresponds to broadband inventory that meets both the stated download and the upload benchmark, and not just the download speeds of 3 Mbps. Many providers across Puerto Rico do offer residential commercial service of at least 3 Mbps download speeds (in some cases as high as 12 Mbps download speeds); however, these commercial offerings are not reflected in the data reported here if they offer upload service capacity below the 768 Kbps benchmark. Similarly and unless the FCC changes its stated plans for the Connect America Fund, infrastructure that does not meet both the download and upload targeted thresholds will not be taken into account by the FCC as it defines eligible areas for broadband subsidies under the new Connect America Fund.

Figure III.2 - Broadband Inventory of Advertised Service of At Least 3 Mbps Download/768 Kbps Upload Speeds, June 2011[13]

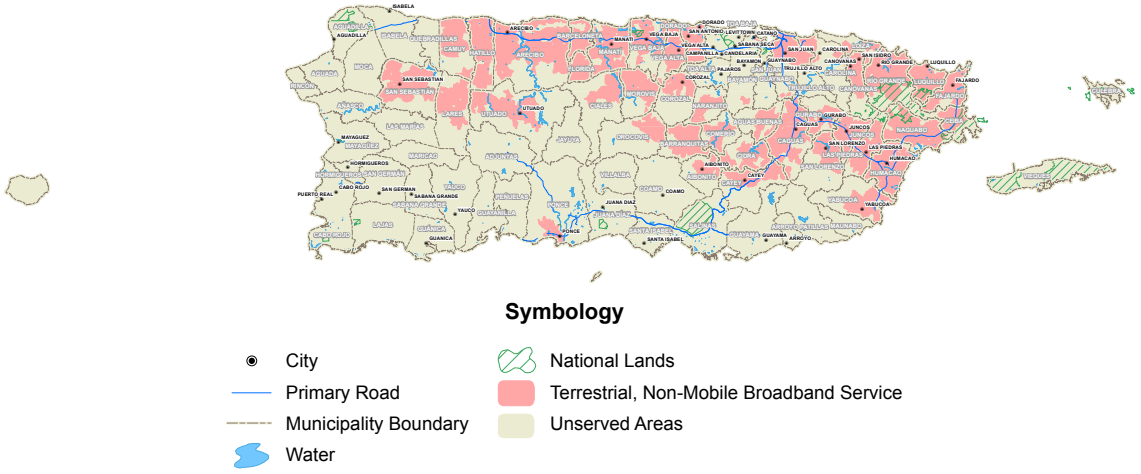



Access to fixed broadband service at speeds of at least 6 Mbps download and 768 Kbps upload is available to approximately 41% of all households. Access to fixed broadband at speeds of at least 6 Mbps download and 1.5 Mbps upload is available to an estimated 34% of all Puerto Rico households as represented in Figure III.3. This suggests that across Puerto Rico the upload speed capacity gap is even more acute than the capacity gap when focusing only on download speed capacity. That translates into 834,000 households that do not have access to broadband at that capacity.

# Only 57% of households have broadband available at speeds of 3 Mbps DL/768 Kbps UL, and only 32% at speeds of 10 Mbps/DL/768 Kbps UL.

Finally, broadband availability at speeds of at least 10 Mbps download and 768 Kbps upload is available to an estimated 32% of households in Puerto Rico. Based on the broadband inventory collected by Connect Puerto Rico, there are no commercial residential offerings across Puerto Rico at higher speed tiers. This contrasts sharply with the roll-out of high-capacity broadband infrastructure across the U.S. as measured in the National Broadband Map. As high-capacity investments continue to be rolled out across urban and suburban areas in the U.S. the digital lag across Puerto Rico is growing.

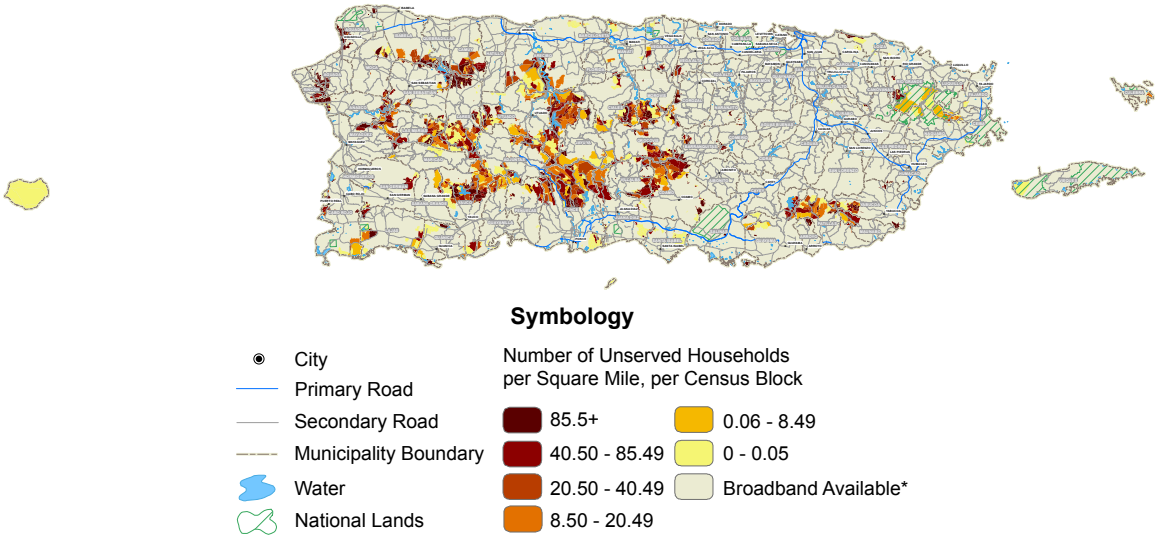
Figure III.3 - Broadband Inventory of Advertised Service of At Least 6 Mbps Download/1.5 Mbps Upload Speeds, June 2011[14]




When zooming in on the broadband infrastructure available in each Puerto Rico community, availability estimates reveal wide variances in measured broadband inventory, highlighting the importance of granular data in order to identify gaps in infrastructure across each community. Detailed inventory estimates at each of Puerto Rico's 78 municipalities are reported below. Availability by municipality as well as more granular, street-level broadband inventory data is available through Connect Puerto Rico's interactive, online broadband inventory map at http://www.connectpr.org/interactive-map.

Data also available through Connect Puerto Rico's interactive map are the density of households that are unserved by broadband providers. These data are available at the Census Block level throughout the island. Figure III.4 below shows the density of households that are unserved by a broadband provider of at least 768 Kbps download and at least 200 Kbps upload speeds.

Figure III.4 - Unserved Areas Without Broadband Infrastructure of At Least 768 Kbps Download/200 Kbps Upload - Indicating Density of Population by Census Block, June 2011[15]




The existing broadband inventory indicates that across Puerto Rico there is a lack of robust broadband offerings at basic and advanced speed capacity. There are two key broadband availability challenges in Puerto Rico: i) bridging the gap for approximately 14% of households that have no broadband available at any broadband speed tier; and, ii) promoting further capacity investment across the existing broadband network to ensure that the supply meets the broadband capacity needs of Puerto Ricans. The data showcase that no community is alike and granular data is essential to identifying and addressing the gaps in networks across each community.

It is important to note that the inventory of broadband measured in these maps and used to conduct this analysis is preliminary in nature. Data collected include the majority of known broadband providers in Puerto Rico; however, there are a few broadband providers that were unable or unwilling to participate. Furthermore, the measured broadband inventory provides an estimate of the true extent of broadband coverage. There is a degree of error inherent in this exercise, which needs to be taken into consideration when analyzing the data. To reduce measurement error, independent statistical and field validation techniques are used to improve the broadband data. The Connect Puerto Rico program encourages feedback on broadband service, which can be analyzed in collaboration with broadband providers to correct errors identified on the maps.[16]

# Approximately 79% of households in Puerto Rico have access to cable broadband, and 64% have access to DSL service.

## 2. Broadband Availability by Technology Platform

The June 2011 Puerto Rico broadband inventory database is based on reported network infrastructure from 6 terrestrial, non-mobile broadband providers. Of the broadband platforms available in Puerto Rico, the most ubiquitous technology available across the territory is cable modem service. Across Puerto Rico, cable providers offer service to 79% of households (Table III.2). This estimate is lower than the national estimate of 81% of households nationwide serviced by cable. Digital Subscriber Line (DSL) service is available to 64% of households in Puerto Rico contrasted to U.S. estimates of 88% of DSL penetration. Fixed wireless services are accessible by 40% of households across Puerto Rico. The national estimate for fixed wireless access is 31%. Access to mobile broadband reaches nearly every household in Puerto Rico. The island has four mobile broadband providers that combined provide access to 99.6% of households. That is slightly higher than the terrestrial mobile national estimate of 97%.[17]

A wide disparity exists between those households with only fixed broadband available and those with fixed broadband or mobile wireless. Indeed, 86% of households are served by broadband platforms of cable, DSL, and fixed wireless. The inclusion of the mobile platform adds to the number of households significantly and serves 99% of Puerto Rico's households with broadband. That number compares directly with the national estimate of all broadband platform service.[18]

**Table III.2 - Availability by Broadband Platform - Puerto Rico & U.S. Comparisons**

| At least 768 Kbps Download/200 Kbps Upload | | | |
|---|---|---|---|
| | Puerto Rico Estimates | | U.S. Estimates |
| Platform Type | Served Households ('000s) | Percent of Households Served | Percent of Households Served |
| Cable | 995 | 79% | 85% |
| DSL | 806 | 64% | 88% |
| Fixed Wireless | 506 | 40% | 31% |
| Mobile | 1,256 | 99.6% | 97% |
| All Platforms Except Mobile | 1,084 | 86% | N/A |
| All Platforms | 1,267 | 99.7% | 99% |

Source: For Puerto Rico estimates, Connect Puerto Rico, June 2011. For U.S. estimates, National Broadband Map, NTIA, December 2010 (which is the latest data available at the national level).
Note: NTIA's National Broadband Map data does not provide estimates for terrestrial service offering excluding mobile broadband.

## 3. Household Density Across Unserved Areas in Puerto Rico

In this subsection, we examine the household density across unserved areas in Puerto Rico. Household density (or number of households per square mile) is a key driver of infrastructure build-out costs in any network industry. Broadband is no exception and, not surprisingly, the National Broadband Map reports that across America the broadband gaps remain mostly across low density, rural areas. Puerto Rico is no exception and data shows that unserved areas tend to be less populated. However, the household density across unserved areas or areas that remain underserved (they may have basic broadband available but are unserved at higher speeds) is significantly higher than across the U.S.

Across Puerto Rico the average household density is 368, varying greatly by municipality as reported in the following segment.[19] Table III.3 reports average household density across Census Blocks that are unserved by basic broadband service based on NTIA definitions (768 Kbps download/200 Kbps upload) and those with higher speeds service. [20] These measures provide an objective means to assess the infrastructure in unserved or served areas.

The average density of households in populated areas without any form of broadband is 106 households per square mile. By contrast, the average density of households in populated areas with service of at least 768 Kbps / 200 Kbps speeds is 957 households per square mile – significantly higher than the average of 368 households per square mile. Across populated areas that have broadband available at speeds of at least 3 Mbps download / 768 Kbps upload, there are an estimated 1,548 households per square mile.

**Table III.3 - Average Number of Households Per Square Mile For Census Blocks with Households Served by Terrestrial Broadband**

| Capacity Available | Density of Households |
|---|---|
| No Broadband Available | 106 |
| At least 768 Kbps/200 Kbps | 957 |
| At Least 3 Mbps/768 Kbps | 1,548 |

Source: Connect Puerto Rico, June 2011.

In comparison to the diverse geographic landscape of Puerto Rico between the connected urban areas and unconnected remote areas, the state of Texas also presents the same unique connectivity challenge. However, Texas has a considerably lower density of households unserved by at least 768 Kbps download / 200 Kbps upload speeds. The average statewide density of households in Texas is 28.24, much lower than Puerto Rico's demographic density.[21] Yet, investment in broadband infrastructure has taken place across Texas in areas that are on average much less populated than the average unserved areas in Puerto Rico. The average density of households across populated areas without any broadband in Texas is just 3.76 households per square mile, drastically contrasting with the above-mentioned estimate for Puerto Rico of 106 households per square mile.[22] This data suggests that broadband economics are different across the two jurisdictions. In the second part of this chapter, we discuss broadband adoption rates by households across Puerto Rico and find that they are significantly lagging behind much of the U.S. Such demand factors are key drivers of the economics of network build-out.

## 4. Broadband Availability Across Puerto Rico Municipalities

This section examines broadband availability across Puerto Rico's 78 municipalities, focusing first on broadband inventory estimates offering service of at least 768 Kbps download and 200 Kbps upload, then service of least 3 Mbps download and 768 Kbps upload, and finally service of at least 6 Mbps download and 1.5 Mbps upload. These service offerings are the three main technology platforms available in Puerto Rico.

### *a. Municipality-Level Broadband Availability*

Beginning at the basic speed tier for broadband (at least 768 Kbps download and 200 Kbps upload speeds), Figure III.5 below is a municipality analysis of the broadband availability. Figure III.6 depicts broadband availability of at least 3 Mbps download and 768 Kbps upload across Puerto Rico by municipality. Finally, Figure III.7 below depicts broadband availability at the speeds of at least 6 Mbps download and 1.5 Mbps upload across Puerto Rico by municipality.

What these data reveal supports the notion that the broadband landscape across Puerto Rico varies greatly by community (Table III.4). Detailed information on the estimated inventory of broadband in each municipality can be found on the Connect Puerto Rico website at http://www.connectpr.org/mapping/municipalities.

For more granular information regarding the estimated broadband inventory, see the Puerto Rico online broadband inventory map at http://www.connectpr.org/mapping/island.

# Across Puerto Rico's municipalities, broadband availability varies widely. While in San Juan all households are served, in Las Marias municipality only 35% of households have access to fixed broadband.

Figure III.5 - Broadband Availability Across Puerto Rico - By Municipality - At Least 768 Kbps Download and 200 Kbps Upload Speeds, June 2011

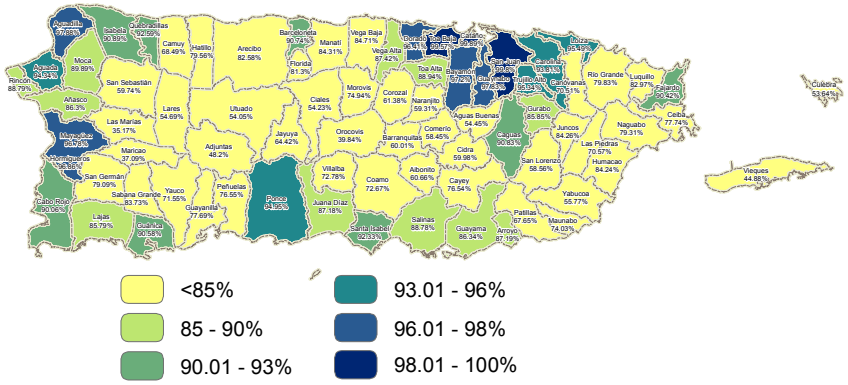



Figure III.6 - Broadband Availability Across Puerto Rico - By Municipality - At Least 3 Mbps Download and 768 Kbps Upload Speeds, June 2011

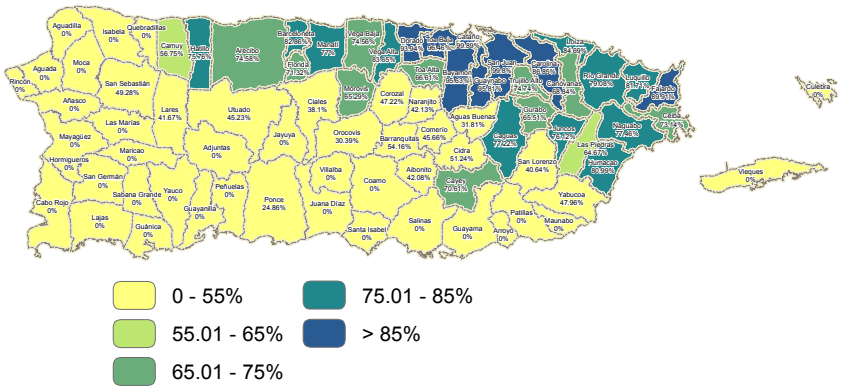
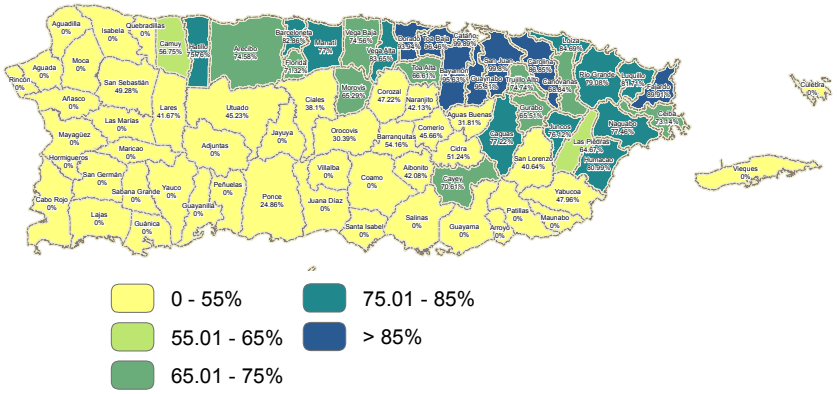



Figure III.7 - Broadband Availability Across Puerto Rico - By Municipality - At Least 6 Mbps Download and 1.5 Mbps Upload Speeds, June 2011



| Table III.4 - Availability of Broadband Service by Municipality by Speed Tier | | | | | | |
|---|---|---|---|---|---|---|
| Terrestrial Broadband Excluding Mobile | | | | | | |
| | | | | Percentage of Households Served by Speed Tier | | |
| Municipality | Median Household Income | Household Density | Number of Households ('000s) | ≥ 768 Kbps Download/ 200 Kbps Upload | ≥ 3 Mbps Download/ 768 Kbps Upload | ≥ 6 Mbps Download/ 1.5 Mbps Upload |
| Adjuntas | $11,983 | 88.4 | 6 | 48% | 0% | 0% |
| Aguada | $14,103 | 437.1 | 14 | 94% | 0% | 0% |
| Aguadilla | $13,956 | 603.6 | 22 | 98% | 0% | 0% |
| Aguas Buenas | $14,751 | 302.3 | 9 | 55% | 32% | 31% |
| Aibonito | $15,487 | 268.7 | 8 | 61% | 42% | 42% |
| Anasco | $15,244 | 239.3 | 9 | 86% | 0% | 0% |
| Arecibo | $16,564 | 271.8 | 34 | 83% | 75% | 75% |
| Arroyo | $14,815 | 410 | 6 | 87% | 0% | 0% |
| Barceloneta | $16,124 | 402.4 | 8 | 91% | 83% | 83% |
| Barranquitas | $14,751 | 253.2 | 9 | 60% | 54% | 54% |
| Bayamon | $25,294 | 1660.5 | 74 | 97% | 96% | 0% |
| Cabo Rojo | $15,809 | 243.3 | 17 | 90% | 0% | 0% |
| Caguas | $22,951 | 800 | 47 | 91% | 77% | 77% |
| Camuy | $14,985 | 246.8 | 11 | 68% | 57% | 57% |
| Canovanas | $21,934 | 409.3 | 13 | 71% | 69% | 69% |
| Carolina | $28,262 | 1401.9 | 64 | 94% | 87% | 16% |
| Catano | $18,144 | 1999.6 | 10 | 100% | 100% | 18% |
| Cayey | $19,040 | 301.2 | 16 | 77% | 71% | 71% |
| Ceiba | $18,461 | 198 | 6 | 78% | 73% | 73% |
| Ciales | $13,564 | 90.7 | 6 | 54% | 38% | 38% |
| Cidra | $21,293 | 365.9 | 13 | 60% | 51% | 51% |
| Coamo | $15,028 | 150.6 | 12 | 73% | 0% | 0% |
| Comerio | $12,927 | 222.3 | 6 | 58% | 46% | 46% |
| Corozal | $14,077 | 264.5 | 11 | 61% | 47% | 45% |
| Culebra | $19,868 | 60.2 | 1 | 54% | 0% | 0% |
| Dorado | $25,473 | 466.7 | 11 | 96% | 94% | 83% |
| Fajardo | $19,803 | 474.6 | 14 | 90% | 90% | 90% |
| Florida | $16,246 | 260.8 | 4 | 81% | 71% | 71% |
| Guanica | $11,870 | 196.5 | 7 | 91% | 0% | 0% |
| Guayama | $17,214 | 218.6 | 14 | 86% | 0% | 0% |
| Guayanilla | $14,243 | 170.2 | 7 | 78% | 0% | 0% |
| Guaynabo | $33,279 | 1255.7 | 34 | 98% | 96% | 5% |
| Gurabo | $27,416 | 421.7 | 12 | 86% | 66% | 65% |
| Hatillo | $16,246 | 303.6 | 13 | 80% | 76% | 76% |
| Hormigueros | $19,834 | 514.1 | 6 | 97% | 0% | 0% |
| Humacao | $18,354 | 430.9 | 19 | 84% | 81% | 81% |
| Isabela | $13,028 | 270.4 | 15 | 91% | 0% | 0% |
| Jayuya | $15,556 | 114 | 5 | 64% | 0% | 0% |
| Juana Diaz | $16,496 | 248 | 15 | 87% | 0% | 0% |
| Juncos | $17,694 | 448.8 | 12 | 84% | 76% | 76% |
| Lajas | $14,500 | 149.9 | 9 | 86% | 0% | 0% |
| Lares | $12,199 | 178.6 | 11 | 55% | 42% | 42% |
| Las Marias | $13,847 | 76.9 | 4 | 35% | 0% | 0% |

| | | | | Percentage of Households Served by Speed Tier | | |
|---|---|---|---|---|---|---|
| Municipality | Median Household Income | Household Density | Number of Households ('000s) | ≥ 768 Kbps Download/ 200 Kbps Upload | ≥ 3 Mbps Download/ 768 Kbps Upload | ≥ 6 Mbps Download/ 1.5 Mbps Upload |
| Las Piedras | $17,680 | 329 | 11 | 71% | 65% | 65% |
| Loiza | $19,460 | 493.7 | 10 | 95% | 85% | 85% |
| Luquillo | $19,672 | 255.8 | 7 | 83% | 82% | 82% |
| Manati | $16,564 | 338 | 15 | 84% | 77% | 77% |
| Maricao | $10,932 | 55 | 2 | 37% | 0% | 0% |
| Maunabo | $15,255 | 189.8 | 4 | 74% | 0% | 0% |
| Mayaguez | $14,059 | 447.5 | 35 | 97% | 0% | 0% |
| Moca | $12,841 | 252.8 | 13 | 90% | 0% | 0% |
| Morovis | $13,646 | 226.4 | 9 | 75% | 65% | 65% |
| Naguabo | $15,250 | 152.3 | 8 | 79% | 77% | 77% |
| Naranjito | $14,275 | 329 | 9 | 59% | 42% | 29% |
| Orocovis | $13,713 | 111.6 | 7 | 40% | 30% | 30% |
| Patillas | $14,860 | 140.8 | 7 | 68% | 0% | 0% |
| Penuelas | $14,872 | 173.5 | 8 | 77% | 0% | 0% |
| Ponce | $16,902 | 519.6 | 60 | 95% | 25% | 25% |
| Quebradillas | $11,943 | 365.6 | 8 | 93% | 0% | 0% |
| Rincon | $16,067 | 360.4 | 5 | 89% | 0% | 0% |
| Rio Grande | $20,850 | 270.5 | 16 | 80% | 79% | 79% |
| Sabana Grande | $15,497 | 247 | 9 | 84% | 0% | 0% |
| Salinas | $13,118 | 147.1 | 10 | 89% | 0% | 0% |
| San German | $15,016 | 235 | 13 | 79% | 0% | 0% |
| San Juan | $23,478 | 3418.3 | 163 | 100% | 100% | 55% |
| San Lorenzo | $17,477 | 247.2 | 13 | 59% | 41% | 41% |
| San Sebastian | $12,115 | 212.4 | 15 | 60% | 49% | 49% |
| Santa Isabel | $17,605 | 198.6 | 7 | 92% | 0% | 0% |
| Toa Alta | $25,133 | 709.5 | 19 | 89% | 67% | 0% |
| Toa Baja | $23,297 | 1314.9 | 30 | 100% | 96% | 0% |
| Trujillo Alto | $30,825 | 1164.3 | 24 | 95% | 75% | 0% |
| Utuado | $13,509 | 98.8 | 11 | 54% | 45% | 45% |
| Vega Alta | $16,608 | 428.6 | 12 | 87% | 84% | 76% |
| Vega Baja | $16,530 | 430.6 | 20 | 85% | 75% | 74% |
| Vieques | $16,220 | 65.3 | 3 | 45% | 0% | 0% |
| Villalba | $15,455 | 217.9 | 8 | 73% | 0% | 0% |
| Yabucoa | $16,894 | 221.6 | 12 | 56% | 48% | 48% |
| Yauco | $14,314 | 220.3 | 15 | 72% | 0% | 0% |

Source: Household Numbers and Density - Census Bureau, 2000. Broadband Availability Rates - Connect Puerto Rico, June 2011.

### *b. Municipality-Level Broadband Availability by Platform*

In Table III.5 platform availability is reported by municipality. Estimates include broadband service at speeds of at least 768 Kbps download and 200 Kbps upload offered by cable, DSL, and fixed wireless technologies. The results in this table show the variation in availability to broadband platforms across municipalities in Puerto Rico.

| Table III.5 - Municipality-Level Availability by Broadband Technology | | | | | | | |
|---|---|---|---|---|---|---|---|
| Percentage of Households Served by Broadband, by Technology Platform | | | | | | | |
| (≥ 768 Kbps Download / 200 Kbps Upload Speeds) | | | | | | | |
| Municipality | Cable | DSL | Fixed Wireless | Municipality | Cable | DSL | Fixed Wireless |
| Adjuntas | 37% | 41% | 0% | Lajas | 84% | 44% | 0% |
| Aguada | 92% | 55% | 1% | Lares | 42% | 42% | 0% |
| Aguadilla | 98% | 74% | 0% | Las Marias | 31% | 27% | 0% |
| Aguas Buenas | 31% | 38% | 8% | Las Piedras | 65% | 51% | 0% |
| Aibonito | 42% | 56% | 0% | Loiza | 85% | 63% | 7% |
| Anasco | 78% | 61% | 62% | Luquillo | 82% | 13% | 0% |
| Arecibo | 75% | 63% | 0% | Manati | 77% | 73% | 0% |
| Arroyo | 85% | 48% | 0% | Maricao | 0% | 37% | 0% |
| Barceloneta | 83% | 74% | 0% | Maunabo | 65% | 58% | 0% |
| Barranquitas | 54% | 26% | 0% | Mayaguez | 93% | 76% | 59% |
| Bayamon | 94% | 86% | 93% | Moca | 88% | 41% | 0% |
| Cabo Rojo | 86% | 63% | 1% | Morovis | 65% | 61% | 0% |
| Caguas | 77% | 72% | 72% | Naguabo | 77% | 40% | 0% |
| Camuy | 57% | 49% | 0% | Naranjito | 29% | 38% | 15% |
| Canovanas | 69% | 11% | 24% | Orocovis | 30% | 26% | 0% |
| Carolina | 86% | 52% | 90% | Patillas | 67% | 24% | 0% |
| Catano | 86% | 83% | 100% | Penuelas | 73% | 61% | 0% |
| Cayey | 71% | 65% | 0% | Ponce | 90% | 87% | 65% |
| Ceiba | 73% | 30% | 0% | Quebradillas | 89% | 58% | 0% |
| Ciales | 38% | 48% | 0% | Rincon | 85% | 50% | 1% |
| Cidra | 51% | 41% | 1% | Rio Grande | 79% | 29% | 0% |
| Coamo | 69% | 64% | 0% | Sabana Grande | 81% | 65% | 0% |
| Comerio | 46% | 51% | 0% | Salinas | 74% | 83% | 0% |
| Corozal | 45% | 49% | 7% | San German | 73% | 59% | 0% |
| Culebra | 0% | 54% | 0% | San Juan | 100% | 76% | 99% |
| Dorado | 83% | 73% | 67% | San Lorenzo | 41% | 49% | 7% |
| Fajardo | 90% | 24% | 0% | San Sebastian | 49% | 45% | 0% |
| Florida | 71% | 75% | 0% | Santa Isabel | 85% | 83% | 0% |
| Guanica | 84% | 75% | 0% | Toa Alta | 57% | 79% | 38% |
| Guayama | 82% | 82% | 0% | Toa Baja | 84% | 80% | 93% |
| Guayanilla | 73% | 66% | 0% | Trujillo Alto | 74% | 86% | 76% |
| Guaynabo | 94% | 73% | 90% | Utuado | 45% | 46% | 0% |
| Gurabo | 65% | 65% | 46% | Vega Alta | 76% | 68% | 31% |
| Hatillo | 76% | 57% | 0% | Vega Baja | 74% | 79% | 2% |
| Hormigueros | 95% | 65% | 8% | Vieques | 0% | 45% | 0% |
| Humacao | 81% | 62% | 0% | Villalba | 64% | 57% | 0% |
| Isabela | 90% | 60% | 0% | Yabucoa | 48% | 39% | 0% |
| Jayuya | 56% | 51% | 0% | Yauco | 71% | 9% | 0% |
| Juana Diaz | 84% | 75% | 0% | | | | |
| Juncos | 76% | 63% | 1% | **TOTAL** | 79% | 64% | 40% |

Source: Connect Puerto Rico, June 2011

# C. Puerto Rico Broadband and Information Technology Adoption

This section analyzes data regarding broadband adoption and usage across the Puerto Rico residential and business sectors. The analysis measures the extent of the digital divide in Puerto Rico and the factors driving it. The section concludes with normative recommendations aimed to achieve digital inclusion across some of the more vulnerable populations in Puerto Rico.

The analysis is based on two core sources of data; the 2010 Puerto Rico Residential Technology Assessment, consisting of a random digital dial survey (RDD) of 1,200 Puerto Rico households, and the 2010 Business Technology Assessment, an RDD survey of 814 business establishments. Both of these surveys were conducted by Connect Puerto Rico on behalf of the Puerto Rico OCIO as part of the State Broadband Initiative (SBI) federal grant program, and funded through the American Recovery and Reinvestment Act.[23] Extensive results of this survey research, beyond the key data highlighted in this section can be found online at the following websites:

2010 Puerto Rico Residential Technology Assessment
- http://en.connectpr.org/research/residential_technology_assessment.php

2010 Puerto Rico Business Technology Assessment
- http://en.connectpr.org/research/business_technology_assessment.php

## 1. The Residential Broadband Adoption Gap

This section analyzes the technology adoption gap across Puerto Rico's residential sector. The analysis is based on the 2010 Connect Puerto Rico Residential Assessment, a consumer survey implemented by Connect Puerto Rico in 2010 aimed at understanding demand-side trends and barriers in the Puerto Rico broadband market. Topics of the consumer survey included computer ownership, broadband adoption, awareness of available broadband service, and residential uses for Internet. In addition, the survey was designed to track information about barriers to technology adoption, including barriers to computer ownership, Internet usage, and broadband adoption.

This section summarizes the main findings of the research and contrasts the Puerto Rico data with U.S. benchmarks released by the National Telecommunications and Information Administration (NTIA), as well as the Federal Communications Commission (FCC) as part of the National Broadband Plan.[24] The purpose of this section is to better understand the drivers and barriers to technology and broadband adoption and estimate the "Broadband Adoption Gap" across Puerto Rico.

# More than two-thirds (69%) of Puerto Rico residents do not subscribe to home broadband service.

Residential data were collected by telephone through live computer-assisted interviews from an island-wide random digit dial (RDD) sample of 1,000 households and 200 cell phone users contacted between May 15 and June 9, 2010. The questionnaire screened to include only adults age 18 or older with quotas set by gender, age, and municipality of residence (urban, suburban, or rural) to ensure adequate representation of all adults on the island. The margin of error for this assessment is ± 3.1% at the 95% level of confidence. Data were collected by Estudios Tecnicos in San Juan, PR. Weights were applied to correct for minor variations and to ensure that the sample matches the most recent U.S. Census estimate of the island's population by age, gender, and urban/rural classification of the respondent's municipality of residence. Weighting and research consultation were provided by Lucidity Research, LLC.[25]

In 2010, more than two-thirds (69%) of Puerto Rico residents did not subscribe to broadband service in the home, an adoption gap that is significantly higher than the U.S. adoption gap measured by U.S. Department of Commerce.[26]

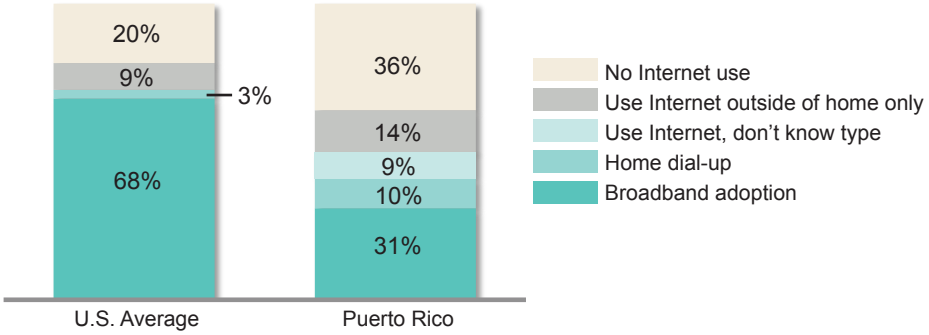
The percentage of households across Puerto Rico that have broadband service in the home is 31%; by comparison, a 2010 survey of U.S. residents revealed that 68% of American households subscribe to home broadband service.[27] Furthermore, nearly two-thirds of Puerto Rico broadband subscribers (63%) began subscribing within the past two years.

The technology gap in Puerto Rico also extends to technology devices. Across the island, 55% of all residents own a home computer, compared to 77% of U.S. households nationwide.[28] This translates into more than 1.3 million adults in Puerto Rico without a home computer, with 27% of those same adults stating that cost was the major limiting factor. Furthermore, 62% of Puerto Rico adults report owning a cellular phone, compared to 86% of U.S. residents.[29]

Furthermore, Connect Puerto Rico's 2010 Residential Technology Assessment indicates that 10% of residents subscribe to dial-up service at home, and 9% are not certain whether they subscribe to broadband or dial-up in their home. Additionally, 14% of adults surveyed report that their only way of accessing the Internet is at a location outside their home. A total of 64% of Puerto Ricans report that they access the Internet from either their home or another location; in contrast, 80% of U.S. adult residents reported accessing the Internet from their home or someplace else in 2010.[30] Across Puerto Rico, 50% of adults surveyed reported accessing the Internet from home, 11% from work, and 3% from a library. Eighteen percent of Puerto Rico residents access the Internet via a cell phone or mobile phone. Finally, 36% report that they do not use the Internet at all, as shown in Figure III.8.

Nationwide, 68% of American households subscribed to broadband service in 2010; 3% of Americans had a dial-up Internet connection at home; 9% of Americans were Internet users but did not access the Internet from home; and 20% of Americans were not Internet users (Figure III.8).[31] These statistics indicate that the Internet use and broadband gaps in Puerto Rico are significantly more severe than in the rest of the United States.

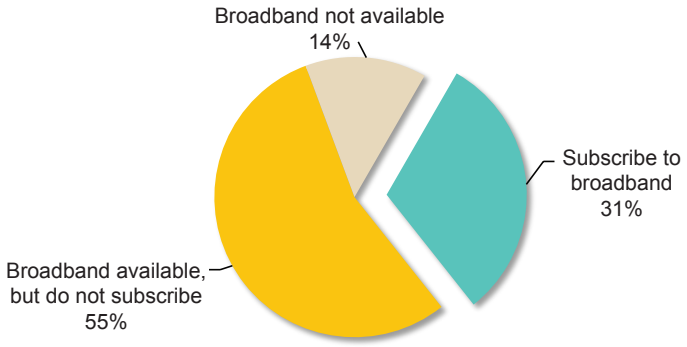
Figure III.8 - Residential Technology Adoption Comparison




According to Connect Puerto Rico's broadband inventory estimates, 86% of all Puerto Rico households have fixed broadband available (or are served) at the basic speeds of 768 Kbps download/200 Kbps upload.[32] Puerto Rico's 31% broadband adoption rate indicates that approximately 55% of Puerto Rico residents have broadband available, but, for various reasons, are choosing not to subscribe to the service in the home, as show in Figure III.9.

Puerto Rico's broadband adoption gap suggests that when it comes to broadband, the old adage of "build it and they will come" does not always work. The FCC's National Broadband Plan concludes that the adoption gap needs to be tackled at the federal, state, and local levels through a series of complementary strategies. The National Broadband Plan also recommends modernizing programs aimed at increasing adoption rates for low-income people to support broadband, improve participation in the digital economy and society, and protect against waste, fraud, and abuse.

Figure III.9 - Puerto Rico Broadband Adoption Gap



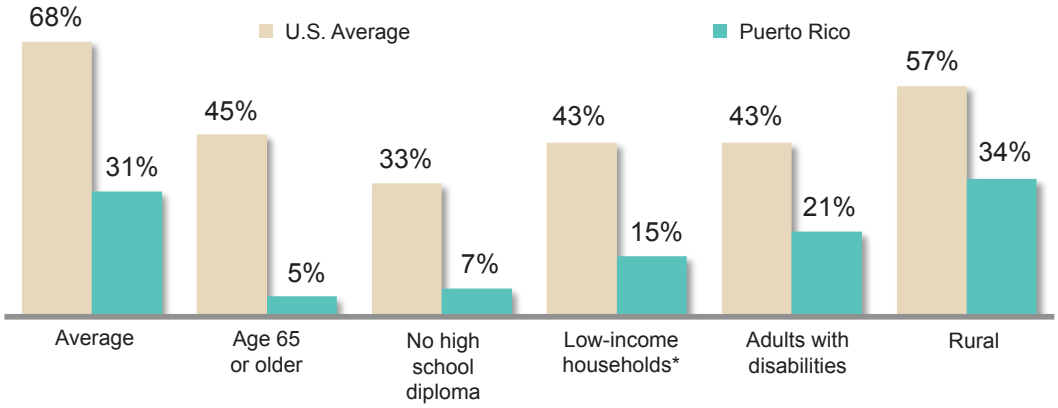

### *a. Broadband Adopters and Non-Adopters*

In October 2010, the U.S. Census Bureau, in collaboration with the National Telecommunications and Information Administration, surveyed approximately 54,300 households regarding their technology use and extrapolated their results to represent 119.5 million American households.[33] The survey analyzed computer ownership and broadband Internet use at the household level and its association with household-level characteristics. The data collected indicates that broadband non-adopters are generally people of low-income, senior citizens, members of ethnic minorities, rural dwellers, people with disabilities, and/or people with less education.

These trends are in line with non-adoption rates reported by similar demographic groups in Puerto Rico; however, the adoption gap in Puerto Rico for each of these demographic groups is more acute. Figure III.10 contrasts Puerto Rico and U.S. adoption gaps among selected demographic groups.[34] While 31% of Puerto Rican residents subscribe to broadband, senior citizens, low-income residents, adults with disabilities, and adults with lower educational levels disproportionately find themselves on the wrong side of the digital divide. The broadband adoption rate is 5% among adults 65 and older; 7% among residents without a high school diploma; 15% among households with annual incomes below $15,000; 21% among adults with disabilities; and 34% among rural households. Plans to stimulate broadband and technology adoption need to incorporate strategies specifically targeting these demographic groups.

# Only 15% of Puerto Ricans earning less than $15,000 annual income subscribe to broadband.

Figure III.10 - U.S. and Puerto Rico
Residential Broadband Adoption by Demographic Group




* U.S. low-income = households reporting annual income below $25,000. Puerto Rico low-income = households reporting annual income below $15,000.

***b. Barriers to Adoption***

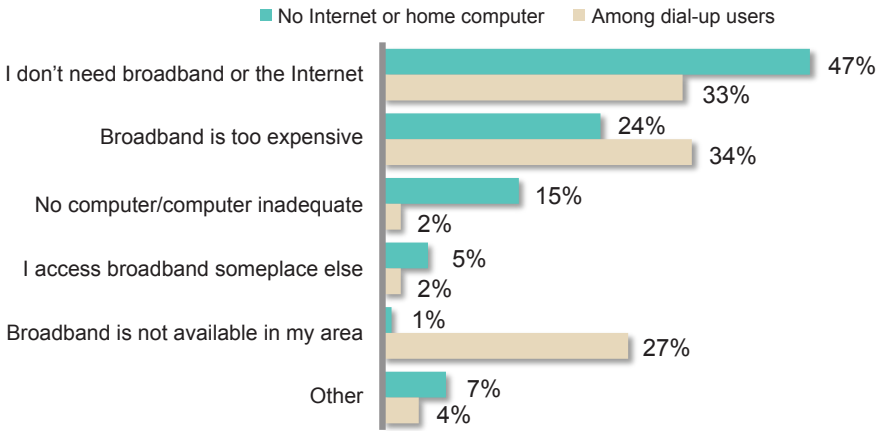
This section will analyze and compare barriers to computer ownership and broadband adoption reported among Puerto Rico and U.S. households. The factors impeding more robust computer ownership and broadband adoption are varied and are likely to have significant policy implications. For example, if a lack of availability of broadband services is the main impediment to broadband adoption at home, then policies to expand usage may require attracting broadband providers to offer service. However, if there is a lack of information about broadband service availability, or a perceived lack of need or interest in broadband, then policies may incorporate public awareness campaigns.[35]

Figure III.11 shows that, in the U.S., expense, lack of need, and lack of availability are the main impediments to broadband adoption for dial-up households.[36] One-third of dial-up users reported lack of need (33%), approximately one-third reported that broadband is too expensive (34%), and about one-fourth (27%) cited lack of availability. In the U.S., dial-up households accounted for three percent of households in 2010.

In contrast, almost one-half (47%) of households without a computer or home Internet access stated the lack of need as their main reason for not having home Internet services. Nearly one-fourth (24%) reported affordability, and 15% reported inadequate computer as the primary reason for no home Internet access. U.S. residents without a computer or home Internet access represent a much larger group (29%) than the collective dial-up households (representing about 3% of American households).[37]

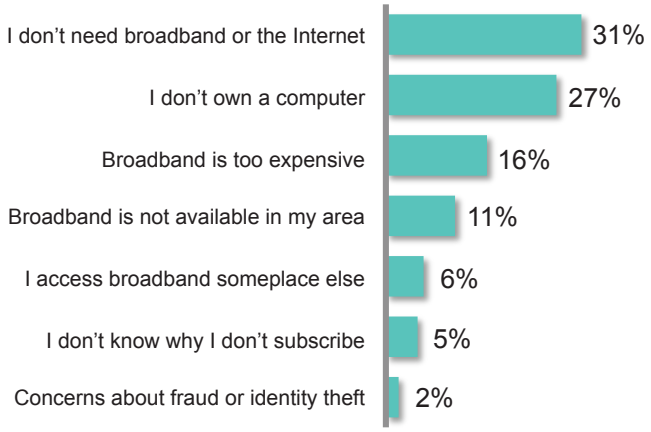
# The top barriers to computer ownership and broadband adoption are lack of perceived relevance and affordability.

Figure III.11 - U.S. Broadband Adoption Barriers




Connect Puerto Rico's 2010 Residential Technology Assessment indicates similar barriers to technology adoption, as indicated in Figures III.12 and III.13.[38]* Among Puerto Rican broadband non-adopters, the top barrier to computer ownership and broadband adoption is the lack of relevance that the technologies have to their everyday lives and endeavors.

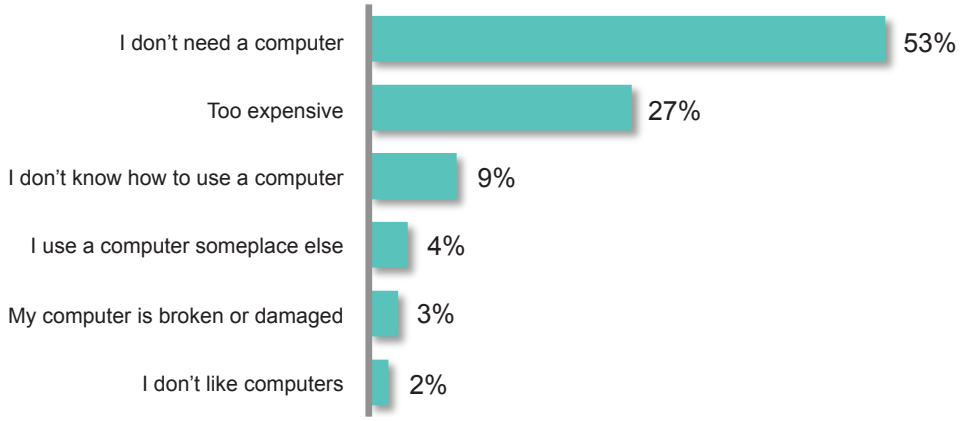
Figure III.12 - Puerto Rico Broadband Adoption Barriers




* Percentages do not add up to 100% because individuals could give multiple responses.

# The top barrier to computer ownership in Puerto Rico is lack of perceived need.

Figure III.13 - Puerto Rico Computer Ownership Barriers




The barriers to adoption among Puerto Rico adults who do not have broadband in the home and those who do not own a computer at home are:

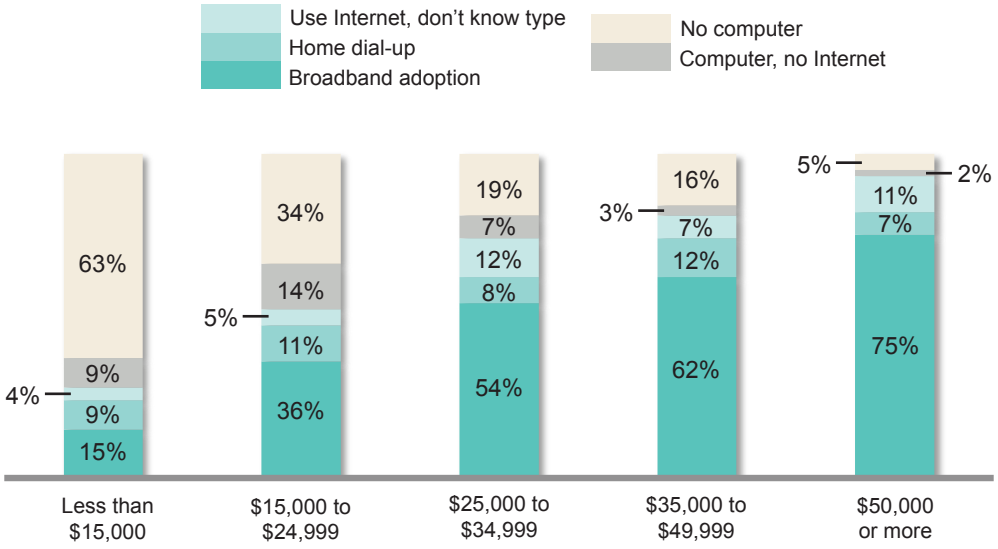
- **Relevance**: Thirty-one percent of Puerto Rico residents who do not have home broadband service say it is because they do not need Internet service. Fifty-three percent of residents who do not have a computer in the home say they do not need one.
- **Computer Ownership**: Twenty-seven percent of broadband non-adopters say that the lack of a home computer is a barrier to broadband adoption. Three percent of residents who do not have a computer in the home say that their previous computer is broken or damaged.
- **Affordability**: Sixteen percent of broadband non-adopters say broadband is too expensive while 27% percent of those lacking a computer in the home say it is because computers are too expensive.
- **Availability**: Eleven percent of Puerto Rico residents who do not subscribe to home broadband service report a lack of available broadband service as a barrier.
- **Other Locations**: Six percent of broadband non-adopters claim they access the Internet from somewhere else (8% of those without any home Internet access report accessing the Internet from somewhere else).
- **Digital Literacy and Perceived Online Risks**: Nine percent of non-computer-owners report that they do not have one because they don't know how to use a computer. Two percent of broadband non-adopters and three percent of Internet non-adopters report concerns about fraud and identity theft as a barrier to adoption.[39]

### *c. Dividing Lines on Technology Adoption*

Technology adoption is not distributed evenly in the population; however, the disparity becomes most glaring when income level is considered. Nearly two-thirds (63%) of Puerto Rico households in the lowest income category do not have a computer, compared to only 5% of the highest income households (Figure III.14).

If we focus on broadband, adoption exhibits a similar relationship with income. Only 15% of all households with annual incomes below $15,000 reported having broadband Internet access at home, compared to three-fourths (75%) of households with incomes exceeding $50,000. Dial-up service subscriptions account for a larger segment of lower-income households, although those households in the lowest income bracket still report significantly lower Internet adoption levels, regardless of connection type. This indicates that perhaps many people with low incomes simply cannot afford the costs associated with having an Internet connection at home.

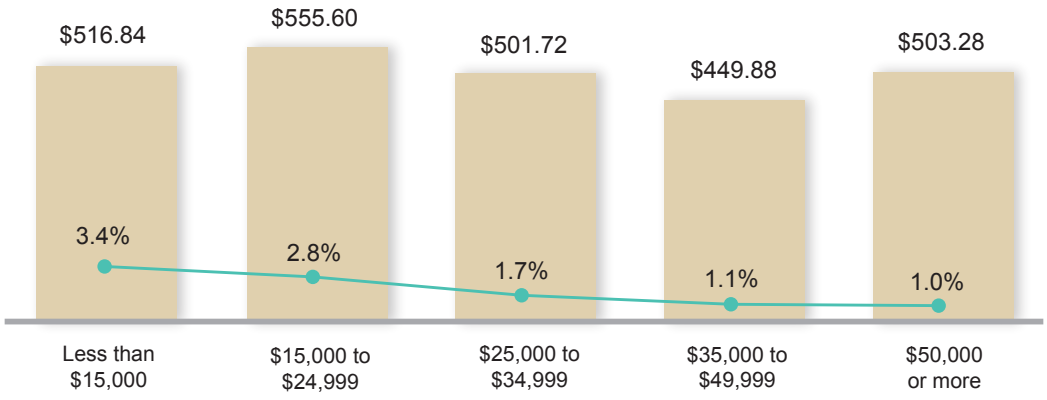
Figure III.14 - Computer and Internet Use by Household Income



# For low income Puerto Ricans, lack of computer and subscription expense are key barriers to broadband adoption.

To put the income challenge in perspective, approximately 42% of Puerto Rico households have an annual income of less than $15,000.[40] Connect Puerto Rico's residential survey revealed that households in this income group subscribing to home broadband pay $43.07 monthly for their subscription, which equals $516.84 annually, as seen in Figure III.15. For these residents, the cost of broadband represents approximately 3.4% of their annual income, which, according to the International Telecommunications Union, is considered unaffordable.[41] In other words, by international standards, more than two-fifths of Puerto Rico residents do not have access to affordable broadband. If we consider that approximately six out of ten (60%) Puerto Rico residents have a median household income of less than $25,000, it could be said that the majority of the households in Puerto Rico have difficulty accessing affordable broadband.

Figure III.15 - Annual Broadband Subscription Cost as a Percentage of Income




When asked what contributed to their decision to subscribe to broadband service, 20% of households in the lowest income bracket (those making less than $15,000) responded that receiving (or purchasing) a computer for their home prompted them to subscribe. Additionally, 15% of households in this income bracket reported that the realization that broadband was worth the extra money contributed to their subscription. In comparison, only 7% of households reporting annual incomes of $50,000 or more reported that realizing the value of broadband was a contributing factor in their decision to subscribe.

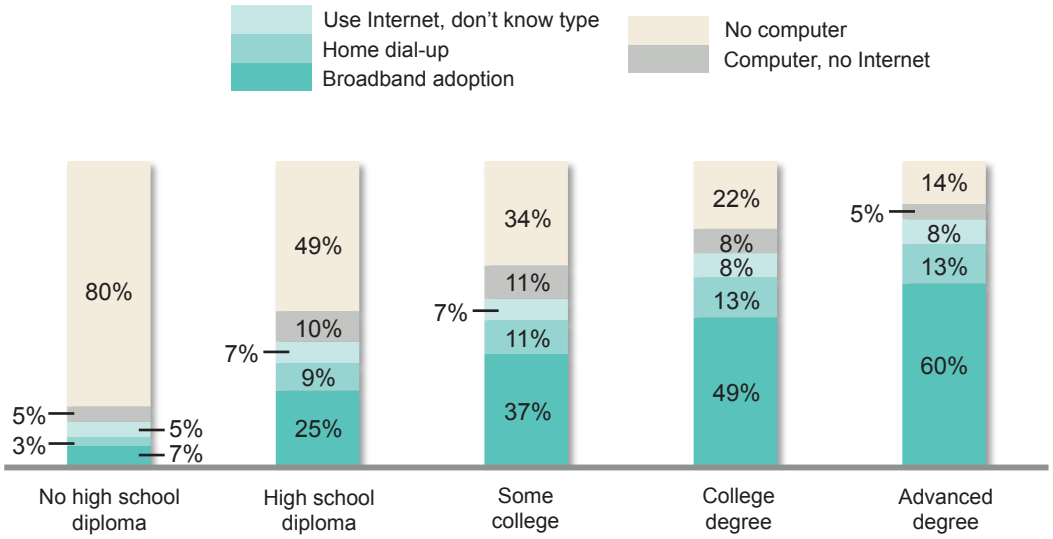
Those who do not subscribe to broadband offer a range of reasons for not being online. Affordability clearly comes to the forefront when Puerto Rico households are asked about the barriers to broadband adoption. Connect Puerto Rico's 2010 Residential Technology Assessment revealed that residents with the lowest incomes are significantly more likely to cite the lack of a computer or expense as barriers to a home broadband subscription, when compared to other income groups (Table III.6).

| Table III.6 - Barriers to Broadband Adoption by Income | | | | | |
|---|---|---|---|---|---|
| Income Level | Percent of Population | Relevance | Lack of Computer | Too Expensive | Not Available |
| **Puerto Rico Average** | - | **31%** | **27%** | **16%** | **11%** |
| Less than $15,000 | 42% | 31% | 33% | 18% | 10% |
| $15,000 - $24,999 | 18% | 24% | 23% | 13% | 15% |
| $25,000 - $34,999 | 12% | 33% | 17% | 17% | 17% |
| $35,000 or more | 28% | 35% | 12% | 4% | 13% |

Regardless of income level, broadband's perceived lack of relevance is the most cited barrier to broadband adoption. What this means is that cutting prices alone will probably not have a major effect on broadband adoption. But lowering prices on service, coupled with adding programs that teach people the digital skills they need to access the Internet while also educating them on how the Internet can enhance their lives, could have a substantial effect.

Puerto Rico also has a unique opportunity to spur adoption by making broadband content relevant to non-adopters, regardless of socioeconomic background. For example, while income is the key driver to Puerto Rico's digital divide, the differences in adoption also break out prominently along educational attainment levels. Among Puerto Rican adults, approximately 42% of Puerto Ricans have had some college experience (even if they have not or did not graduate).[42] Among those who have some college experience, 45% have a home broadband subscription, compared with 18% of those whose highest educational attainment is a high school diploma. If viewed at a more granular level, the digital divide is even more acute. As Figure III.16 presents, among Puerto Rican adults who have not graduated from high school, 20% have a home computer and only 7% have a home broadband subscription. As the data shows, the majority of residents with at least a high school diploma have a computer, and Internet adoption of any connection type increases directly with educational attainment.

Figure III.16 - Technology Adoption in the Home by Educational Attainment




Approximately one-third of residents with a high school diploma or less say that they do not need the Internet or broadband, or that the service isn't compelling enough to justify purchasing. These residents may lack the digital skills to utilize broadband or they may view broadband as an avenue to irrelevant content. These non-adopters, more so than residents with higher educational levels, are on the wrong side of the perceptual chasm with respect to broadband. Unlike broadband users, they are not attuned to online content's potential to provide information or opportunities for learning.[43] Additionally, residents with lower educational attainment are significantly more likely to report the lack of a computer as a barrier to home broadband subscription. As educational attainment rises, Puerto Rico residents are less likely to cite relevance and lack of a computer as reasons for not adopting. Instead, availability increases as the main barrier (Table III.7).

**Table III.7 - Barriers to Broadband Adoption by Educational Attainment**

| Education Level | Percent of Population[44] | Relevance | Lack of Computer | Too Expensive | Not Available |
|---|---|---|---|---|---|
| **Puerto Rico Average** | - | **31%** | **27%** | **16%** | **11%** |
| Less than high school | 33% | 39% | 34% | 16% | 6% |
| High school graduate | 25% | 32% | 28% | 16% | 10% |
| Some college | 12% | 29% | 24% | 15% | 13% |
| College graduate + | 30% | 19% | 20% | 15% | 18% |

# Only 5% of Puerto Ricans 65 and older subscribe to broadband in the home. 80% do not own a computer.

In addition to income and education, Connect Puerto Rico's 2010 Residential Technology Assessment also found age to be a significant indicator of technology adoption. In fact, no other demographic group reported a lower broadband adoption level than senior citizens; residents over the age of 65. Residents in this age category report a broadband adoption rate of 5%, and only 20% have a home computer (Figure III.17). In comparison, the U.S. Census Bureau reported in 2010 that 45% of U.S. senior citizens subscribe to home broadband, and 55% own a home computer (Figure III.18).[45]

Figure III.17 - Technology Adoption in the Home by Age

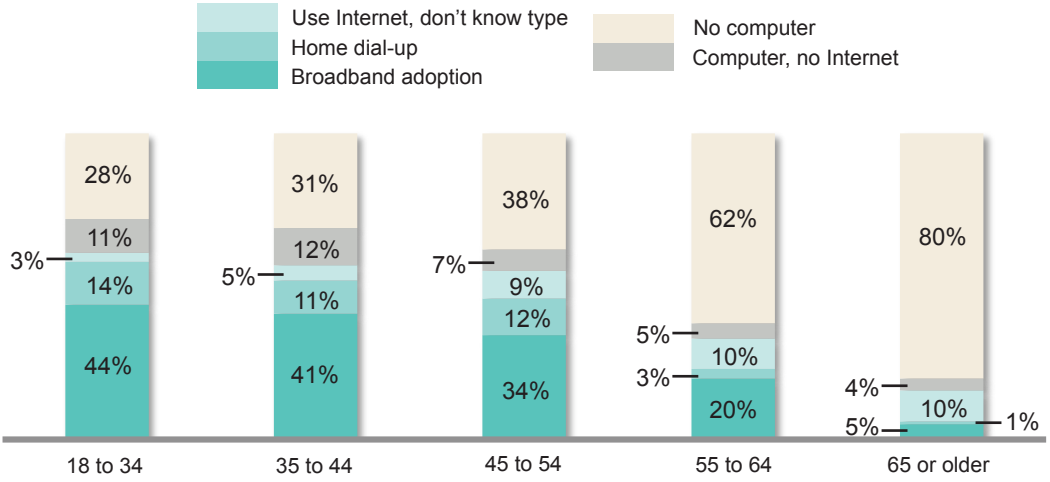
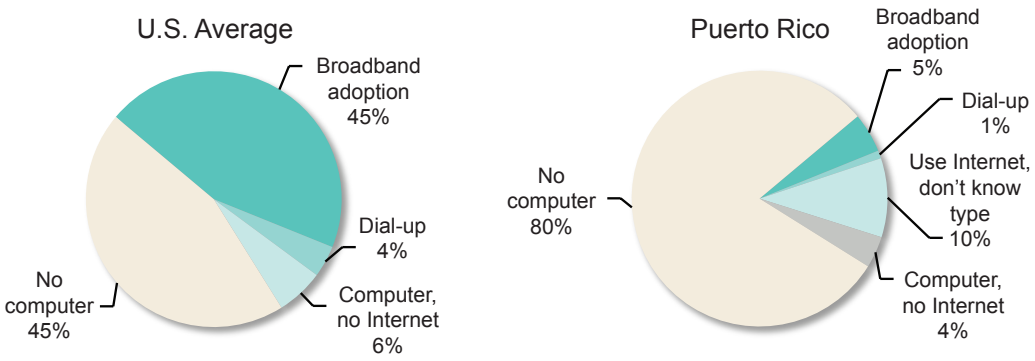



Figure III.18 - Technology Adoption Among Senior Citizens



The issue of relevance is very apparent among older Puerto Rico residents. Nearly two-fifths of residents between the ages of 45 and 64 (37%) cite relevance as a barrier to broadband adoption, and 43% of senior citizens cite the same barrier (Table III.8). In comparison, younger residents are much more likely to cite the lack of a home computer or expense as barriers to a home broadband subscription. More than one-third of residents ages 18 to 24 (35%) report the lack of a computer as a barrier to subscription.

**Table III.8 - Barriers to Broadband Adoption by Age**

| Age | Percent of Population[46] | Relevance | Lack of Computer | Too Expensive | Not Available |
|---|---|---|---|---|---|
| **Puerto Rico Average** | - | **31%** | **27%** | **16%** | **11%** |
| 18 to 24 | 10% | 16% | 35% | 15% | 14% |
| 25 to 44 | 27% | 20% | 21% | 18% | 21% |
| 45 to 64 | 24% | 37% | 28% | 19% | 8% |
| 65 or older | 14% | 43% | 32% | 8% | 1% |

### *d. Internet Applications and Uses*

To better understand how broadband is currently affecting the lives and endeavors of Puerto Ricans today, and what opportunities exist to expand the benefits of this technology, survey research conducted by Connect Puerto Rico explores the online applications used by Puerto Rico residents.[47]

The top applications used by Puerto Rico Internet users include communicating with friends and family online, sending or receiving e-mail, using a search engine, and interacting through social networking sites.

- **Health**: Nearly one-half of Puerto Rico Internet users (45%) search for health or medical information online, while 10% interact with doctors or healthcare professionals online, and 8% communicate with their health insurance company.
- **Government Services**: E-government services are utilized by some Puerto Rico Internet users; 26% report that they search online for information about government services or policies; 8% conduct online transactions with government offices (such as e-filing taxes or filling out forms); 11% interact with Puerto Rico government offices; 8% interact with local government offices; and 3% interact with elected officials or candidates online.
- **Education**: Many Puerto Rico Internet users go online for educational purposes. More than one-half of Puerto Rico Internet users (56%) utilize the Internet to conduct research for schoolwork online, 18% interact with teachers online, and 11% take classes online.

Only 4% of employed adults report teleworking in Puerto Rico, while 43% would like to telework if allowed.

- **Employment and Entrepreneurship**: Puerto Rico residents also use the Internet for work purposes. Among Puerto Rico Internet users, 34% interact with their co-workers online, 37% go online to search for jobs or employment, 12% interact with businesses online, and 14% report that they go online to work from home at least occasionally. Furthermore, in Puerto Rico, 4% of employed adults report that they telework and 43% claim they would telework if allowed. Teleworking could also provide an additional boost to the state's workforce, as 16% of retirees, 26% of adults with disabilities, and 34% of homemakers said they would likely join the workforce if empowered to do so by teleworking.

When comparing these data to available U.S. data collected by the FCC, there is a lag in the degree and scope of online application usage among Puerto Rico residents who are Internet users. For example, 57% of U.S. Internet users get information about employment or apply for a job, compared to 37% in Puerto Rico; 75% of U.S. Internet users visit local, state, or federal government websites, compared to 26% of Puerto Rico Internet users who search online for information about government service or policies; and 22% of U.S. Internet users take online classes compared to 11% in Puerto Rico.[48]

For more information regarding online activities among Puerto Rican Internet users, refer to slides 39-46 of the 2010 Puerto Rico Residential Technology Assessment.[49]

***e. Conclusions***

More than two-thirds of Puerto Ricans (69%) do not have a home broadband subscription. Furthermore, 55% of Puerto Rican households have broadband available, but choose not to subscribe.

**The main dividing lines for adoption are among socioeconomic dimensions such as income and education:**

- Among low-income Puerto Ricans – those whose annual incomes fall below $15,000 – broadband adoption stands at 15%. This accounts for approximately 42% of the population. In comparison, 52% of households with annual incomes of $15,000 or more report subscribing to home broadband service.
- 18% of adults whose highest level of education is a high school diploma are broadband users at home; 45% of adults who have attended or graduated from college are broadband users at home.

**There are three primary reasons why the 69% percent of non-adopting Puerto Ricans do not have broadband: broadband is not sufficiently relevant for them to purchase it; lack of a computer; and cost.**

- 31% of non-adopters do not have broadband because they do not need it or because they question its relevance in their lives
- 27% of non-adopters cite the lack of a computer as a barrier to home broadband adoption
- 16% of non-adopters report expense as a barrier to adoption

Creating the conditions necessary to promote broadband adoption and increase utilization requires a range of activities. The government of Puerto Rico has a role in providing support to people with low incomes, ensuring accessibility, funding sustainable community efforts, convening key stakeholders, and measuring progress.

## 2. Business Technology Assessment

Broadband is a powerful, enabling technology that is fast becoming an engine for economic growth. Increasingly, businesses seeking to open or expand operations look to see not only whether a community has robust broadband access, but also whether potential workers have digital literacy skills and tools. The economic future of communities in Puerto Rico depends on whether businesses and individuals fully utilize the technology to grow and develop local economies.

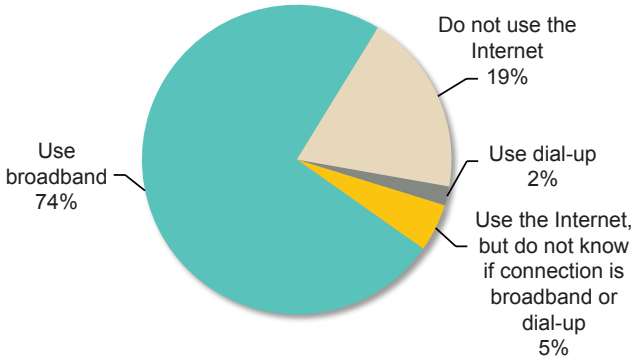
In order to assess business technology adoption in Puerto Rico, Connect Puerto Rico conducted a random digital dial (RDD) survey of 814 businesses contacted between August 5 and September 3, 2010. The purpose of this survey was to set benchmarks for technology adoption and barriers to adoption; determine best practices by identifying which applications Puerto Rican businesses use most often; and to measure the average price and speed of broadband adoption among business establishments across Puerto Rico. The 2010 Puerto Rico Business Technology Assessment can be viewed at the Connect Puerto Rico website: http://en.connectpr.org/research/business_technology_assessment.php.

Data were collected by telephone through live, computer-assisted interviews, with quotas set by business size and industry sector to ensure adequate representation of all businesses across the island. Weights were applied to correct for minor variations and to ensure that the sample matched the most recent U.S. Census estimates of the island's business establishments, as reported in their most recent County Business Patterns Report. The statewide full sample (n=814) provides a margin error of ± 5.1% at the 95% level of confidence. These sample errors account for sample weighting, using the effective sample size. For the purposes of this survey, broadband is defined as "an Internet connection with speeds of 768 kilobits per second or higher in at least one direction."

# Nearly three out of four Puerto Rican businesses (74%, or approximately 35,000 businesses) subscribe to broadband.

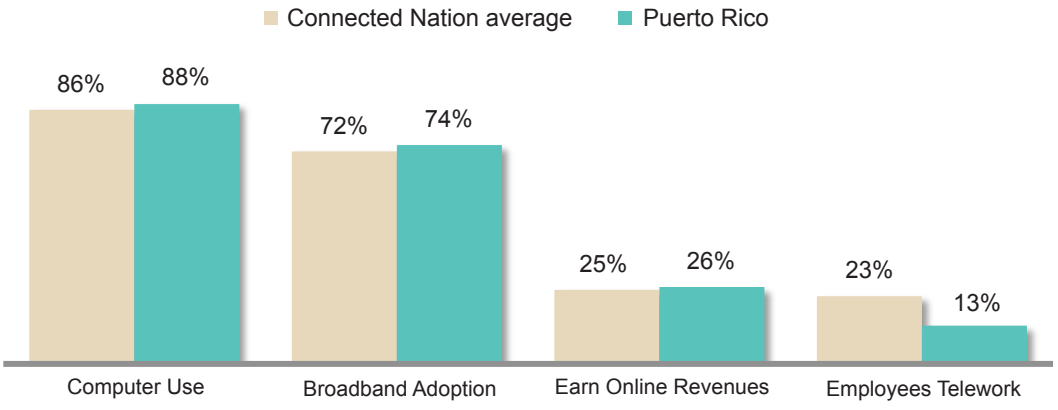
According to Connect Puerto Rico's 2010 Business Technology Assessment, nearly three out of four Puerto Rican businesses (74%, or approximately 35,000 businesses in Puerto Rico) subscribe to broadband.[50] At the same time, approximately 9,000 Puerto Rican businesses (or 19% of all business establishments in Puerto Rico) do not use the Internet at all, and 3,000 businesses either rely on dial-up or don't know what kind of Internet connection they have (Figure III.19). In comparison, a 2010 study completed by the FCC of U.S. businesses with 5 or more employees found that 95% have a broadband connection to a least one location.[51]

Figure III.19 - Technology Adoption among Puerto Rican Businesses



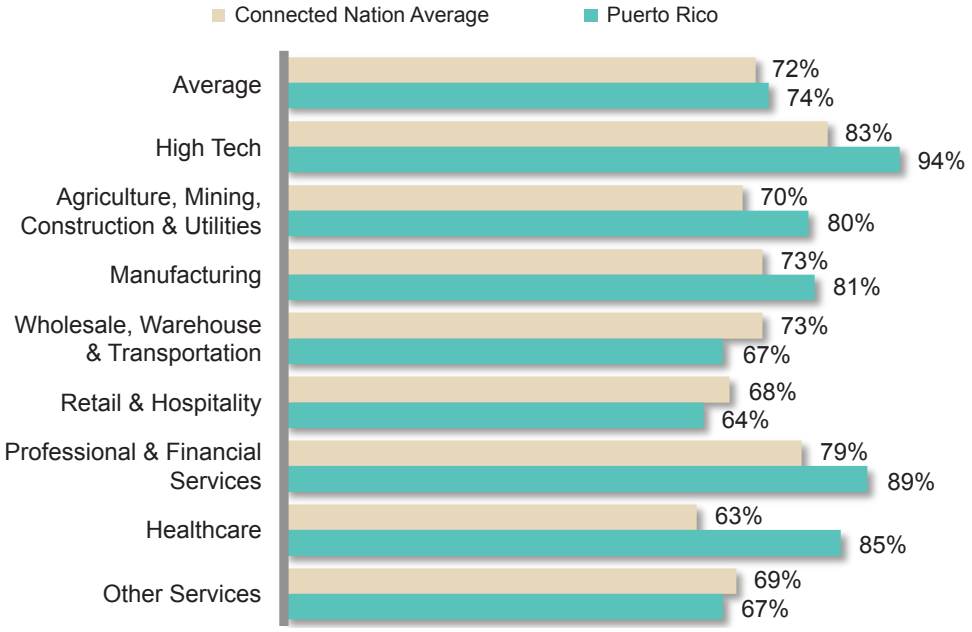

Puerto Rican businesses are on par with other jurisdictions surveyed by Connected Nation in terms of technology adoption. Overall, 88% of businesses in Puerto Rico (approximately 41,000 businesses) use computers, and over one-quarter of Puerto Rican businesses (26%) earn revenues from online sales, which is comparable to the average across all Connected Nation jurisdictions. On the other hand, only 13% of Puerto Rican businesses allow their employees to telework, which is below the Connected Nation average (Figure III.20).

Figure III.20 - Business Technology Adoption Comparison



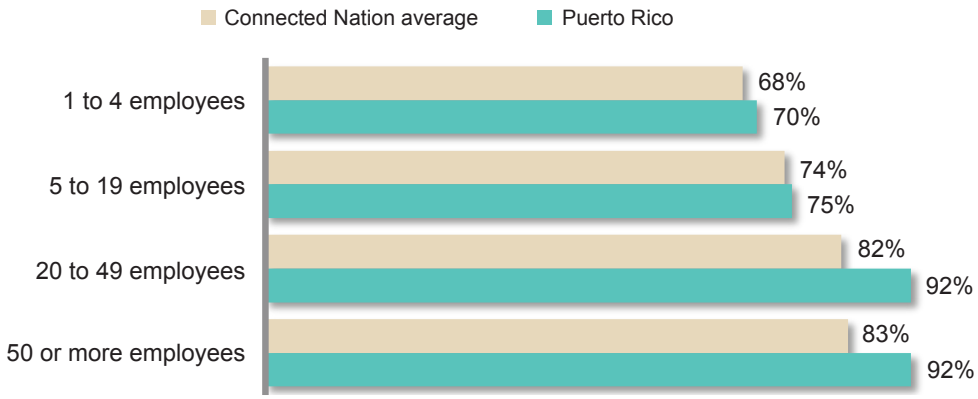
The Professional and Financial Services and High Tech sector lead in broadband adoption, with 89% of businesses in the Professional & Financial Services sector subscribing to broadband and 94% of businesses in the High Tech sector using broadband (Figure III.21). On the other extreme, adoption in crucial supply-chain sectors such as the Wholesale, Warehouse, and Transportation sector trails even further, as one-third of all Puerto Rico businesses in this sector still do not use broadband. Furthermore, only 64% of businesses in the Retail and Hospitality sector use broadband, which means that about 6,000 Retail and Hospitality related businesses do not subscribe.

Figure III.21 - Broadband Adoption by Sector




Broadband adoption rates in Puerto Rico mirror those in other Connected Nation jurisdictions by size and industry sector; there are no significant differences between Puerto Rico businesses and the average for each industry sector and size bracket (Figure III.21, III.22).

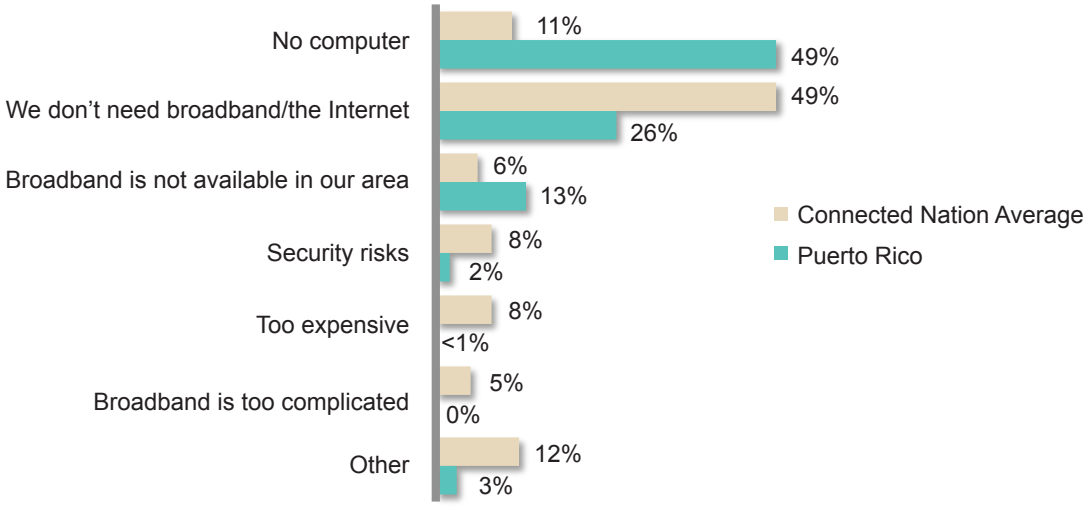
Figure III.22 - Broadband Adoption by Business Size




### *a. Barriers to Broadband Adoption Amongst Businesses*

Compared to businesses located in other jurisdictions surveyed by Connected Nation, businesses located in Puerto Rico indicate more concrete barriers to broadband adoption. For example, among Puerto Rican businesses that do not subscribe to broadband, nearly one-half (49%, or 6,000 businesses) either do not use a computer to handle business functions, or cite the lack of a computer as a barrier to broadband adoption, while only 26% of non-adopting businesses report a perceived lack of need for broadband service (Figure III.23).[52] Additionally, in comparison to businesses located in other jurisdictions surveyed by Connected Nation, non-adopting businesses in Puerto Rico are less likely to say that expense or security risks keep them from subscribing to broadband. Rather, the lack of available broadband service is a barrier to adoption for approximately 2,000 Puerto Rican businesses.

Figure III.23 - Barriers to Broadband Adoption




### *b. Business Broadband Cost and Speed*

Puerto Rican businesses pay a median monthly price of $83.93 for their broadband service, which is considerably higher than the median price of $71.92 paid by all businesses located in jurisdictions surveyed by Connected Nation in 2010. Puerto Rican businesses also tend to subscribe to lower-than-average broadband speed of 3.9 Mbps, which is significantly lower than the average advertised download speed of 6.7 Mbps reported by businesses located in jurisdictions surveyed by Connected Nation.

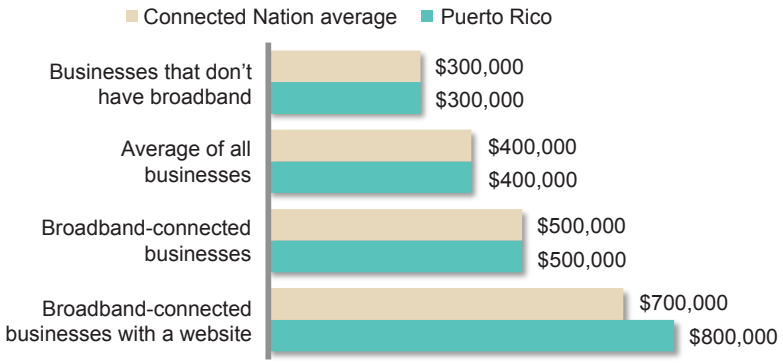
Additionally, broadband-connected Puerto Rico businesses are significantly more likely than other states surveyed by Connected Nation to say that they are not satisfied with their broadband service. Among Puerto Rico businesses that are not satisfied with their broadband service, nearly three out of four (74%, or approximately 1,000 businesses) cite frequent service outages as the reason they are unsatisfied.

### *c. The Financial Impact of Broadband Adoption*

The impact of broadband on Puerto Rican businesses can be seen in the difference in revenues between businesses with and without broadband, the number of businesses that increase their revenues by using the Internet, and the number of businesses that empower their employees to telework.

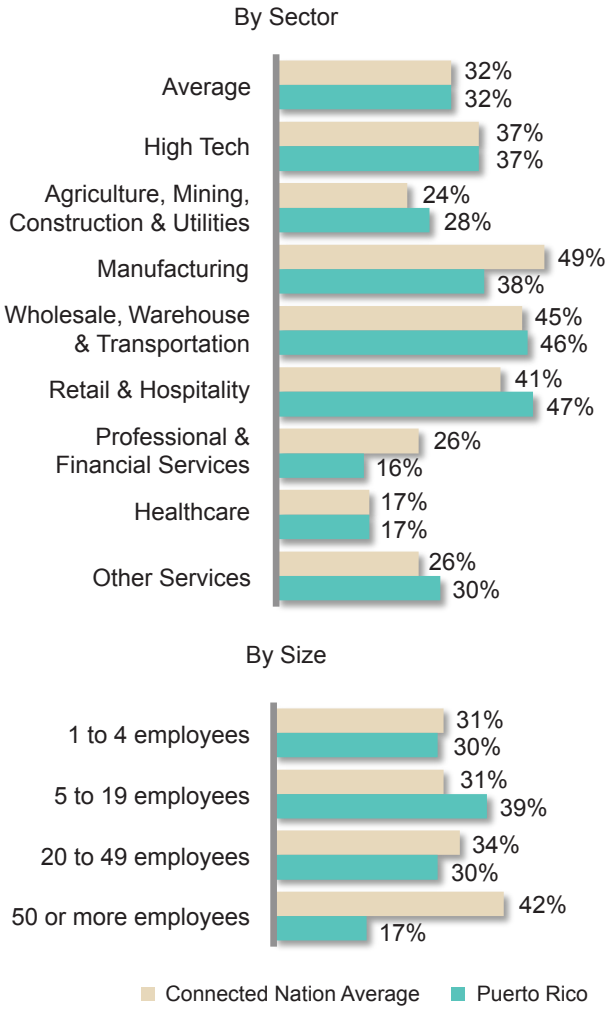
Businesses with broadband subscriptions report median annual revenues that are $200,000 higher than businesses that do not subscribe to broadband. In addition, Puerto Rico businesses that subscribe to broadband and maintain a website report median annual revenues that are $500,000 higher than businesses that do not use broadband at all. Businesses in Puerto Rico with and without broadband subscriptions report annual revenues that are comparable to competitors in other states surveyed by Connected Nation (Figure III.24).

Figure III.24 - Median Annual Revenues (Self-Reported)




Island-wide, 32% of Internet-connected businesses in Puerto Rico (approximately 12,000 Puerto Rico businesses) report earning revenues through online sales and transactions, which is on par with the Connected Nation average of 32% (Figure III.25). In Puerto Rico, this includes approximately 1,000 businesses in the Wholesale, Warehouse, and Transportation sector and 5,000 businesses in the Retail and Hospitality sector.

Figure III.25 - Internet-connected Businesses that Earn Revenue from Online Transactions



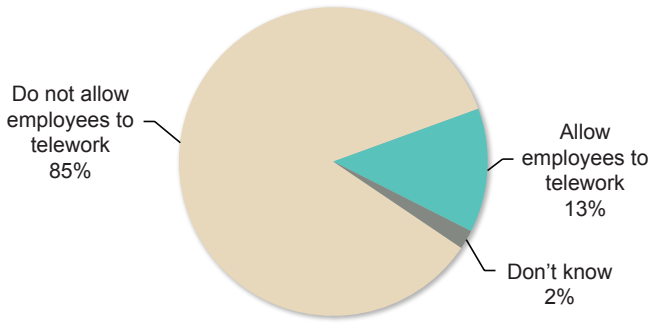

### *d. Business Uses for the Internet*

Puerto Rican businesses use technology in ways that make the territory stand out and highlight ways that the island's unique character has influenced its workforce.

# Across Puerto Rico, 13% of businesses (nearly 6,000) allow employees to telework.

- **Online Banking**: Nearly seven out of ten (69%) Internet-connected businesses utilize online banking. This is the most-cited use of the Internet among businesses in Puerto Rico and is most often used by Internet-connected businesses in the Manufacturing sector. In comparison, only 63% of all Internet-connected businesses located in jurisdictions surveyed by Connected Nation report banking online.
- **Marketing and Advertising of Products and Services**: Businesses located in Puerto Rico are significantly less likely than average to market and advertise their products and services online. While six out of ten Internet-connected businesses located in jurisdictions surveyed by Connected Nation utilize online marketing and advertising, only forty-two percent of Internet-connected Puerto Rican businesses do so.
- **Business Websites**: Four out of ten Puerto Rican businesses (40% or approximately 19,000) businesses have a website. Median annual revenues reported among broadband-connected businesses that have a website are $800,000, twice that of the territory-wide average.
- **E-Government**: Island-wide, 60% of all Puerto Rican businesses (approximately 28,000 businesses) access Puerto Rico government websites, mostly to search for information about Puerto Rican government services or locations.
- **Fixed Wireless Broadband**: One out of five broadband-connected businesses (20%, or approximately 7,000 businesses) rely on fixed wireless broadband service, which is significantly higher than the average reported by businesses located in jurisdictions surveyed by Connected Nation.
- **New Adopters**: Many Puerto Rican businesses are new broadband adopters, as Puerto Rican businesses are significantly more likely than average to say they began using broadband less than a year ago.
- **Small Businesses**: Among small Puerto Rican businesses (those with fewer than five employees), businesses that sell goods or services online report that over one-third (36.3% on average) of their sales revenues come from online transactions.
- **Teleworkers**: In addition, broadband helps empower Puerto Rico's workforce by enabling workers to telework. Across Puerto Rico, 13% of businesses (approximately 6,000) allow employees to telework (Figure III.26). By comparison, 23% of businesses located in states and territories surveyed by Connected Nation allow their employees to telework.

Figure III.26 - Teleworking among Puerto Rico Businesses



### *e. Conclusions*

**Increasing broadband adoption among Puerto Rican businesses will require a concerted effort between the public and private sector.**

More than one-quarter of Puerto Rico businesses (26%) do not use broadband, translating into 12,000 Puerto Rican business establishments that do not use broadband or benefit from the opportunities it offers. Furthermore, some sectors lag far behind. Only 64% of businesses in the Retail and Hospitality sector use broadband, which means approximately 6,000 Retail and Hospitality-related businesses do not subscribe.

**There are three primary barriers non-adopting businesses report: the absence of a computer; the lack of a perceived need or benefit gained from broadband; and unavailability of broadband service.**

- The most often cited barrier to broadband is the absence of a computer. Nearly one-half (49%, or 6,000 businesses) do not have a computer or cite that as a barrier to adoption.
- More than one-quarter (26% or 3,000 businesses) cite the perceived lack of need for broadband service.
- The lack of available broadband service is a barrier to 13% (or about 2,000) Puerto Rican businesses, and is reported more often by businesses in Puerto Rico than in other jurisdictions surveyed by Connected Nation.

# Endnotes

[1] Department of Commerce, National Telecommunications and Information Administration. (2009). *Broadband Technology Opportunities Program*. Retrieved from website: http://www.ntia.doc.gov/files/ntia/publications/fr_bbnofa_090709.pdf

[2] Federal Communications Commission. (2011). *High-cost universal service support*. Retrieved from website: http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0206/FCC-11-161A1.pdf
Note: On October 27, 2011, the FCC voted for a vast reform of the High-Cost USF program to transition the legacy program from a system aimed to subsidize voice telephony to a system aimed to subsidize broadband build-out.

[3] American Recovery and Reinvestment Act (ARRA) of 2009, Pub. L. No. 111-5, 123 Stat. 115, 516 (Feb. 19, 2009). Retrieved from website: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h1enr.pdf

[4] **Participating Providers**:
AT&T Mobility, Inc.
Ayustar Corporation
Critical Hub Networks
DataAccess Communications
Hughes Network Systems, LLC
Liberty Global, Inc.
MCI Communications Services, Inc.
Neptuno Media, Inc.
Puerto Rico Cable Acquisition Company, Inc.
PREPA Networks, LLC
Puerto Rico Telephone Company
Sprint Nextel Corporation
T-Mobile USA, Inc.
Worldnet Communications, Inc.

**Non-Participating Providers**:
Aeronet Wireless Broadband Corp. Provided backhaul data but did not supply last-mile fixed wireless data.
Orizon Wireless Corp. Never provided data for alleged fixed wireless service.
Telefónica International Holding, BV. No residential service; backhaul only. Provider did make contact but did not supply data.
San Juan Cable Holding, LLC, OneLink Communications. OneLink has been nonresponsive and has not submitted data. Field validation was completed to create estimated service area.

[5] Questions regarding the maps and data collection can be directed to maps@connectpr.org

[6] National Telecommunications and Information Administration, U.S. Department of Commerce. (2009). *Notice of funding availability (nofa) for the state broadband data and development grant program*. Retrieved from website: http://www.ntia.doc.gov/files/ntia/publications/fr_broadbandmappingnofa_090708.pdf

[7] United States Department of Commerce, Bureau of the Census. (2000). *Census 2000 data for Puerto Rico* . Retrieved from website: http://www.census.gov/census2000/states/pr.html

[8] A word about nomenclature of speed tiers. Broadband service speed capacity is typically reported based on download and upload speeds of service. Throughout the Puerto Rico Broadband Strategic Plan, we refer to such download and upload speeds in various ways, for example: 768 Kbps download and 200 Kbps upload speeds, or 768 Kbps download / 200 Kbps upload speeds, or 768 Kbps /200 Kbps speeds, or more simply 768/200.

[9] Federal Communications Commission. (2010). *National Broadband Plan*. Retrieved from website: http://www.broadband.gov/plan/3-current-state-of-the-ecosystem/

[10] Federal Communications Commission. (2011). *High-cost universal service support*. Retrieved from website: http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0206/FCC-11-161A1.pdf

[11] As required by the US Department of Commerce's State Broadband Initiative, if broadband service is available to at least one household in a Census Block, then for mapping purposes, that Census Block is reported to have some level of broadband availability. As such, broadband availability at an exact address location cannot be guaranteed. Providers supplying more specific data than Census Block are displayed as such. This map represents areas of broadband service availability determined by ongoing, in-depth technical analysis of provider networks and accommodations for the impact of external factors on service quality. However, this map does not include mobile wireless or satellite broadband services, which also may be available. Map users are encouraged to participate in improving broadband data granularity through data validation and field testing efforts. Learn more about this and other broadband mapping facts at http://www.connectpr.org/. Submit questions or recommended changes to: maps@connectpr.org.

[12] Federal Communications Commission. (2011). *High-cost universal service support*. Retrieved from website: http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0206/FCC-11-161A1.pdf

[13] Refer to endnote 11. Learn more about this and other broadband mapping facts at http://www.connectpr.org/. Submit questions or recommended changes to: maps@connectpr.org.

[14] Ibid.

[15] Ibid.

[16] Ibid.

[17] National Telecommunications and Information Administration, Federal Communications Commission. (2011). *National Broadband Map*. Retrieved from website: http://www.broadbandmap.gov/

[18] Ibid.

[19] Bureau of the Census, United States Department of Commerce. (2000). *United States Census 2000*. Retrieved from website: http://www.census.gov/main/www/cen2000.html
Note: Household density is defined as number of households per square mile of land area.

[20] National Telecommunications and Information Administration, U.S. Department of Commerce. (2009). *Notice of funding availability (nofa) for the state broadband data and development grant program*. Retrieved from website: http://www.ntia.doc.gov/files/ntia/publications/fr_broadbandmappingnofa_090708.pdf
Note: "Unserved area means a proposed funded service area, composed of one or more contiguous Census Blocks, where at least 90 percent of households in the proposed funded service area lack access to facilities based, terrestrial broadband service, either fixed or mobile, at the minimum broadband transmission speed (set forth in the definition of broadband above). A household has access to broadband service if the household can readily subscribe to that service upon request." SBI NOFA. "Underserved area means a proposed funded service area, composed of one or more contiguous Census Blocks meeting certain criteria that measure the availability of broadband service and the level of advertised broadband speeds. […] Specifically, a proposed funded service area may qualify as underserved for last mile projects if at least one of the following factors is met, though the presumption will be that more than one factor is present: 1. No more than 50 percent of the households in the proposed funded service area have access to facilities-based, terrestrial broadband service at greater than the minimum broadband transmission speed (set forth in the definition of broadband above); 2. No fixed or mobile broadband service provider advertises broadband transmission speeds of at least three megabits per second (''mbps'') downstream in the proposed funded service area; or 3. The rate of broadband subscribership for the proposed funded service area is 40 percent of households or less."

[21] United States Department of Commerce, Bureau of the Census. (2000). *United States Census 2000*. Retrieved from website: http://www.census.gov/main/www/cen2000.html
Note: Household density is defined as number of households per square mile of land area.

[22] Connected Texas, (2010). *The broadband landscape in the state of Texas*. Retrieved from website: http://www.connectedtx.org/sites/default/files/connected-nation/Texas/ctx_planning_report_final_web.pdf

[23] National Telecommunications and Information Agency, (2010). *Puerto Rico governor's office*. Retrieved from website: http://www2.ntia.doc.gov/grantee/puerto-rico-governor's-office

[24] Federal Communications Commission. (2010). *National Broadband Plan*. Retrieved from website: http://www.broadband.gov/download-plan/

[25] Connect Puerto Rico, (2010). *Connect Puerto Rico residential technology assessment results*. Retrieved from website: http://www.connectpr.org/sites/default/files/connected-nation/Puerto%20Rico/files/PR_RTA_2010Q1_FINAL.PDF
Note: Connect Puerto Rico interviewed 1,000 Puerto Rico households and 200 cell phone users via random telephone dialing for this technology assessment. The margin of error for this assessment is +3.1% at the 95% level of confidence. To access more information regarding the methodology of the 2010 Connect Puerto Rico Residential Technology Assessment, review slides 148-150.

[26] National Telecommunications & Information Administration, Economics & Statistics Administration (2011). *Exploring the digital nation: Computer and internet use at home*. Retrieved from website: http://www.ntia.doc.gov/files/ntia/publications/exploring_the_digital_nation_computer_and_internet_use_at_home_11092011.pdf
Note: In October 2010, the U.S. Census Bureau within the Economics and Statistics Administration, in collaboration with the National Telecommunications and Information Administration, significantly expanded the Current Population Survey (CPS) to include new questions on computer and Internet use. The Census Bureau surveyed about 54,300 households, and through statistical methods extrapolated the survey results to represent 119.5 million American households.

[27] Ibid.

[28] Ibid.

[29] Federal Communications Commission. (2010). *Broadband adoption and use in America: OBI working paper series no. 1.* Retrieved from: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296442A1.pdf

[30] National Telecommunications & Information Administration, Economics & Statistics Administration (2011). *Exploring the digital nation: Computer and internet use at home.* Retrieved from website: http://www.ntia.doc.gov/files/ntia/publications/exploring_the_digital_nation_computer_and_internet_use_at_home_11092011.pdf

[31] Ibid.

[32] Connect Puerto Rico, (2011). *Broadband landscape*. Retrieved from website: http://www.connectpr.org/broadband-landscape

[33] National Telecommunications & Information Administration, Economics & Statistics Administration (2011). *Exploring the digital nation: Computer and internet use at home.* Retrieved from website: http://www.ntia.doc.gov/files/ntia/publications/exploring_the_digital_nation_computer_and_internet_use_at_home_11092011.pdf

[34] Connect Puerto Rico, (2010). *Connect Puerto Rico residential technology assessment results*. Retrieved from website: http://www.connectpr.org/sites/default/files/connected-nation/Puerto%20Rico/files/PR_RTA_2010Q1_FINAL.PDF

[35] National Telecommunications & Information Administration, Economics & Statistics Administration (2011). *Exploring the digital nation: Computer and internet use at home.* Retrieved from website: http://www.ntia.doc.gov/files/ntia/publications/exploring_the_digital_nation_computer_and_internet_use_at_home_11092011.pdf

[36] Ibid.

[37] Ibid.

[38] Connect Puerto Rico, (2010). *Connect Puerto Rico residential technology assessment results*. Retrieved from website: http://www.connectpr.org/sites/default/files/connected-nation/Puerto%20Rico/files/PR_RTA_2010Q1_FINAL.PDF

[39] Ibid.

[40] United States Department of Commerce, Bureau of the Census. (2010). *2006-2010 American community survey 5-year estimates: Puerto Rico community survey*. Retrieved from website: http://www.census.gov/acs/www/

[41] United Nations Development Group, International Telecommunications Union. Retrieved from website: http://www.itu.int/en/Pages/default.aspx
Note: According to the ITU, broadband is considered "affordable" if its annual cost is no more than 3 percent of household income.

[42] United States Department of Commerce, Bureau of the Census. (2010). *2006-2010 American community survey 5-year estimates: Puerto Rico community survey*. Retrieved from website: http://www.census.gov/acs/www/

[43] Federal Communications Commission. (2010). *Broadband adoption and use in America: OBI working paper series no. 1.* Retrieved from: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296442A1.pdf

[44] United States Department of Commerce, Bureau of the Census. (2010). *2006-2010 American community survey 5-year estimates: Puerto Rico community survey*. Retrieved from website: http://www.census.gov/acs/www/

[45] National Telecommunications & Information Administration, Economics & Statistics Administration (2011). *Exploring the digital nation: Computer and internet use at home.* Retrieved from website: http://www.ntia.doc.gov/files/ntia/publications/exploring_the_digital_nation_computer_and_internet_use_at_home_11092011.pdf

[46] United States Department of Commerce, Bureau of the Census. (2010). *2006-2010 American community survey 5-year estimates: Puerto Rico community survey.* Retrieved from website: http://www.census.gov/acs/www/

[47] Connect Puerto Rico, (2010). *Connect Puerto Rico residential technology assessment results*. Retrieved from website: http://www.connectpr.org/sites/default/files/connected-nation/Puerto Rico/files/PR_RTA_2010Q1_FINAL.PDF

[48] Federal Communications Commission. (2010). *Broadband adoption and use in America: OBI working paper series no. 1.* Retrieved from: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296442A1.pdf

[49] Connect Puerto Rico, (2010). *Connect Puerto Rico residential technology assessment results*. Retrieved from website: http://www.connectpr.org/sites/default/files/connected-nation/Puerto Rico/files/PR_RTA_2010Q1_FINAL.PDF

[50] Connect Puerto Rico, (2010). *Connect Puerto Rico business technology assessment results*. Retrieved from website: http://www.connectpr.org/survey-results/business
Note: The source for all Puerto Rico business data is the 2010 Connect Puerto Rico Business Technology Assessment, a random digit dial phone survey of 814 Puerto Rican businesses, including 133 businesses that do not subscribe to broadband service. This provides a margin of error for the territory-wide sample of ±5.1%. Connected Nation Average data comes from similar phone surveys conducted of 9,650 business establishments in Alaska, Iowa, Kansas, Michigan, Minnesota, Nevada, Ohio, Puerto Rico, South Carolina, Texas, Florida, and Tennessee. This sample provides a margin of error of ± 1.6% at the 95% confidence level.

[51] Federal Communications Commission. (2010). *Business broadband capability survey results*. Retrieved from website: http://transition.fcc.gov/Daily_Releases/Daily_Business/2010/db1129/DA-10-2251A1.pdf

[52] This response was collected differently in Puerto Rico than in other jurisdictions surveyed by Connected Nation, thus the percentage of Puerto Rican businesses that reported "no computer" as a barrier is not directly comparable to other jurisdictions surveyed by Connected Nation.

# Chapter IV: A 21st Century Broadband Infrastructure for Puerto Rico

# A. Introduction

Puerto Rico needs broadband access that is fast, robust, redundant, and ubiquitous to meet the economic challenges of the twenty-first century, ensure continued competitiveness of our business community, help contain the cost of government and social services, and ensure that all Puerto Ricans continue to partake in the social discourse that is increasingly taking place online.

A robust twenty-first century island-wide broadband infrastructure is essential, in both urban and rural areas and across higher and lower income communities. A robust twenty-first century broadband infrastructure will include multiple competing networks offering both fixed and mobile broadband connections to all citizens, business, and government and community anchor institutions. A robust twenty-first century broadband infrastructure will offer fast broadband retail services aimed at all citizens and households (both fixed and mobile), and ultra-fast wholesale and retail services aimed at the business community, public safety and government facilities, and institutions including schools, libraries, hospitals, clinics, and other community anchor institutions.

A robust broadband infrastructure is essential to attract foreign direct capital that will generate the jobs and opportunities needed to sustain Puerto Rico's competitiveness. Puerto Rico recently enacted the Export Services Law that gives substantial incentives for companies to relocate offices and plants to Puerto Rico. The objective of this legislative initiative is to promote foreign investment, particularly targeting companies that provide services in industries such as aerospace, manufacturing and other high-tech industries, that will leverage the large number of well-trained, bilingual engineers and other professionals graduating from the University of Puerto Rico system. A strong broadband backbone that will allow these investors to deliver better services to clients in and out of Puerto Rico is an essential asset to ensure the success of this initiative.

The networks that support broadband service and connectivity across the island will stand as a barrier to twenty-first century growth and competitiveness if they are inadequate to meet the capacity demanded by Puerto Rico's consumers and businesses. On the other hand, with a robust broadband infrastructure, there is nothing that prevents the establishment of Puerto Rico as a key target of direct foreign investment and as the central point of broadband and information economy commerce for the Caribbean and the Southern Hemisphere.

There is no reason why, for example, every municipality in Puerto Rico cannot be "as connected" to the Internet as any other city in the Western Hemisphere. Puerto Rico businesses can overcome the distance barrier by interacting with their customers worldwide via broadband-enabled applications such as video conferencing. Students in Puerto Rico's schools and universities can have the same access to distance learning opportunities as those on the U.S. mainland. Through telemedicine, patients in Puerto Rico can receive better quality of healthcare and access to doctors worldwide.

All of this is possible.

This is the vision that the Puerto Rico Broadband Taskforce has set as a goal for Puerto Rico. To define a strategy to achieve these goals, this chapter establishes a timeline with aspirational metrics. These goals are then contrasted with the measured broadband availability across the island to identify the scope of the digital challenges faced today across Puerto Rico and help establish quantifiable milestones. Finally, it examines different strategies aimed at accelerating investment in broadband built-out across the island, and establishes a series of strategic recommendations to achieve these goals.

## 1. Broadband Capacity Goals for Puerto Rico

Broadband infrastructure in Puerto Rico needs to support access to residential broadband services as well as a myriad of higher capacity applications and uses demanded by Puerto Rico's businesses, government, and community institutions. The broadband needed by a small business to stay connected with customers and suppliers may necessitate different capacity and quality of service requirements than those needed to meet the usage demands of a hospital in San Juan, or an elementary school in the interior or in Vieques, or public safety needs across the island, or households across Puerto Rico. As a result, this Strategic Plan sets standards and goals for broadband infrastructure that address the capacity needs of multiple applications and uses.

Furthermore, the Puerto Rico Broadband Taskforce understands that these goals will only be achieved as private sector investors identify and pursue economic opportunity and invest in better and more infrastructure and services across the island. For this reason, a key goal of this Strategic Plan is to ensure that competition across the broadband sector thrives.

This framework of complementary broadband networks offering different capacity depending on the type of demand served is built on the foundation laid out by the FCC in the National Broadband Plan, as well as various international telecommunications institutions that are increasingly framing the broadband access challenge in this multi-layered network approach. This principle is consistent with a market driven sector where supply grows to meet demand where it emerges and as it evolves. In its National Broadband Plan, the FCC sets various broadband capacity goals depending on the intended demand and usage. These FCC standards are based on estimates of the actual capacity needs that consumers have today, given the type of institution, usage, and applications typically run through the broadband connection.

In particular, the FCC estimated the broadband capacity needed to support applications typically used by most online users. For example, while basic web-browsing or e-mail applications typically need about 0.1-0.3 Mbps actual speed connection, other applications need greater actual capacity to be viable, such as streamed classroom lectures (1-5 Mbps actual download speeds), video conference + VoIP for lower definition telemedicine (0.6 - 1.0 Mbps) or enhanced video teleconferencing (5-10 Mbps).[1] Taking into account the broadband capacity needed to deliver these applications, the typical usage patterns by online users, and consumer broadband purchasing patterns, the FCC establishes in the National Broadband Plan a National Broadband Availability Target of 4 Mbps download/ 1Mbps upload actual speeds.[2] This target broadband speed would meet the demand needs of the average consumer and can be thought of as a proposed floor – or minimum – network capacity essential to all Americans. The National Broadband Plan notes that such standards will need to be revised as consumer patterns for broadband demand change. The FCC recently created the Connect America Fund, which will subsidize the provision of broadband in areas of the United States where no broadband exists.[3] At the same time (and as discussed below), the FCC recognized the need for higher speeds in certain (yet-to-be defined) areas of the country, and additionally established that all Connect America Fund recipients discuss and incorporate the unique needs of community anchor institutions like government, schools, libraries, and hospitals in their network planning.

The people of Puerto Rico contribute to the historical Universal Service Fund, and, eventually and as it replaces the USF program, to the Connect America Fund, through regulatory fees applied to their telecommunications bills. Many of Puerto Rico's broadband providers benefit from the existing Universal Service Fund program, and are expected to partake in the newly created Connect America Fund. The standards and goals for broadband connectivity across Puerto Rico established by the Puerto Rico Broadband Taskforce take this reform into account to ensure consistency.

# By 2015, 98% of all households should have broadband available at actual minimum speeds of 4 Mbps download /1 Mbps upload.

While the FCC National Broadband Availability Target establishes a de facto minimum capacity goal over the coming years, the FCC set in the National Broadband Plan higher aspirational goals for broadband capacity to most citizens. These goals recognize that across many metropolitan and suburban areas across the U.S. where the competition is thriving and investment is readily flowing, this minimum capacity standard has already been met and greatly surpassed. As a result, the National Broadband Plan established aspirational capacity goals of at least 100 million U.S. homes with affordable access to actual download speeds of at least 100 Mbps and actual upload speeds of at least 50 Mbps by 2020. It also establishes a milestone that by 2015, 100 million homes should have affordable broadband access to actual download speeds of 50 Mbps and actual upload speeds of 20 Mbps.[4] Further, the National Broadband Plan called for the U.S. to lead the world in mobile innovation with the fastest and most extensive wireless network of any nation, and establishes recommendations to reach this goal and accelerate deployment of 3G mobile networks where it is lacking and the deployment of new 4G technology across the country. The National Broadband Plan further sets a goal of 1 Gbps connectivity for community anchor institutions such as schools, hospitals, and government institutions.[5]

Taking into account these rich precedents as well as the current state of broadband networks across Puerto Rico, the Puerto Rico Broadband Taskforce establishes the following goals over the coming decade for a robust broadband infrastructure across Puerto Rico:

## Strategic Goals for Puerto Rico - Access

All urban areas across Puerto Rico should have available ubiquitous broadband infrastructure able to provide service at speeds, and quality of service comparable to that available in any city in the Western Hemisphere. All citizens across Puerto Rico, in both urban and rural areas, should have available ubiquitous broadband service meeting a minimum speed standard. Similarly, mobile broadband technology should continue expanding and ensure rapid expansion of next generation services across the island. Such service should be accessible to all residential, commercial and, or government customers.

**Fixed Broadband Capacity Goals:**

- By 2015, 98% of all households should have broadband available at actual minimum speeds of 4 Mbps download (DL)/1 Mbps upload (UL) at affordable prices to allow for at-home web 2.0 service offerings such one-way video streaming applications and two way video conference and collaboration applications.
- By 2015, all urban locations and 50% of all rural and remote areas should have access to broadband actual speeds of at least 10 Mbps DL/3 Mbps UL at affordable prices; 70% of urban locations should have access to at least 25 Mbps DL/10 Mbps UL, and 50% of urban locations should have access to at least 50 Mbps DL/10 Mbps UL.

- By 2015, across the island the average capacity available across all fixed broadband service offerings, provided through wireline or fixed-wireless networks, should be no less than 6 Mbps download speeds.
- By 2020, at least 85% of all customers should have access to at least 100 Mbps DL/50 Mbps UL.
- By 2015, average latency for IP traffic which originates and terminates in Puerto Rico should be no greater than 20 milliseconds; average latency for IP traffic which originates in Puerto Rico and terminates in the southeast coast of the U.S. mainland should be no greater than 90 milliseconds.

**Mobile Broadband Capacity Goals:**

- Mobile broadband offerings at next generation speeds will be available across at least 98% of the island's geography where the population resides by 2015. Expansion of smart phone penetration and tablet end-user devices will be promoted.

**Connectivity Across Community Anchor Institutions:**

- By 2015, higher education, K-12 schools, and healthcare institutions across all urban and rural areas should have access to 100 Mbps DL/25 Mbps UL speeds to sustain virtual community learning and telemedicine.
- By 2020, higher education, K-12 schools, and healthcare institutions across all urban and rural areas should have access to 1 Gbps speeds to sustain virtual community learning and telemedicine.

**Broadband Submarine and Backhaul Network Security:**

- Puerto Rico broadband providers and local and national government officials will work together to derive a plan to improve the security, robustness, and redundancy of the backhaul broadband infrastructure across the island. Particular emphasis will focus on the security standards of alternative submarine cables, and strategies to encourage the underground construction of backhaul infrastructure across the island.
- A more robust backhaul and underwater cable infrastructure will support the expansion of Puerto Rico as a telecommunications and data hub for the Hemisphere.

**Competition across the Broadband Service Market:**

- By 2015, 98% of Puerto Ricans will have at least three competitive broadband offerings available.

Achievement of these goals will enable continued improvement of Puerto Rico within international rankings of ICT services by entities such as the World Bank and the World Economic Forum. In 2012 Puerto Rico made a significant gain, now 2nd in the region, elevating from a 43rd to 36th ranking on The Global Information Technology Report 2012, Network Readiness Index (NRI).[6] Such rankings matter a great deal to companies assessing where to locate new expansions or initiatives. Hence, these advancements are important to improve Puerto Rico's competitiveness and promote relocation of companies to Puerto Rico.

Across Puerto Rico, 14% of households, or approximately 177,000, lack any form of fixed broadband

## B. The Broadband Infrastructure Challenge in Puerto Rico

As the previous chapter describes in detail, thanks to the federally funded State Broadband Initiative program, there is timely data available to assess Puerto Rico's progress toward these goals. However, more information will need to be collected and analyzed over the next ten years to continue to mark progress on meeting all of these goals. This segment summarizes the information available today to assess the access challenge, and identifies gaps in necessary data to track progress and assess the completion of strategic milestones.

### 1. Access Challenge - Fixed and Mobile Infrastructure

The previous chapter summarized the data available today regarding the state of the broadband landscape in Puerto Rico. Based on the broadband inventory data collected from service providers across Puerto Rico by Connect Puerto Rico, it is evident that Puerto Rico's broadband infrastructure is markedly inadequate to meet the increasing needs for capacity of consumers, businesses, and institutions, and significantly lagging behind most jurisdictions across the U.S., and other regions. Table IV.1 restates the data presented in Chapter III summarizing broadband availability by speed tier as of June 2011.

**Table IV.1 - Broadband Availability by Fixed Networks Across Puerto Rico - by Speed Tier**

| Download/Upload Speed Tiers | Percent Households Served |
|---|---|
| At least 768 Kbps/200 Kbps | 86% |
| At least 1.5 Mbps/200 Kbps | 85% |
| At least 3 Mbps/768 Kbps | 57% |
| At least 6 Mbps/768 Kbps | 41% |
| At least 6 Mbps/1.5 Mbps | 34% |
| At least 10 Mbps/768 Kbps | 32% |
| At least 25 Mbps/768 Kbps | 0.00% |
| At least 50 Mbps/768 Kbps | 0.00% |
| At least 100 Mbps/768 Kbps | 0.00% |
| At least 1 Gbps/768 Kbps | 0.00% |

Source: Connect Puerto Rico, June 2011

This infrastructure is markedly insufficient to sustain the growing demand of businesses, citizens, schools, hospitals, or government for broadband connectivity and speed and falls far short of most basic capacity goals set in this Strategic Plan for 2015. Based on Connect Puerto Rico data, as of June 2011, between 34% and 57% of households across Puerto Rico did not have access available at the minimum target speeds capacity of 4 Mbps download (DL)/1 Mbps upload (UL).[7] A core goal of this Strategic Plan is to close this significant access gap by ensuring broadband access at this capacity or higher to 98% of Puerto Rico households by 2015.

# Approximately 43% of households lack broadband at 3 Mbps/768Kbps, speeds necessary to run applications increasingly demanded by online users.

By contrast, data obtained from Puerto Rico's mobile providers indicates that mobile broadband access across much of the island already meets the strategic goals set in this Plan, and surpasses estimates across the U.S. and the goals set by federal policy makers. As of June 2011, 99% of areas where households are located had broadband access available from at least one mobile broadband provider. By contrast, the National Broadband Map estimates that approximately 97% of U.S. households have access to at least one mobile broadband network.

## 2. Competition

As of June 2011, there were multiple competing broadband providers throughout Puerto Rico including 8 fixed broadband providers serving residential customers, 3 cable modem providers, 1 DSL island-wide provider, and at least 5 fixed wireless providers. Furthermore, there were 5 mobile broadband providers serving the great majority of the populated areas across Puerto Rico. Supporting the retail networks of all of these providers and, in certain areas offering retail service to customers, there are 11 broadband backhaul or middle-mile providers in Puerto Rico.

While these data indicate a degree of competition in broadband service across Puerto Rico, the data is insufficient to ascertain actual competition across the island. The level of competition across the island will depend on the degree of overlap and redundancy of alternative networks and the market strategies of broadband providers across different segments of the broadband market. To assess competition, it will be necessary to determine what competing alternatives are available to most Puerto Rican households, citizens, businesses, and institutions. Table IV.2 estimates the degree of penetration of various retail technology platforms across Puerto Rico. These data indicate that, relative to comparable mainland U.S. data available, platform penetration in Puerto Rico is lagging. As such, inter-platform and inter-carrier competition across Puerto Rico is likely lagging behind comparable areas in the rest of the U.S. Further research will be necessary to ascertain the level of competitive options availability to most Puerto Rico broadband consumers.

**Table IV.2 - Availability by Broadband Platform - Puerto Rico & U.S. Comparisons**
**At least 768 Kbps Download/200 Kbps Upload**

| | Percent of Households Served | |
|---|---|---|
| **Platform Type** | **Puerto Rico Estimates** | **U.S. Estimates** |
| Cable | 79% | 85% |
| DSL | 64% | 88% |
| Fixed Wireless | 40% | 31% |
| Mobile | 99% | 97% |

Source: For Puerto Rico estimates, Connect Puerto Rico, June 2011. For U.S. estimates, National Broadband Map, NTIA, December 2010 (which is the latest data available at the national level).

**Recommendation**:
Puerto Rico should continue to collect and analyze data on broadband infrastructure availability, capacity, and competition over the next decade to assess progress in meeting the Strategic Plan's goals.

## C. Strategies to Promote Investment in Broadband Capacity Across Puerto Rico

The broadband availability gap across Puerto Rico is an essential competitive challenge that necessitates a coordinated effort involving both public and private stakeholders. Achieving the infrastructure and speed goals set out in this Strategic Plan will require a significant increase in capital investments over the coming decade. This section first examines the impact across Puerto Rico of the FCC's Universal Service Fund reform underway. It then addresses proposed strategies to enhance the economics of broadband and promote investment in broadband capacity across Puerto Rico.

### 1. FCC Universal Service Fund Reform - Impact Across Puerto Rico

In October 2011, the Federal Communications Commission adopted a sweeping reform of the federal Universal Service Fund's (USF) High-Cost program that transitions it to a broadband-oriented structure. The reform establishes a transition of the High-Cost program, historically aiming to support voice-telephony service in rural and remote areas where market forces – left to their own devices – will not provide service, to a Connect America Fund that will aim to subsidize broadband infrastructure.[8] This reform will impact Puerto Rico's broadband sector in a number of ways. Private and public stakeholder members of the Puerto Rico Broadband Taskforce have monitored this reform as it unfolded, and sought to work collaboratively with the FCC to ensure a fair and effective allocation of subsidies to unserved areas in Puerto Rico under the new Connect America Fund.

The USF program is managed by the FCC and historically aimed to subsidize traditional voice telephony network build-out and services (a) across rural and remote areas; (b) across education, libraries or healthcare institutions; and (c) among low-income households. The fund is financed through a regulatory fee imposed by the FCC on all telecommunications providers and is passed on to consumers through a regulatory fee on their telecommunications services bill of approximately 15% in 2010. The size of the USF program in 2010 amounted to approximately $8.4 billion.[9] The historical USF program is comprised of four components, including:

- **High Cost Program**: This support ensures that consumers in all regions of the nation have access to and pay rates for telecommunications services that are reasonably comparable to those in urban areas. The size of the program in 2010 was approximately $4.5 billion disbursed across an estimated 1,800 eligible telecommunications carriers.
- **Low Income Program**: This support, commonly known as Lifeline and Link Up, provides discounts that make basic, local telephone service affordable for more than 7 million low-income consumers. In 2010, approximately $1.2 billion was disbursed through this program.
- **Rural Health Care Program**: This support provides reduced rates to rural healthcare providers for telecommunications and Internet services so they pay no more than their urban counterparts for the same or similar telecommunications services. In 2010, approximately $240 million was disbursed through this program.
- **Schools & Libraries or E-Rate Program**: This support, commonly referred to as E-rate support, provides affordable telecommunications and Internet access services to connect schools and libraries to the Internet. This support goes to service providers that provide discounts on eligible services to eligible schools, school districts, libraries, and consortia of these entities. In 2010, approximately $2.7 billion was disbursed to schools and libraries through this program (Table IV.3).

**Table IV.3 - Universal Service Disbursements - 2010[10]**

| USF Program | Total USF Subsidies (Billion) | Puerto Rico USF Subsidies (Million) | Puerto Rico Subsidies as Percentage of USF Disbursements |
|---|---|---|---|
| High Cost Program | $4.5 | $208.6 | 4.89% |
| Low Income | $1.2 | $39.9 | 3.03% |
| Rural Health Care | $0.24 | $0.0 | 0.00% |
| E-Rate | $2.7 | $23.2 | 1.02% |
| Total USF Disbursement | $7.95 | $271.8 | 3.42% |

Source: USAC, Annual Report 2010.

Table IV.4 summarizes the amounts disbursed under the High-Cost program across Puerto Rico fixed and mobile carriers.

**Table IV.4 - High-Cost Program Funds in Puerto Rico by Company - 2010[11]**

| Company Name | Study Area Name | 2010 Support |
|---|---|---|
| AT&T Inc. | Centennial Puerto Rico Operations Corp. | $27,058,494 |
| AT&T Inc. | Cingular Wireless | $37,380,228 |
| América Movil | P R T C - Central | $6,996,693 |
| América Movil | Puerto Rico Tel Co | $38,918,358 |
| América Movil | Puerto Rico Telephone Company D/B/A Verizon Wireless Puerto | $46,091,439 |
| Deutsche Telekom AG | Suncom Wireless Puerto Rico Operating Co. | $26,658,105 |
| PR Wireless LLC | PR Wireless Inc. | $17,010,954 |
| Spring Nextel Corporation | Spring Spectrum, LP | $7,935,228 |
| Worldnet Telecommunications | Worldnet Telecommunications | $576,753 |
| **TOTAL** | | **$208,626,252** |

Source: Federal Communications Commission Response to United States House of Representatives Committee on Energy and Commerce Universal Service Fund Data Request of June 22, 2011, Request 3, State-by-State List of Universal Service Fund High-Cost Support Payments.

### *The New Connect America Fund*

The FCC is currently undertaking a step-by-step reform of all the USF's components, starting with the High-Cost program. The core objective of the ongoing reform is to transition the $4.5 billion fund from a support system for voice-telephony networks – a twentieth century technology – to a system that would subsidize broadband access across the U.S. through the creation of the Connect America Fund. This reform is more than a decade in the making and represents a significant development across the broadband industry. The details of the transition of the $4.5 billion annual fund towards both fixed and mobile broadband network construction will have a profound impact upon the quality and nature of broadband services available to millions across the U.S. There will be winners and losers as a result of this reform, with some providers and states experiencing a decrease in total USF disbursements relative to historical levels, with others experiencing a net growth in funding from the Connect America Fund. In the case of Puerto Rico, as discussed below, it is unclear at this point what the final impact will be.

The FCC's USF reform order is complex and involves extensive discussion of a number of important issues, including the use of the State Broadband Initiative broadband availability data to direct funding to "unserved" areas. The transition to the Connect America Fund will take place in two phases starting in 2012 and should be completed by 2017. Through this process funds disbursed under the rules of the historical High-Cost program will be phased out from 2012 through 2015. The purpose of this staged approach is to avoid sudden disruption of businesses and existing services. In particular, the FCC's USF reform plan will:

- Cap the high-cost support program at $4.5 billion per year;
- From 2012-2017, progressively shift that $4.5 billion from existing voice-service subsidies to a program that will support the provision of multi-use broadband and voice networks offering at least **4 Mbps download/1 Mbps upload (actual) fixed broadband** service in "unserved" areas;
- Create a **Mobility Fund** to subsidize mobile broadband that will support the expansion of 3G/4G mobile service in areas currently without such access;
- **Immediately implement a one-time injection of $600 million as early as July 2012** to subsidize fixed and mobile broadband service in areas that have no access available.

The reform underway calls for disparate transition rules and timelines for different categories of service provider, depending on whether they are mobile or fixed carriers, the size of the firm and its regulatory classification. Across Puerto Rico this implies that the impact of these reforms will be different for mobile and fixed providers, for Incumbent Telecommunications Carrier (ILEC) (the Puerto Rico Telephone Company), the three cable operators on the island, and new entrants into the market in the last decade.

To supplement the Connect America Fund, dedicated funding for tribal and remote areas is included in the order. This funding is designed to overcome the distinct, legacy challenges to telecommunications development in those areas and represents an effort by the FCC to ensure that the Order's reforms do not impact tribal or remote areas any more adversely than absolutely necessary.

As a result of this transition, millions of dollars in Connect America Funds will be directed based upon how states, communities, carriers, and policymakers use and understand the State Broadband Initiative (the federal broadband mapping initiative) data in Puerto Rico collected by Connect Puerto Rico in collaboration with broadband providers across the island. The FCC will use current State Broadband Initiative mapping information to create a list of census blocks unserved by fixed broadband infrastructure. These census blocks will be eligible for disbursement of a component of the Connect America Fund - Phase I funds, which amount to $300 million. In parallel, the FCC has already defined eligible areas across the U.S. for the Mobility Fund – Phase I program, which will disburse a maximum of $300 million to subsidize mobile infrastructure build-out across unserved areas. In February of 2012, the FCC released a database identifying eligible areas across the U.S. for the Mobility Fund – Phase I program and established a "challenge" process to this database open to any stakeholder who believes the FCC database is inaccurate. To help assess the accuracy of the eligible areas database, Connect Puerto Rico has conducted an analysis of these eligible areas in Puerto Rico which is available at http://www.connectpr.org/es/node/1492. This analysis reveals that there are very few geographic areas across Puerto Rico that are eligible for funding under the rules set for the Mobility Fund – Phase I.

***Impact Across Puerto Rico - Strategic Recommendations***

Possibly nowhere more than in Puerto Rico will this reform have a greater potential impact. Like in any reform of this magnitude there will be winners and losers. Individual providers and states or territories may experience a net decrease or increase in revenues disbursed under the Connect America Fund. The impact across individual providers and states or territories will depend on a myriad of program implementation details that the FCC has yet to determine. It is too soon to predict the full impact of this vast reform across Puerto Rico. This will ultimately depend on details determined by the FCC via rule making regarding the process to determine subsidy distributions.

The ultimate goal of this FCC reform is to prioritize funds to areas without broadband service, and where market forces are unlikely to drive investment for lack of a viable business case. As is detailed in Chapter III, Puerto Rico broadband access is significantly lagging behind most jurisdictions across the U.S. Across most U.S. states, upwards of 95% of households have broadband available. By contrast, as of June of 2011, approximately 86% of households across Puerto Rico have broadband available.[12] Due to this significant lag in broadband availability across the island it is expected that – if the FCC succeeds in its stated goals – overall Puerto Rico will be a net winner from this reform. In other words, given Puerto Rico's documented lag in broadband infrastructure and capacity, logic dictates that the amount of funds disbursed across Puerto Rico under the new Connect America Fund should be greater than under the historical High-Cost fund. However, much depends on the details of how this transition will be implemented, which the FCC is working to develop throughout 2012 and the ensuing years. It is imperative that Puerto Rico public and private stakeholders monitor and contribute to the public debate underway at the FCC as these important programmatic details are determined.

In particular, the FCC is in the process of developing complex cost models to estimate the cost of infrastructure build-out where broadband is unavailable, assess expected revenues in those areas from any commercial operation, and estimate the size of the gap to achieve sustainability of these business operations. Based on these generic costs models - the theory goes - the FCC will determine the necessary subsidies needed to attract investment in those areas. Simply put, these cost models strive to determine how much subsidy would be necessary to make a commercial operation whole and, thus, attract private investment now willing to enter those unserved markets. Such cost models are currently being developed at the FCC and will be applied to any area across the U.S. that remains unserved.

On April 25 2012, the FCC released estimates of maximum eligible subsidies for large price cap telecommunications carriers under the planned Connect America Fund – Phase I.[13] Under this Connect America Fund – Phase I up to $300 million will be disbursed across price cap carriers providing a one-time capital injection to subsidize network build-out in unserved areas served by these carriers. In Puerto Rico the only eligible carrier for this Connect America Fund – Phase I is the incumbent carrier Puerto Rico Telephone Company (PRTC). FCC estimates for eligible subsidies by company are based on a cost allocation model designed to simulate the economics of network investment in unserved areas along the contiguous U.S. states. PRTC did not qualify to receive any subsidies under Phase I of the Connect America Fund. One possible explanation for this result is that the logic the FCC used to allocate that $300 million in funding was based on national estimates of the cost of building broadband networks. These estimates did not take into account the unique conditions in Puerto Rico that limit network investment. In particular, the low adoption rate across the island and the costs of broadband backhaul simply were not accounted

# Three key factors behind investment lag: lagging demand, high capital investment costs, and high operations costs.

for by the FCC's model, which focused nearly exclusively upon population and business density.

For Puerto Rico, it is imperative that such models take into account critical factors defining the Puerto Rico broadband landscape; in particular, and as described in Chapter III, a drastic lag in broadband demand, resulting in significantly lower expected revenues from any commercial operation. In order to develop a fair assessment of subsidies needed to sustain business operations across unserved areas in Puerto Rico, it is important that the FCC's models do not assume economic factors prevalent across other U.S. jurisdictions, and instead reflect the economic reality of Puerto Rico. Such details will be crucial to achieve fairness for Puerto Rico citizens and businesses that remain unserved, and help overcome the access challenge still facing Puerto Rico. The Puerto Rico Broadband Taskforce will work collaboratively with the FCC to achieve this goal.

Much depends on the reliability of the broadband inventory data that will be used to determine eligible areas for subsidies under the new Connect America Fund. The FCC has determined that a key input into those decisions will be the National Broadband Map database, which in Puerto Rico is managed under the State Broadband Initiative grant program by the Office of the Chief Information Officer and collected by Connect Puerto Rico. It is imperative that these mapping efforts continue and that all broadband providers voluntarily collaborate with Connect Puerto Rico to ensure that the data source used by the FCC to determine the Connect America Fund transition is comprehensive and accurate.

Taking these important considerations into account, the Puerto Rico Broadband Taskforce recommends the following strategies to ensure Puerto Rico citizens fully leverage the opportunities under the new Connect America Fund.

**Recommendation**:
Puerto Rico's public and private broadband stakeholders should work collaboratively with the FCC to ensure fair and effective allocation of subsidies to unserved areas in Puerto Rico. In particular, models determining the size of subsidies needed to achieve sustainable broadband business plans across Puerto Rico should be based on the economic realities of Puerto Rico, including levels of broadband demand half those expected elsewhere across the U.S.

**Recommendation**:
All broadband providers should collaborate with Connect Puerto Rico to ensure that broadband inventory data collected under the SBI grant program and used by the FCC to determine the Connect America Fund transition is comprehensive and accurate.

**Recommendation**:
Public and private broadband stakeholders in Puerto Rico should work collaboratively to reform the Puerto Rico Universal Service Fund (PRUSF) to support the deployment of broadband in unserved areas and ensure that the PRUSF complements the new FCC Connect America Fund program.

While ensuring that the Puerto Rico broadband sector fully leverages the new opportunities under the FCC's Connect America Fund is important and will be instrumental in helping close the access gap across Puerto Rico, it is not the panacea to Puerto Rico's broadband challenge. Ensuring the sustainability and growth of this sector demands coordinated island-wide strategies involving the private and public sectors, including broadband providers and multiple other stakeholders who depend on the technology for their viability. The rest of this chapter examines key challenges affecting the access gap and proposes a series of strategies to ensure sustainability of this critical twenty-first century technology.

With expected demand and revenue flows less than half the U.S. average, the business case for deployment is weakened.

## 2. Promote Universal Adoption of Broadband Services

Greater adoption of broadband services across the whole population is a key and primary goal to make the broadband sector in Puerto Rico vibrant and sustainable. In a free market, such as the broadband market in Puerto Rico, demand is the key driver of capital investments. As more consumers are willing to pay for services, investment will follow. Yet, with home adoption rates in Puerto Rico less than one-half of the U.S. average – 31% home broadband adoption in Puerto Rico in 2010, contrasting with a U.S. national estimate of 68% home broadband adoption — this lagging demand is a hindrance to continued capital investment.[14]

The challenges of the digital gap that exists today in Puerto Rico are documented in Chapter V of this Strategic Plan, focusing on the adoption gap. **This adoption challenge cannot be met solely by the broadband provider community. Private and public partnerships must work together to address this challenge**. Barriers to adoption primarily include relevance of the service and technology for many disconnected Puerto Ricans, and affordability of both devices to connect to the Internet and the broadband services.

While universal adoption is a key driver of investment, strategies to address the adoption gap are explored in a separate chapter and will not be further discussed here. However, it is essential that efforts to stimulate broadband adoption be understood as essential to achieve investment sustainability in the sector. The following chapter examines in detail factors affecting digital inclusion across Puerto Rico and proposes strategies to overcome the digital divide across vulnerable demographics. Chapters V, VI, and VII of this Strategic Plan examine the broadband adoption and usage challenge across Puerto Rico in depth.

**Recommendation**:
To encourage sustainable investment in network build-out, Puerto Rico must aggressively implement strategies to promote broadband adoption across vulnerable populations, whether residing in rural or urban areas.

## 3. Streamline the Regulatory Process to Promote Fair Competition and Market Entry

Competition in the market is a key trigger for continued investment in broadband upgrades, and improved quality of service and pricing across broadband providers striving to obtain and retain broadband subscribers. As such, it is imperative that the regulatory process effectively monitors anti-competitive behavior in the market, and aggressively strives to remove any entry barriers into the market that may delay or eliminate competition. Where competition is found to be lacking, or anti-competitive behavior is deemed to take place, appropriate action by the Junta or through legislation should be implemented.

Government should facilitate the provision of broadband at higher speeds in rural and urban areas enhancing competitiveness and provision of broadband in unserved and underserved communities. In order to foster economic development, social betterment, promote sustainable competition, and encourage private investment in broadband networks, it is important that the executive branch and the legislative branch understand ways in which government assets, processes, corporations, and other entities can block or promote these goals. In particular, it is important that government assets support the expansion of the broadband market in a competitively neutral way that will promote, and not distort, the competitive process. Government owned assets should facilitate a fair, competitively neutral environment for the telecommunications and broadband market, void of unfair competition from any private or public entity.

Government assets that have a profound impact in the broadband market and can either effectively contribute to broadband expansion, or block its development include Ultracom's underwater cable facilities that provide essential backhaul for data transport; PREPA's network of civil infrastructure including pole attachments that are essential for continued expansion of broadband infrastructure and competition; PREPA.Net's retail and wholesale broadband offers to providers, institutions and end-users; Puerto Rico's roads and transportation infrastructure, providing essential paths for broadband expansion; etc.

In order to promote a vibrant competitive broadband market that attracts the influx of capital necessary to continue expanding our broadband infrastructure, careful assessment of how these assets are contributing or deterring to broadband expansion is necessary.

**Recommendation**:
Streamline regulatory process to promote network investment and increase competition in the broadband sector.

**Recommendation**:
The legislative and executive branches, as well as the Junta Regulamentadora de las Telecomunicaciones, should work to ensure that government assets critical to the broadband market are effectively contributing to the expansion of the market in a fair and competitively neutral way. The Government and regulatory agency should be vigilant of anti-competitive activity blocking market expansion and increased capital investment in broadband capacity across Puerto Rico.

## 4. Lower Cost Barriers to Improve the Business Case for Broadband Deployment

Puerto Rico is an island territory, which results in inherently higher costs of deployment and operations of broadband services than across most other jurisdictions in the U.S. The need to connect the island to the Internet backbone via undersea fiber optic cables increases the cost of service. In addition, Puerto Rico's high construction costs, and mountainous tropical topography with high elevations, steep hills, valleys, and thick vegetation result in very high costs for the deployment of last mile infrastructure. These supply-side challenges are aggravated by a lagging demand across the island, which negatively impacts the business case for deployment and broadband growth. Puerto Rico's current economic situation, and the unwillingness and inability of its citizens to pay for the cost of service are at the heart of the digital divide in Puerto Rico. These combined realities are the heart of the deployment lag, documented for the first time through the Connect Puerto Rico mapping data, that persists across many areas of Puerto Rico.[15]

Moreover, the cost of doing business in Puerto Rico is a major deterrent to attracting network operators to the island. Primary concerns include:

- Puerto Rico's labor laws are the most regulated in the nation, and present a serious challenge toward job creation and economic growth.
- Puerto Rico's electricity costs are surging to the point that the Governor has declared an Energy Emergency. The electricity which is provided by the Puerto Rico Electric Power Authority (PREPA) is unreliable and unstable, and results in significant additional costs to broadband providers who must install and maintain costly and insufficient alternative power generation and backup systems (generators/batteries) to ensure ongoing operation of their services in spite of regular power interruptions.

- Puerto Rico's labor pool is shrinking, as a result of increased migration from the island to the mainland. This "brain drain" has resulted in the loss of knowledgeable telecommunications and Internet networking staff.

There are, however, meaningful ways to promote investment by eliminating regulatory, institutional, and other hurdles that impact negatively the business case for deployment. Significant steps can and must be taken across Puerto Rico to improve the business case for broadband deployment and encourage private investment across low-income communities and nonurban areas of the island. This section discusses the challenges to broadband infrastructure investment in Puerto Rico and recommends strategies to address them.

***Planning and Coordination***

Access to right-of-way inventory at a state and municipal level is essential for effective and expedited outside plant fiber optic network design, deployment and operation, and will spur investment in telecommunication networks. In Puerto Rico, this doesn't exist. This lack of infrastructure planning, coordination, and rights of way and conduit inventory at the state and municipal levels negatively impacts the business case for broadband deployment by resulting in:

- Increased costs for network planning and design, due to ill-defined rights of ways and lack of transparent information regarding local conduits and poles;
- Delays in the permitting processes (which is expanded on below);
- Lack of coordination of infrastructure deployment in urban, densely-populated areas of the island, resulting in spaghetti-like overhead cable infrastructure;
- Lack of identification & coordination of rights of ways, resulting in damages to existing network infrastructure.

The Government of Puerto Rico is already working to improve this process by working with local government officials to improve the planning processes for construction projects. Such efforts should be redoubled as they will impact positively the business case for broadband deployment, as well as other civil engineering and construction projects.

**Recommendation**:
Promote island-wide and municipal planning and coordination of construction projects.

## High capital investment costs, including permit processing, pole attachment costs, and lack of effective planning and coordination with public authorities, negatively impacts the case for deployment.

***Construction Permitting Processes***

According to the World Bank's "Doing Business 2012" comparative data regarding the ease of acquisition of construction permits, Puerto Rico is ranked 152 of 183 economies assessed on the ease of dealing with construction permits (up from 166th in 2011).[16] This significant improvement is the result of a concerted effort by the Government of Puerto Rico, working in partnership with the private sector, to streamline the construction permitting process at all levels of government. Despite these significant improvements, permitting and Rights of Way (RoW) processing remains a significant burden for construction of any kind across Puerto Rico. According to the World Bank, dealing with construction permits in Puerto Rico entails an average of 189 days, at a cost of 369.1% of average income per capita. By contrast, across OECD countries, construction permits entail an average of 152 days at a cost of 45.7% of the average income per capita. Across Latin America and the Caribbean construction permits entail an average of 221 days at a cost of 160.3% of the average income per capita.[17]

These permitting delays and the relative high costs of permitting processing directly impact the business case for broadband deployment in Puerto Rico by resulting in higher construction costs, greater cost of capital, and delayed revenue sources. The current administration has recognized this challenge and changes have been implemented to streamline the processes. However, for Puerto Rico to compete in the global economy, additional measures must be implemented to speed permitting and RoW approval and lower its costs.

This goal affects not only the broadband sector, but also all aspects of the Puerto Rico society. As a result, we recommend the formation of a public-private taskforce charged with reviewing this challenge and proposing specific tactics to improve this process. The taskforce would be ideally comprised of representatives from multiple industries including the broadband sector and other network industries, transportation and other construction and general manufacturing, as well as representatives from both local and island-wide government directly involved in permitting processes. The taskforce will address, among other, the following objectives:

1. Overall assessment of the layers of bureaucracy entailed in the permitting process with the goal to eliminate redundancies and streamline the process;
2. Encourage consolidation of processes island-wide so that permitting can be accelerated;
3. Institute a fast-track permitting route across all municipalities so permit applicants faced with a rejection can resubmit applications without having to necessarily start the process over;
4. Establish maximum timeline goals for permitting, pole attachment, and RoW approval that can be measured and tracked across various local and island-wide government jurisdictions. For example, in order to encourage and support efforts to build out networks, permitting processes should be accelerated, with a target of response within 30 days.

**Recommendation**:
Continue streamlining the construction permit process and Right of Way (RoW) approvals process in order to ensure lower costs of infrastructure build-out and processing timeframes.

### *Dig-Once Policies*

Dig-Once policies would require any new roads, mass-transit projects, sidewalks, housing developments, and other construction projects partially or fully funded by the government of Puerto Rico, to include plans to incorporate conduits that can house fiber-optic cable that will sustain future data services (high-speed broadband/IPTV/Voice Over IP, etc.). The legislation must be competitively neutral and ensure that all broadband providers, regardless of technology used or regulatory status, have equal access to these conduits. Similar proposals have been made by the FCC's National Broadband Plan[18] as well as by members of the U.S. Congress including Rep. Anna Eshoo (California) who introduced similar federal legislation, and stated: "The legislation is a creative approach to more rapidly deploy broadband service, promote competition and do so with limited dollars. The 'dig once' policy would expand broadband at a fraction of the cost by including the conduit as roads are being built."[19] Puerto Rico Law 101 of 2005 is a step in the right direction regarding the needs to coordinate underground infrastructure deployment. Resolution of the Senate 1639 (R. de la C. 1639), approved in the Senate in December 2011 to study the viability and convenience of including subterrain conduit systems in all public contracts for highway and road construction, is also an important step in the right direction.[20]

**Recommendation**:
Institute legislation that will encourage "Dig Once" policy for all future transportation and civil engineering construction projects.

### *Colocation in Public Buildings*

Across regions of Puerto Rico that remain unserved, there is a need for access to colocation space in public buildings. Such colocation space would enable competing broadband providers to securely house the network access equipment necessary to provide service to public institutions, including government offices, public schools and hospitals, public housing buildings, public safety locations, etc.

Because government remains a key source of demand in the overall Puerto Rico broadband market, the expansion of such colocation space across public buildings will help spur competition. The proposed legislation would ensure that all colocation facilities in public buildings would be made available to all providers on equal terms and conditions, regardless of historic distinctions between telecommunication providers.

**Recommendation**:
Institute legislation that ensures competitively neutral access to colocation infrastructure in public buildings.

### *State & Municipal Tax Policies Pro-Investment*

As a result of Puerto Rico‘s current economic downturn, public sector leaders are seeking new revenue sources to address budget shortfalls. This search for new local government revenue sources has led various municipal governments to contemplate the idea of imposing future fees or taxes on broadband infrastructure in their municipalities. These proposals present uncertainty in the broadband market and, as in any market, uncertainty of future costs means weaker business cases for deployment. All of which ultimately results in lagged network deployment and higher costs to the Puerto Rico consumer.

As importantly, these short-sighted proposals fail to understand that, if implemented, such strategies would slow growth of the very infrastructure that is necessary to reverse the island’s economic contraction and to stimulate economic development and ultimately recuperate recent municipal tax losses. Municipalities with broadband infrastructure will (a) attract and retain residents and businesses; (b) create new job opportunities; (c) improve educational opportunities for students; (d) provide more effective means to deliver local healthcare services; (e) improve efficiencies of local public safety enforcement; and many others. In short, taxing local broadband deployment means taxing the economic engine necessary for that local community to ensure economic growth and competitiveness.

To encourage the expansion of high-speed broadband networks and ameliorate cost uncertainties, the Puerto Rico government should work with municipal government officials to ensure that new infrastructure installed for broadband services on public or private property, roads, easements or rights-of-way will not be subject to further state or municipal tax or fees.

**Recommendation**:
Reduce uncertainty of future costs by encouraging implementation of tax and fee policies by state and municipal government aimed to attract investment and encourage broadband network build-out.

***Pole Attachment Costs***

Broadband providers rely on pole attachments to deploy their infrastructure across the Puerto Rico landscape. Pole attachment costs are an important component of the capital investment and operations necessary to deliver broadband services. Recognizing the role of pole attachment in the development of the broadband market, the FCC recommended in its National Broadband Plan for the establishment of rental rates for pole attachment as low and close to uniform as possible.[21] According to the FCC's National Broadband Plan, the national average pole attachment rate ranges between $7-$10 per foot per year.[22]

In Puerto Rico, PREPA.Net, a competitive broadband service provider and a subsidiary of the Puerto Rico Electric and Power Authority (PREPA), a wholly-owned government entity and the island's electric power supplier, is the primary provider of poles used by broadband providers. Contractual documentation regarding PREPANET's pole attachment rates reveals higher rates across Puerto Rico, despite the fact that Puerto Rico's average household income significantly lags even some of the poorest U.S. states. Pole attachment rates charged by PREPA are $12.10 per attachment of a cable or other device. If the equipment requires more than one attachment, each would be charged separately. The minimum number of pole attachments per contract is 1,000. Finally, contractually PREPA can take up to 45 days to approve or reject petitions for new pole attachments.[23]

## High and volatile energy costs, high cost of backhaul traffic and high rates of theft and fraud drive costs and, ultimately, result in higher prices for consumers.

These high pole attachment rates are ultimately passed on to consumers, unnecessarily increasing the retail prices and potentially pricing out of the market low income households across Puerto Rico. As such, high pole attachment costs are a key barrier to overcome the digital divide in Puerto Rico. To overcome this challenge, we recommend the formation of a taskforce to evaluate pole attachment costs and processes across the island and work to reduce its costs and improve efficiency of attachment processes. Such a taskforce should include key stakeholders in this process, including government officials, PREPA, JRT, broadband providers, and other stakeholders. The recent rulemaking by the FCC on pole attachment fees should be considered by the taskforce in the evaluation process.

**Recommendation**:
Establish low and uniform pole attachment rental rates and efficient processes.

**Recommendation**:
To achieve this goal, establish the formation of a taskforce to evaluate pole attachment costs across the island and work to improve efficiency of pole attachment processes.

***IP Traffic Peering***

One of the drivers of high cost for broadband providers in Puerto Rico is the means of terminating local IP traffic between networks and the high cost of backhaul. There are clear cost, quality of service, and security benefits to maintaining the flow of local communications through the island's local broadband networks and within the island's shorelines.

The Government of Puerto Rico should encourage efforts for the local interconnection and peering of broadband networks, and support compliance with the FCC rules for network openness, non-discrimination & interconnection by establishing minimum service level requirements from broadband providers.

**Recommendation**:
Promote local network interconnection and peering to lower costs of backhaul traffic in Puerto Rico.

**Recommendation**:
Create minimum service level requirements for broadband providers serving local government agencies and entities.

### *Economic Incentives to Promote Broadband Investment*

While the Economic Incentives for the Development of Puerto Rico Act (Act No. 73 of May 28, 2008) was created to "provide an adequate environment and opportunities for the continued development of our local industry" and provide tax benefits that "fosters the economic development and social betterment in Puerto Rico," it does not specifically provide benefits to broadband service providers, whose services are essential in order to facilitate the export of services and goods outside of Puerto Rico.[24] Expanding these economic incentives to apply to the operation of operation and deployment of broadband services will promote broadband infrastructure investment and have a significant impact across the broadband landscape in Puerto Rico. Significant local and foreign investment could be attracted if the benefits under the Act were also extended to revenues and costs associated with broadband services (as defined by the FCC).

**Recommendation**:
Institute legislation to amend Act No. 73 of May 28, 2008, to include companies which operate and deploy broadband networks in Puerto Rico.

### *Promote Public-Private Partnerships to Expand Infrastructure Across Unserved Areas*

There are areas of Puerto Rico where it is not economically viable for the private sector to invest in the deployment of next-generation broadband services. Given that universal access and adoption of broadband is critical for Puerto Rico's economic growth and well-being, additional efforts must be made to facilitate the provision of competitive broadband services in these areas by private network operators.

In order to serve the residents of these regions, the Government of Puerto Rico should consider the development of public-private partnerships (PPP) to provide infrastructure for use by all telecommunication and broadband providers. This PPP network would be composed only of dark, passive network infrastructure (i.e. dark fiber) that would provide layer-1 service elements to third parties on a wholesale basis exclusively, thus eliminating any potential anti-competition distortions generated between PPP operators serving an area and competitive broadband or telecommunication providers using the network. All end users and customers of this PPP network would be able to receive similar, competing services from multiple providers over this common infrastructure. All service providers must be given access to the infrastructure at a regulated, tariffed rate to ensure appropriate end-user pricing.

To implement such a program, planning should be coordinated with existing network operators, Puerto Rico's municipal governments, and the Junta Reglamentadora de Telecomunicaciones to ensure that such PPP infrastructure will not overbuild into areas where significant private investment has already been made and competitive services are available. The availability of accurate, comprehensive broadband inventory data will be essential to streamline this process and avoid implementation of such PPP in areas that are already served. Existing network operators and broadband providers should play a critical part in the planning of the network, as well as the organization which administers it. Areas of the island without existing broadband service must be the initial priority for the PPP infrastructure deployment.

**Recommendation**:
Institute legislation for the establishment of public-private partnerships (PPP) for the exclusive purpose of designing, building, and operating a fully-passive fiber optic network to the premise in currently unserved areas for wholesale use by any *bona fide* telecommunications or broadband provider.

***Energy Costs***

To address these structural problems, the Government of Puerto Rico should continue to develop measures to help stabilize the price and reliability of energy on the island, and shelter Puerto Rico from sharp price fluctuations in the international energy market. Predictability of energy costs will significantly improve the business cases for broadband deployment as well as across any other sector with high energy use.

**Recommendation**:
Continue implementing policies aimed to stabilize the price of energy across the island.

***Theft Law Enforcement***

Crime in Puerto Rico is at an all-time high, and has its impact on the telecommunications industry as well. Over the past decade, there has been a significant increase in the theft of service as well as infrastructure, including copper cables, telecommunication tower parts, generators, batteries, among other items. Ultimately, service and infrastructure theft leads to higher prices and poor service to consumers.

The Puerto Rico Telecommunications Regulatory Board (JRT) has taken strong, swift action in the past year to address the rising problem of copper theft. JRT also is pursuing cases of theft of service. These efforts should be complemented to prevent future crime by working proactively to more effectively enforce existing laws and prosecute individuals who cause physical harm and damage to Puerto Rico's communications infrastructure.

**Recommendation**:
Improve law enforcement efforts to reduce the theft of broadband network infrastructure and reduce service theft.

**Recommendation**:
Incentivize deployment of fiber networks, thereby reducing reliance on copper networks targeted by thieves.

***Excavation Law Enforcement***

Another problem affecting the security and robustness of broadband infrastructure, and ultimately increasing the cost of providing the service across the island, is the poor enforcement of excavation laws designed to ensure protection for all existing infrastructure. The Public Service Commission's Center for the Coordination of Excavations and Demolitions (Centro de Coordinación Excavaciones y Demoliciones) is the state entity responsible for coordinating all excavation and, or demolition work. Its goal is to ensure ease of construction projects while ensuring the protection of subterranean infrastructure and assets, such as tubes, ducts, gas lines, and telecommunication facilities. Due to poor enforcement of excavation laws, including inconsistent issuance of fines to violating public and private entities, broadband infrastructure across the island is being seriously affected. This results in increased costs to network operators, serves as a deterrent to broadband network build out, and impacts the reliability and quality of Puerto Rico's broadband systems. All of which ultimately harms Puerto Rican consumers who will experience unnecessary service outages and greater cost of the broadband service. To ensure ongoing communication services and to protect consumers against unnecessary service interruptions, swift action must be taken to ensure compliance by all entities that carry out excavation work.

**Recommendation**:
Improve the enforcement of existing excavation laws to reduce damages to infrastructure assets and end-user service interruptions.

# Endnotes

[1] Federal Communications Commission. (2010). *Broadband performance: obi technical paper no. 4*, p. 9. Retrieved from website: http://download.broadband.gov/plan/fcc-omnibus-broadband-initiative-(obi)-technical-paper-broadband-performance.pdf

[2] Federal Communications Commission. (2010). *Broadband performance: obi technical paper no. 4*, p. 16. Retrieved from website: http://download.broadband.gov/plan/fcc-omnibus-broadband-initiative-(obi)-technical-paper-broadband-performance.pdf

[3] Federal Communications Commission, (2011). *Connect America fund report & order*. Retrieved from website: http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0206/FCC-11-161A1.pdf

[4] Federal Communications Commission. (2010). *National Broadband Plan*, p. 9. Retrieved from website: http://www.broadband.gov/plan/3-current-state-of-the-ecosystem/

[5] Ibid.

[6] Dutta, S., & Bilbao-Osorio, B. World Economic Forum, (2012). *The global information technology report*. Retrieved from website: http://www3.weforum.org/docs/Global_IT_Report_2012.pdf

[7] Availability data by speed tier collected Connect Puerto Rico follows the speed tiers prescribed by the National Telecommunications Information Administration broadband mapping rules (see the previous chapter for further details). As such, the National Broadband Map and data in Puerto Rico does not measure availability at actual speeds of 4 Mbps (DL)/1 Mbps (UL). To proxy the digital gap, the FCC has proposed to use a combination of the most relevant speed tiers measured via the National Broadband Map (3 Mbps/768 Kbps and 6 Mbps/1.5 Kbps).

[8] Federal Communications Commission, (2011). *Connect America fund report & order*. Retrieved from website: http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0206/FCC-11-161A1.pdf

[9] For more information on the USF program and its components refer to Universal Service Administrative Company (USAC) at www.usac.org

[10] Universal Service Administrative Company, (2010). *Usac 2010 annual report*. Retrieved from website: http://www.usac.org/_res/documents/about/pdf/annual-reports/usac-annual-report-2010.pdf

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[12] For a detailed assessment of the broadband inventory across Puerto Rico see Chapter III of this Strategic Plan.

[13] Federal Communications Commission, (2012). *Wireline competition bureau announces support amounts for Connect America Fund-Phase One incremental support*. Retrieved from website: http://transition.fcc.gov/Daily_Releases/Daily_Business/2012/db0425/DA-12-639A1.pdf

[14] Ibid.

[15] Ibid.

[16] World Bank Group, International Finance Corporation. (2012). *Ease of doing business in Puerto Rico*. Retrieved from website: http://www.doingbusiness.org/data/exploreeconomies/puerto-rico/

[17] Ibid.

[18] Federal Communications Commission. (2010). *National Broadband Plan*. Retrieved from website: http://www.broadband.gov/plan/6-infrastructure/

[19] California's 14th District. (2011). *Rep. Eshoo urges department of transportation to implement cost-saving measures to expand broadband deployment*. Retrieved from website: http://eshoo.house.gov/index.php?option=com_content&view=article&id=1111:rep-eshoo-urges-department-of-transportation-to-implement-cost-saving-measures-to-expand-broadband-deployment&catid=51:2011-press-releases

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[21] Federal Communications Commission. (2010). *National Broadband Plan*, p. 128. Retrieved from website: http://www.broadband.gov/plan/6-infrastructure/

[22] Ibid.

[23] Puerto Rico Electric and Power Authority. Retrieved from website: http://www.prepa.com/

[24] Puerto Rico Industrial Development Company, (2008). *Economic incentives for the development of Puerto Rico Act*. Retrieved from website: http://www.puertoricodoesitbetter.com/en/Pages/default.aspx

# Chapter V:
# All Puerto Ricans Online!
# Expanding Broadband Adoption

# Stimulating broadband adoption across all segments of society is imperative to ensure a vibrant economy and to promote continued investment in broadband capacity.

## A. Introduction

Promoting adoption of broadband service across all segments of society and in all areas across Puerto Rico, whether urban or rural, is a key goal of this Strategic Plan for two core reasons. First, in a market economy, demand drives supply – investment in access or infrastructure build-out – and, hence, demand stimulation becomes a core strategy in promoting investment in capital infrastructures and addressing the infrastructure gap described in the previous chapter. Private Puerto Rico entities competing for government, business, and residential customers determine their infrastructure build-out based on the expected revenue stream stemming from those investments. As demand for broadband services grows, the economics of network build-out and capacity expansion are improved, leading to more and better networks. Broadband and information technology are "sticky" – once used, citizens, businesses, and government agencies alike become dependent upon the economic and welfare benefits of online activities and rarely revert back. Hence, demand stimulation is a core strategy for sustainability of this Strategic Plan.

Second, adoption of broadband service – and not access – is the true objective of this Strategic Plan. The goal is not to have universal access per se, but rather to have citizens adopting and using this network and information technology for ever-more empowering and productive activities. The success of the digital age does not rest in more or better broadband "pipes" and should not be measured in terms of access bits, but rather in terms of number of adopters and scope and quality of usage of the technology.

Some might question what should be the role of government to address barriers to broadband adoption across vulnerable populations. While market forces are effectively driving market growth in the sector across a large segment of the society, that growth does not reach all segments and regions. Broadband technology is today a key enabler of economic opportunity, social interaction, and is critical in supporting first responders during a disaster situation. Increasingly, communities and citizens that are left behind this empowering technology have to overcome ever-greater challenges to obtain economic independence and fully participate in the social discourse of our nation. Hence, it is in the interest of both private and public leaders to work together to overcome the barriers to IT and broadband technology among the most vulnerable.

In assessing this position, it is important to understand that there is a big difference between traditional voice telecommunications services and the adoption of IT and broadband technology. In traditional voice telecommunications, demand and adoption of the service has not been a primary concern of policy makers. Voice telecommunications policy frameworks have been primarily focused on supply-side concerns. Where lack of access to voice telephony networks has been a core concern, telecommunications policy has been focused first and foremost on promoting universal access to the service, and, secondarily, to promote and monitor competition where it exists, or regulate the voice service monopoly where competition is not deemed possible. Traditional voice telecommunications policy has not been focused on demand-side issues because, for voice services, the old adage of "build it and they will come" works. Appreciating the value of voice communications and understanding how they work requires only a try. Importantly, the entry cost of acquiring a customer access device – in this case a phone – is limited and rarely constitutes a significant barrier to entry even across low-income segments of the population.

By contrast, the cost of a computer or personal device necessary to use broadband service and access the Internet can be prohibitive to lower-income demographics, and across the region can be an important barrier to the full expansion and leverage of broadband technology. In order to close the digital gap, it is imperative that we address this adoption challenge and examine computer or device cost entry challenges through policies that may include fiscal incentives for the purchase or lease of the equipment, direct subsidies of equipment aimed to certain segments of the population or key professionals (such as educators, healthcare providers, first responders, or others), or the promotion of public computing centers serving vulnerable populations.

Furthermore, failing to understand the value of online resources and how to use a computer, tablet, or mobile device to access the benefits of broadband is a barrier to adoption of broadband technology for many. Historically, adopting voice communications devices was a self-taught discovery process that may have required several minutes. By contrast, data communications devices are much more complex and usually require external training and guidance. Addressing these barriers to broadband expansion through policies to promote digital literacy and campaigns to build awareness of the benefits of online interaction for both personal use and small business enterprises need to be incorporated into the tool kit of effective broadband policy.

# By 2013, residential home broadband adoption across Puerto Rico should be at least 50% and by 2015 at least 70%.

The vision and recommendations presented in this Chapter builds upon previous work conducted by Puerto Rico partners, as outlined in Section B of this Chapter, and federal resources including:

- FCC's National Broadband Plan – Adoption Chapter[1]
- FCC's NPRM and Order on the USF Low Income Program reform (Lifeline)[2]
- FCC Chairman's vision for a connected America through the Connect to Compete program[3]
- The U.S. Department of Commerce's report, *Exploring the Digital Nation: Computer and Internet Use at Home*.[4]

With this vision of the importance of universal adoption and the role of public-private partnership to achieve this goal, the Puerto Rico Broadband Taskforce sets the following goals:

**Strategic Goals for Puerto Rico - Adoption**

All Puerto Ricans, regardless of income, race, gender, age or location, should have access and the willingness to partake and benefit from the online opportunities available through broadband.

Adoption Goals:

- By 2013, residential home broadband adoption across Puerto Rico should be at least 50% and by 2015 at least 70%.
- By 2015, adoption of broadband by all business with more than 4 employees.
- By 2015, 90% of the Puerto Rico population should have access to a broadband enabled computer or other mobile devices, either at home, work or via personal connection.

This chapter builds upon Chapter III, and examines the broadband adoption gap across Puerto Rico in detail, focusing attention on at-risk demographic groups and the barriers to broadband and related technologies adoption. It then presents an inventory of existing programs across Puerto Rico working to overcome barriers to broadband and IT. Building upon this information the final section outlines a series of aspirational goals for broadband adoption across Puerto Rico and strategic recommendations to achieve these goals.

An estimated 69% of all Puerto Rico households do not subscribe to broadband. Of those that have broadband available, 55% choose not to subscribe.

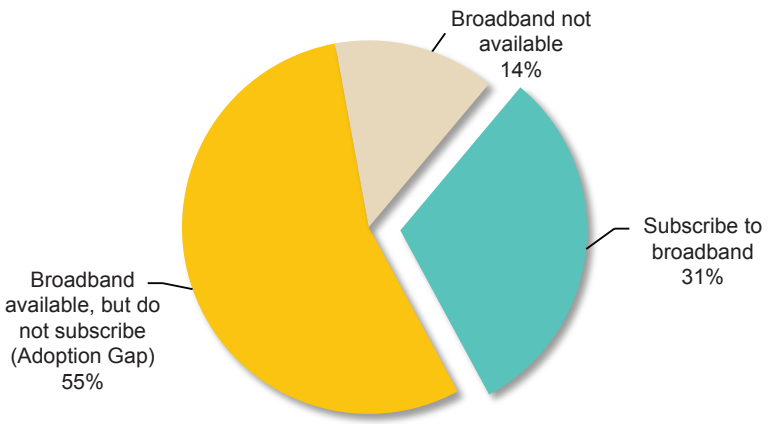
## B. The Puerto Rico Technology Adoption Gap

This section analyzes the technology adoption gap across Puerto Rico's residential sector. The analysis is based on the 2010 Connect Puerto Rico Residential Assessment, a consumer survey implemented by Connect Puerto Rico in 2010 aimed at understanding demand-side trends and barriers in the Puerto Rico broadband market. The survey was conducted by Connect Puerto Rico on behalf of the Office of the Chief Information Officer as part of the State Broadband Initiative (SBI) federal grant program, and funded through the American Recovery and Reinvestment Act. Data were collected by Estudios Técnicos in Puerto Rico and weighting and research consultation were provided by Lucidity Research, LLC.

### 1. Fixed Broadband Adoption

According to the broadband landscape outlined in Chapter III of this Plan, residential survey research conducted by Connect Puerto Rico in 2010 indicates that 31% of Puerto Ricans have a broadband connection in the home.[5] The most recent comprehensive broadband network inventory conducted by Connect Puerto Rico estimates that 86% of all Puerto Rico households have broadband available at the basic speeds of 768 Kbps download/ 200 Kbps upload. This implies an adoption gap in Puerto Rico of 55% of households; in other words, more than one-half of Puerto Ricans have basic broadband service available but, for various reasons, are choosing not to subscribe to the service in their home (Figure V.1).

Figure V.1 - Puerto Rico Broadband Adoption Gap

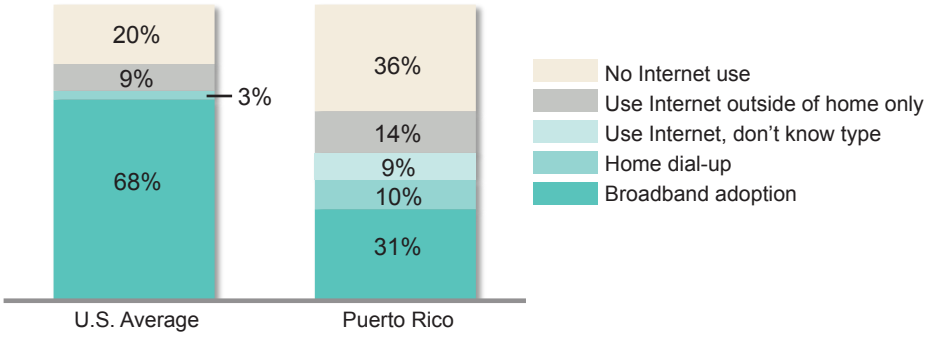


# Across Puerto Rico, only 31% of households subscribe to broadband, compared to an average of 68% across the U.S.

In 2010, 50% of Puerto Rico adults reported having a home Internet subscription. Of these 1.5 million adults, 31% reported subscribing to home broadband, 10% reported subscribing to dial-up Internet service, and 9% report home Internet subscriptions, but could not recall the connection type (Figure V.2). Another 14% reported only accessing the Internet outside of their home. Combined, 64% of Puerto Rico adults accessed the Internet either at home or outside of the home in 2010, but only 31% report accessing the Internet from a home broadband connection.

In comparison, 71% of U.S. households report subscribing to the Internet in 2010, and more than two-thirds (68%) reported subscribing to broadband.[6] Indeed, a shrinking share of home Internet users – about 3% of households in 2010 – used dial-up to access the Internet, down from 5% in 2009.[7] Another 9% of households had Internet users who only access the Internet outside the home. Together, these figures indicate that 80% of American households in 2010 had a least one resident who accessed the Internet from home or elsewhere.

Figure V.2 - Broadband Adoption Gap Comparison

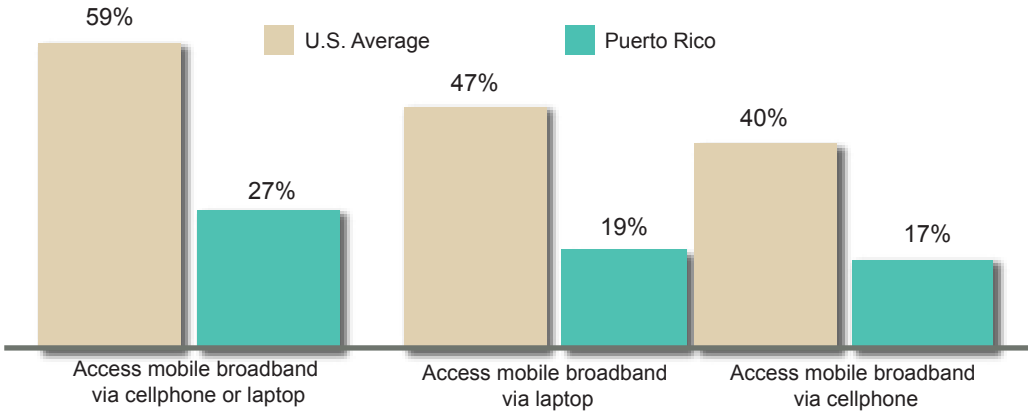



## 2. Mobile Broadband Adoption

Advances in mobile technologies are making Internet access more available and affordable than ever before, highlighting the critical role that mobile broadband deployment plays in bridging the digital divide. According to Connect Puerto Rico's June 2011 broadband inventory, 99.6% of Puerto Rico households have access to mobile broadband from at least one mobile provider.[8] However, while over one-third of Puerto Rico residents (37%) own a laptop computer, and more than three out of five residents (62%) report owning a cellphone, only 27% of Puerto Rico residents report accessing mobile broadband service (Figure V.3).[9] In comparison, according to Pew Internet's Mobile Access 2010 report, 59% of U.S. adults reported accessing mobile broadband.[10]

Among Puerto Rico adults, 19% own a laptop and access the Internet either via a paid subscription to mobile wireless service or through Wi-Fi zones. In comparison, Pew Internet's research indicates that 47% of U.S. adults go online with a laptop using a Wi-Fi connection or mobile broadband card. Additionally, Connect Puerto Rico's research indicates that only 17% of Puerto Rican adults access the Internet via cell phones; which is significantly lower than the U.S. average, reported as 40% of the population by Pew Internet.

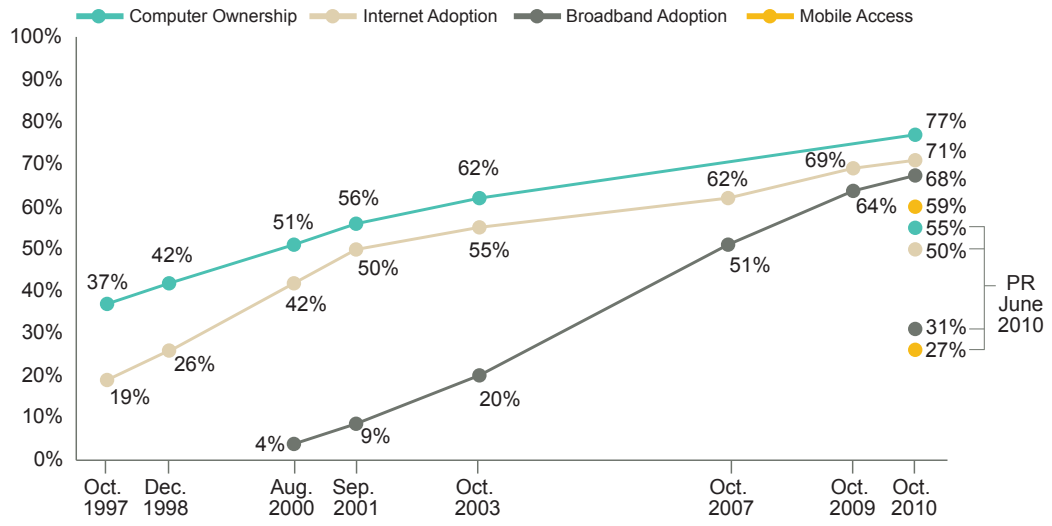
Figure V.3 - Mobile Broadband Access




During the first decade of the twenty-first century, U.S. household technology adoption grew dramatically. Figure V.4 provides a measure of the time lag in technology adoption across Puerto Rico relative to the U.S. Despite this technology becoming an ingrained feature of everyday life for most Americans, Puerto Rico's overall home computer and Internet adoption in 2010 is comparable to the September 2001 U.S. average. Furthermore, mobile broadband usage in Puerto Rico is equal to about one-half of the U.S. average. Finally, at 31%, Puerto Rico's broadband adoption is less than one-half of the U.S. average, meaning approximately 2.1 million Puerto Rico residents do not have home broadband access.

# Puerto Rico's overall home computer and Internet adoption in 2010 is comparable to the U.S. average in 2001.

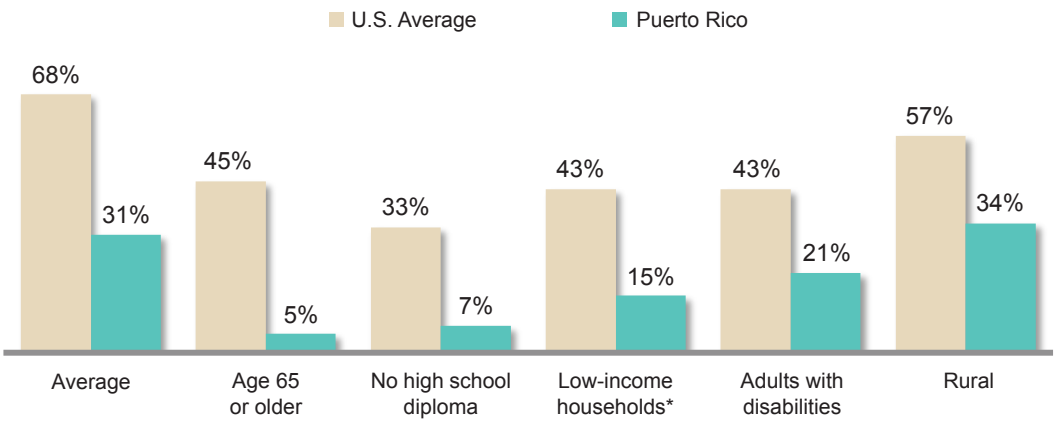
Figure V.4 - Overview of Household Adoption Rates by Technology - Percent of U.S. and Puerto Rico Households[11, 12, 13]




## 3. Broadband Adopters and Non-Adopters

In the United States, the U.S. Census Bureau, in collaboration with the National Telecommunications and Information Administration, found that broadband non-adopters are generally people of low-income, senior citizens, members of ethnic minorities, rural dwellers, people with disabilities, and/or people with less education. According to the 2010 Connect Puerto Rico Residential Technology Assessment, these trends are in line with non-adoption rates reported by similar demographic groups in Puerto Rico; however, the adoption gap in Puerto Rico for each of these demographic groups is more acute. Figure V.5 contrasts Puerto Rico and U.S. adoption gaps among selected demographic groups.[14] While across Puerto Rico broadband adoption is 31%; senior citizens, low-income residents, adults with disabilities, and adults with lower educational levels disproportionately find themselves on the wrong side of the digital divide. The broadband adoption rate is 5% among adults 65 and older; 7% among residents without a high school diploma; 15% among households with annual incomes below $15,000; 21% among adults with disabilities; and 34% among rural households.

Figure V.5 - Residential Broadband Adoption by Demographic Group in U.S. and Puerto Rico




* U.S. low-income = households reporting annual income less than $25,000.
Puerto Rico low-income = households reporting annual income less than $15,000.

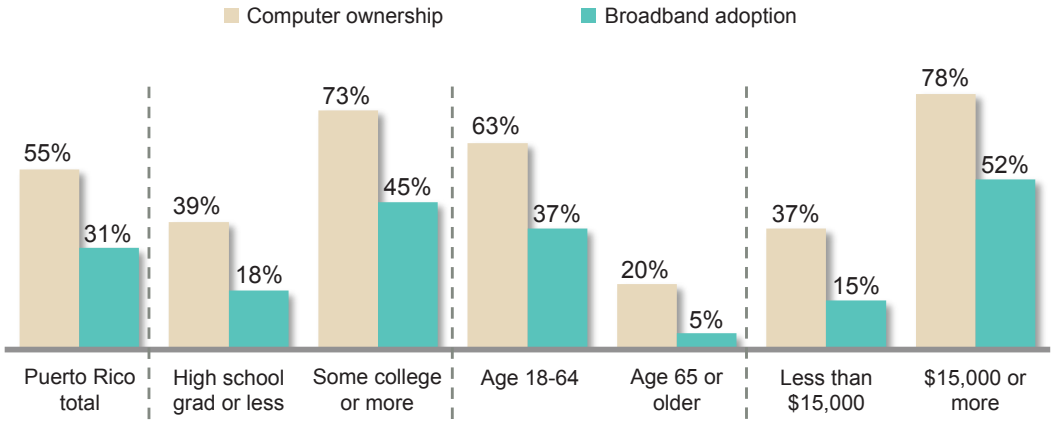
## 4. Main Drivers of the Adoption Gap

The 2010 Connect Puerto Rico Residential Technology Assessment indicates that the main demographic drivers of broadband adoption are income, education attainment, and age; the first two being highly correlated (Figure V.6).

- **Income**: Income appears to be the biggest dividing line of broadband adoption. More than one-half of Puerto Rico residents reporting an annual median household income of more than $15,000 (52%) report having home broadband subscriptions. Among those reporting an income of less than $15,000, only 15% report having home broadband subscriptions.
- **Education**: Among those who have some college experience, 45% have broadband at home, compared with 18% of those whose highest level of education attainment is a high school diploma.
- **Age**: While older residents tend to have lower broadband adoption rates, in Puerto Rico adoption is very low. Only 5% of residents age 65 or older report subscribing to home broadband.

# The main demographic drivers of broadband adoption are income, education attainment, and age.

Figure V.6 - Technology Adoption by Education, Age, and Annual Household Income



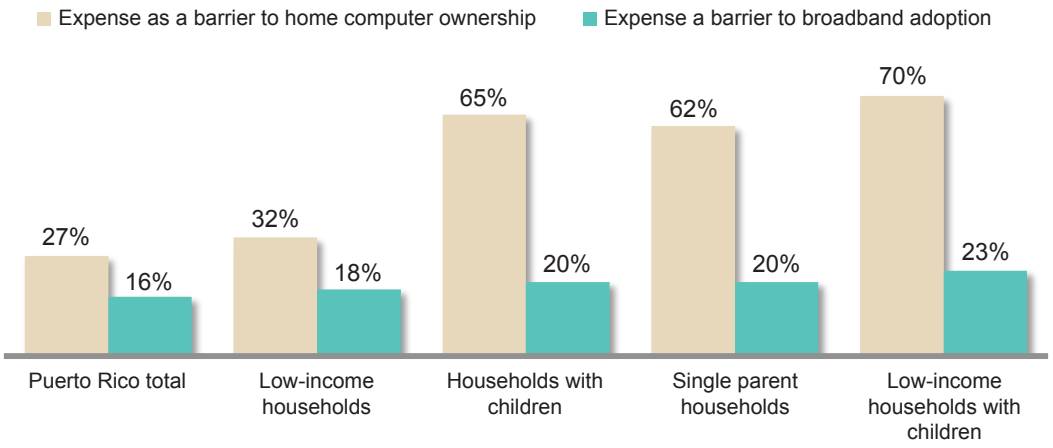

### *a. Affordability*

While income appears to be the main driver of the broadband adoption gap in Puerto Rico, Connect Puerto Rico's 2010 Residential Technology Assessment confirms that affordability is indeed a key reason why Puerto Rico's residents do not adopt.

In 2010, Puerto Rico residents surveyed reported paying an average of $42.37 per month for their home broadband service. In comparison, a 2010 Pew Internet study found that the average American broadband subscriber paid $41.18 per month for service.[15] Furthermore, although Puerto Rico households are, on average, paying more for their broadband, despite having a considerably lower average household income, they're receiving significantly slower speeds. Puerto Rico broadband subscribers who know their broadband speed report an average download speed of 3.3 Mbps, compared to the average of 6.0 Mbps reported across various U.S. states similarly surveyed by Connected Nation.[16] When Puerto Rico broadband subscribers were asked about their satisfaction with their home broadband subscriptions, 64% responded that they were very satisfied, followed by 34% who were somewhat satisfied, and 2% who reported being dissatisfied with their current broadband service. Among unsatisfied subscribers, the majority reported that frequent service outages were an issue.

Affordability of the service is a key factor for many non-adopters across Puerto Rico. An estimated 16% of Puerto Rico's non-adopters (approximately 322,000 Puerto Rico residents without a home broadband subscription) report that expense is a barrier to their broadband adoption. In addition, 27%, or approximately 362,000 Puerto Ricans, report that expense is a barrier to home computer ownership, a prerequisite for a home broadband subscription. Unfortunately, vulnerable population segments feel the impact of expense more than others (Figure V.7). Low-income households and households with children – two population segments that could stand to benefit most from broadband – have particularly low adoption levels. Approximately 433,000 children across Puerto Rico cannot enjoy the benefits of broadband in the home, largely due to the inability to purchase a computer or to pay the monthly subscription fee.[17]

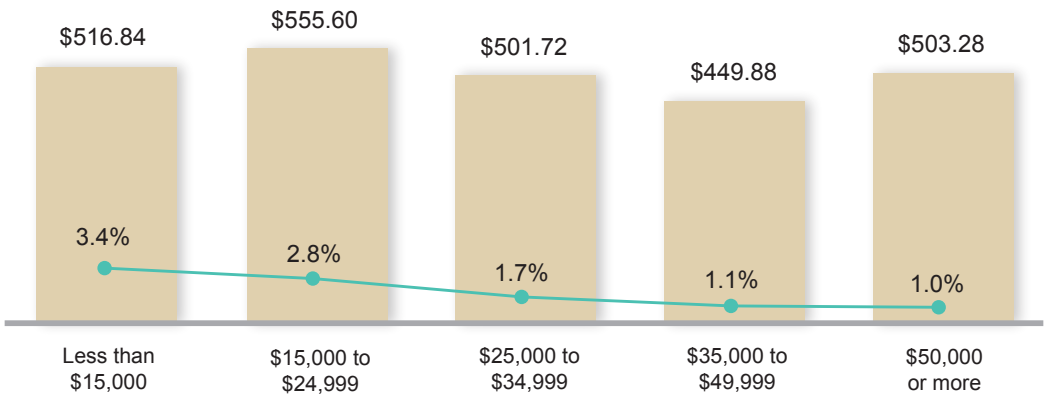
Figure V.7 - Expense as a Barrier to Technology Adoption




To put the affordability challenge in perspective, it is estimated that approximately 42% of Puerto Rico households have an annual income of less than $15,000.[18] For these residents, the cost of broadband represents approximately 3.4% of their annual income, which, according to the International Telecommunications Union, is considered unaffordable (Figure V.8).[19] According to this standard, more than two-fifths of Puerto Rico residents do not have access to "affordable broadband."

# The cost of broadband for Puerto Rico households with annual income below $15,000 represents approximately 3.4% of their annual income.

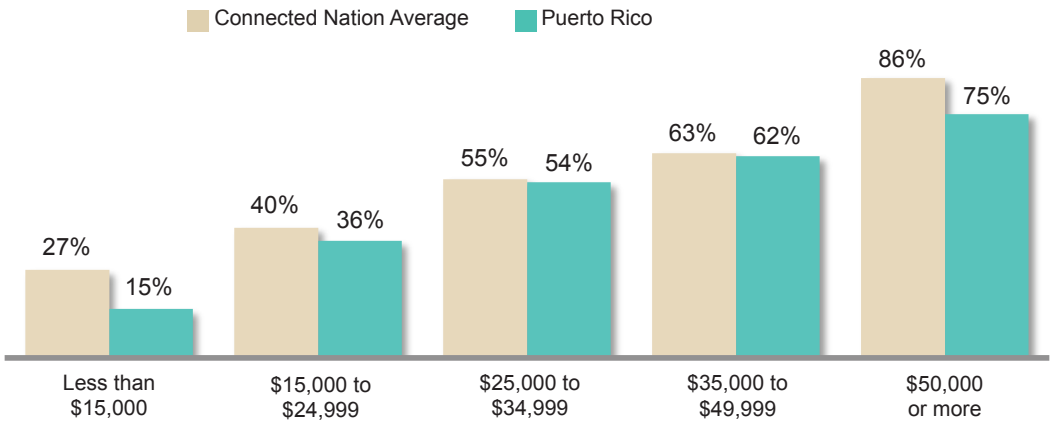
Figure V.8 - Annual Broadband Subscription Cost as a Percentage of Income




***b. Relevance and Computer Ownership***

While making broadband and related technologies affordable is fundamental to bridging the digital divide, cost alone is not a sufficient factor to explain, nor an adequate lever to address, the gap in home broadband adoption. Communities with a large percentage of non-adopters face multiple overlapping challenges to broadband use, from skill and language barriers, to provider access as well as public access points. For instance, Figure V.9 presents a comparison of broadband adoption among Puerto Rico and the average of jurisdictions surveyed by Connected Nation in 2010. While adoption levels among higher income categories are comparable, broadband adoption among Puerto Rico households making less than $15,000 are nearly one-half of the Connected Nation average.

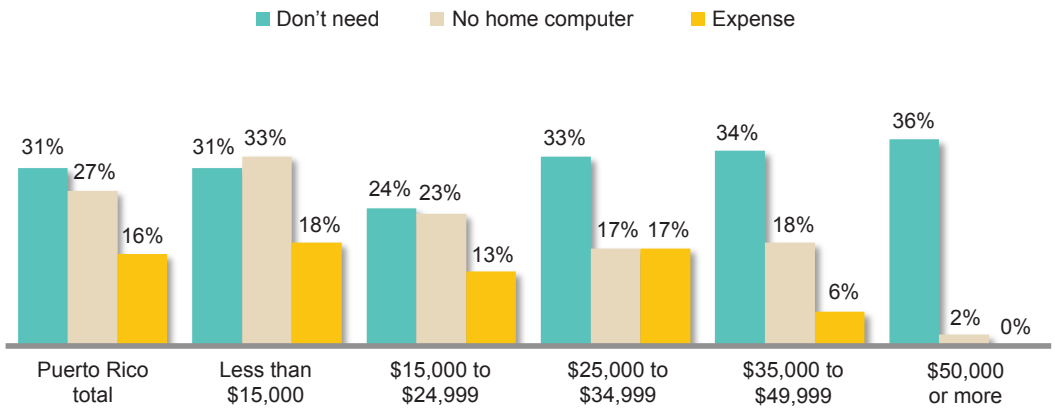
Figure V.9 - Broadband Adoption by Annual Household Income



# Lack of relevance of broadband technology is the key barrier to broadband adoption among Puerto Rico non-adopters.

What else is driving non-adoption? Among low-income Puerto Rico households, the lack of a home computer is the main barrier reported. However, overall, the largest barrier to broadband reported among Puerto Rico non-adopters is the lack of relevance that broadband has in their lives, cited by nearly one-third of non-adopters. In other words, their perceived benefits of broadband do not justify the monthly expense. In fact, regardless of household income, relevance as a barrier remains fairly consistent (Figure V.10).

Figure V.10 - Barriers to Broadband Adoption by Household Income




Thus, addressing the adoption gap will include affordability solutions, as well as addressing computer ownership and relevancy issues. However, despite these barriers, the ways that Puerto Rico residents use other forms of technology bodes well for the future of broadband adoption. Most residents have a positive view of the benefits of new technology; they buy and use such technology, even though they have not purchased broadband. For example, according to the Puerto Rico Telecommunications Regulatory Board, approximately 48% of households have paid TV subscriptions and 97% have a color television set.[20] Additionally, research conducted by Connect Puerto Rico indicates that 62% of Puerto Rican adults own a cell phone.

## C. Broadband Digital Inclusion Projects Underway Across Puerto Rico

There are many initiatives across Puerto Rico working to promote ICT adoption and close the digital divide. Some of the efforts bring people closer to computer technology, train how to use computer technology and navigate the Internet and encourage leveraging the network's power. Others focus on broadband accessibility, either by increasing penetration and/or making it more affordable. These initiatives are sponsored through public and private partnerships that include non-profit entities working to promote economic development across various regions of the island, private corporations in the IT sector, broadband providers, and national and local government agencies. In this section we highlight several examples of some of the more comprehensive and effective initiatives promoting digital inclusion across Puerto Rico. We also include a list of institutions providing digital resources and training across Puerto Rico communities.

### 1. Government-Sponsored Free Wi-Fi and Internet Access Centers

Puerto Rico Law 101, enacted July 28, 2010, mandates the Puerto Rico Telecommunications Regulatory Board (PRTRB) establish a Free Internet Access Center (FIAC) in each of the 78 municipalities of Puerto Rico in coordination with central government agencies, the municipalities themselves, and other private, educational, and community entities as deemed necessary. These Internet Access Centers will serve as public computer centers, making broadband access available to all citizens. These centers are specifically designed to provide "lifeline" access to the Internet for citizens who may not have access to the Internet through home, mobile or work connections.

The law also dictates that the PRTRB implements free wireless Internet access (fWi-Fi) in all public "plazas" of Puerto Rico. This free Wi-Fi access will allow all citizens to access the Internet at these central community locations, and generally promote Internet use across the community. The law authorizes the PRTRB to receive and administer funds from legislative appropriations, transfers, delegations, contributions and donations of any kind received from agencies, municipal governments, and the Government of the United States, as well as from individuals, NGOs, and other private entities for the design and implementation of projects, programs or services to be performed or offered in the FIACs. As of December 31, 2011, there were 33 fWi-Fi installation projects for public "plazas" and 46 FIACs.

# Law 101-2010 mandates the Telecommunications Regulatory Board to establish Free Internet Access Centers in each of the 78 municipalities of Puerto Rico.

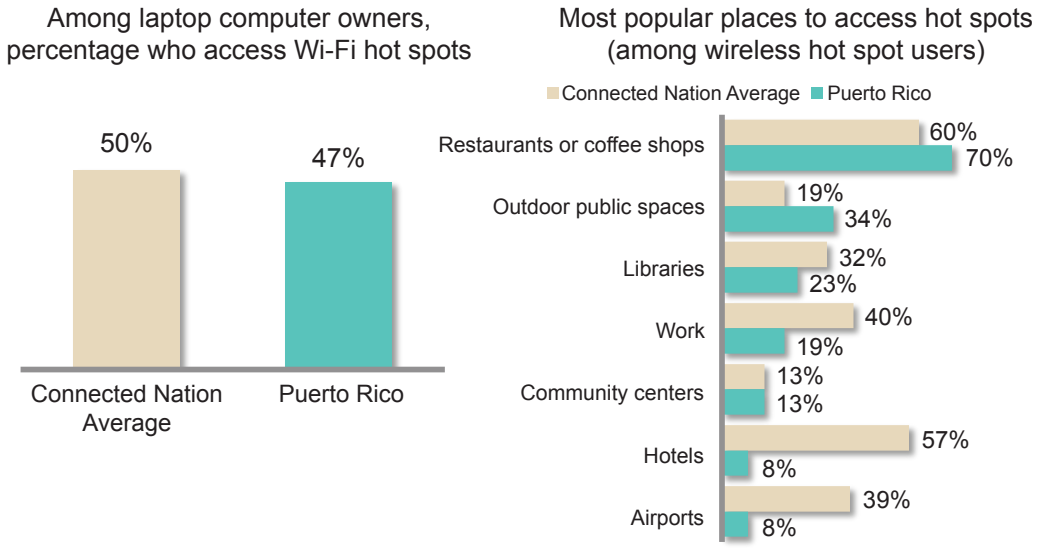
Connect Puerto Rico's 2010 Residential Technology Assessment confirms the value of these Internet access centers. While 15% of Puerto Rican laptop owners (or 5% of Puerto Rican residents) subscribe to a mobile wireless service that allows them to access the Internet on their laptop computer via a cellular network, nearly one-half of laptop owners (47%) utilize Wi-Fi "hot spot" zones to access the Internet; which is on par with laptop owners similarly surveyed by Connected Nation. Fifty percent of laptop owners surveyed by Connected Nation reported using wireless hotspots to access the Internet (Figure V.11).

When hot spot users were asked about the most popular places to access Wi-Fi, the results revealed an interesting landscape. Nineteen percent of wireless hotspot users living in the 13 jurisdictions surveyed by Connected Nation use outdoor public space for Internet access; across Puerto Rico, more than one-third (34%) of laptop computer owners visit an outdoor public space for Internet access. This suggests that Puerto Ricans seeking hot spots rely heavily on public spaces for Internet access. Furthermore, 70% of Puerto Rico laptop owners go to a restaurant or coffee shop for Internet access, compared to 60% across all jurisdictions surveyed by Connected Nation. In comparison to usage patterns in other U.S. jurisdictions surveyed by Connected Nation, Puerto Rico laptop owners are significantly less likely to go to a library, their employer, a hotel, or an airport for access to the Internet. Less than one-quarter (23%) of Puerto Rico laptop owners report going to the library for Internet access, 19% access hot spots at their place of employment, and 8% access hot spots at hotels or airports.

A convenient tool to promote hot spot usage would be an online map of all publically available hot spots across Puerto Rico. Such a map could include available resources both for free and for a fee. Useful data to ascertain the efficacy of these hot spots would include statistics on usage of the networks, number of patrons, and broadband capacity used.

Relative to their U.S. mainland counterparts, Puerto Rico laptop owners are significantly less likely to go to a library, their employer, a hotel, or an airport for access to the Internet.

Figure V.11 - Hot Spot Usage among Laptop Computer Owners




## 2. Regional Economic Development Public-Private Partnership Promoting Broadband Infrastructure and Technology Use

Across Puerto Rico there are regional economic development initiatives that have embraced broadband and information technology as a key engine for economic growth. One example of such an initiative is INTECO (Iniciativa Tecnológica Centro Oriental), a nonprofit organization that promotes the economic development of the East-Central Region of Puerto Rico comprising the following municipalities: Cayey, Caguas, Gurabo, San Lorenzo, Juncos, Las Piedras, Naguabo, and Humacao. INTECO was created in 2003 and brings together local elected officials, higher education institutions present in the region, and corporate partners such as Microsoft.[21]

## The Tecnológica Centro Oriental (INTECO) is a regional public-private partnership that aims to promote technology expansion in the region.

INTECO sponsors a series of initiatives aimed to promote technology expansion in the region. Key among these are its Centros de Innovación Tecnológica (CIT), or Center for Technology Innovation, which aims to promote innovation and growth through youth-oriented educational programs that focus on science, engineering, technology, and mathematics. The CITs were founded in 2004 with the expressed goal of promoting a culture for innovation and entrepreneurship and to bring ICT closer to the region's youth. There are currently three such centers located in the communities of Caguas, Cayey, and Juncos where ongoing training is offered in ICT and computer software skills, and entrepreneurship. Since its foundation, more than 60,000 citizens have benefited from these resources.[22] In partnership with the municipality of Caguas, INTECO also founded CIMATEC, a magnet high school specialized in sciences, mathematics, and technology. The CITs aim to expand the outreach of this educational initiative to youth beyond the municipality of Caguas.

In 2010, INTECO was awarded a $12.9 million grant from the U.S. Department of Commerce's National Telecommunications and Information Administration, and complemented by local investment totaling $3.4 million, to build a wireless backhaul broadband network in its focus region. To do so, it formed an alliance with the Puerto Rico Bridge Initiative to obtain Internet access at a reduced cost. This will enable INTECO to offer affordable broadband services on a wholesale basis to retail broadband providers across the region, significantly expanding the broadband capacity in the area and contributing to the competitive dynamics in the broadband sector. This broadband capacity expansion will serve to support the broadband needs of the CITs, among others. This project is currently underway with a Phase I go-live date of June, 2012.[23]

More recently, in early 2012, the Puerto Rico Industrial Development Company (PRIDCO) approved the allocation of $1.6 million to INTECO for the purpose of matching federal funds from the U.S. NTIA.[24] The goal of this funding is to expand Internet access in economically disadvantaged communities in the East Central region of the island and is expected to enable direct connection to 250 institutions; including schools, universities, hospitals, municipal buildings, and police stations. Additionally, INTECO expects this funding to facilitate broadband access to local customers, including 136,000 residents and 600 business and industrial sites. The project also includes Wi-Fi zones free of cost to promote Internet use among youth and economically disadvantaged adults.

Investments such as these, involving private and federal and local public resources, are the key to overcoming the digital lag across Puerto Rico's remote areas and spurring investment in outreach and training resources targeting vulnerable populations.

# Leveraging the local library and K-12 institutions to promote digital learning is a key strategy to bridge the digital adoption gap.

## 3. Promoting ICT Use Across Public Libraries

Recognizing the important, new role of the public library as an Internet and technology hub for the community it serves, local leadership across Puerto Rico is taking action. One such example is the Vega-Alta municipality, which has funded a project to create a public computing center in the local library.[25] The goal of the initiative is to help close the digital divide in that community by creating a public computing center, offering broadband connectivity and specialized information resources to the community. The initiative brings together public and private partners including local public government, local schools, and community advocacy groups, and private citizens working together to create this new public resource. The public computing center was inaugurated in 2008 and since then has developed outreach and training programs targeting demographics with high risk of exclusion, such as single mothers, drug addicts, homeless, HIV+ patients, the elderly, people with physical disabilities, and school dropouts. Digital literacy training is provided to help citizens understand the relevance and use of broadband and related technology.

## 4. Leveraging Information Technology in the Classroom

Intel Corporation and the Government of Puerto Rico have formed a public-private partnership to expand the scope of "Intel Teach" program to Puerto Rico, helping to bridge the digital gap by fully leveraging Information Technology in the classroom. The program is geared to improve teacher effectiveness through professional development, helping teachers integrate technology into their lessons, and promoting students' problem-solving, critical thinking, and collaboration skills. The main goal of the program is to increase access to technology in an effort to improve formative opportunities for the public school system, positioning them on more competitive footing in the shifting labor market. This public-private partnership was consolidated in January 2012 and is scheduled to provide training to approximately 21,000 public school teachers across Puerto Rico.

Puerto Rico's "Schools for the 21st Century" is a school modernization program that strives to improve the teaching and learning environments through addressing key design elements in each school.[26] One key element is integrating relevant education technology into the curriculum. School modernization would include ensuring high bandwidth broadband access, wireless access, increasing computer access in the library, providing two desktop computers in every room, integrating the use of electronic whiteboards, and providing access to other equipment such as digital cameras, video cameras, printers, and scanners as needed.

## 5. Other Programs Working to Bridge the Adoption Gap

Across Puerto Rico there exists 168 Centros Tecnologicos Comunitarios (CTC), or Community Technology Centers that were initially established via funding under a law for the integral development of the Special Communities of Puerto Rico, otherwise known as la Law Num. 1 of 2001 for "Comunidades Especiales." The objective for each CTC is to provide public computer access and training to all residents of disadvantaged communities throughout Puerto Rico. These disadvantaged communities were essentially defined by factors such as high unemployment rate, high percentage of population below the poverty level, and high percentage of school dropouts. Over time, the CTCs have been handed over for administration by the municipality, Department of Education, a public-private partnership or other entity and serve as a community resource.

**Table V.1 - Programs Across Puerto Rico Working to Bridge the Adoption Gap**

| Municipality | Program Name | Center Type | Training Focus | Support Organization | Target Population (average ages) | Community Impact (average #people / day) |
|---|---|---|---|---|---|---|
| Ceiba | Casa de la Juventud | Community Center | General computer/Internet utilization | Municipal Government | 13-29 | 20 |
| Caguas | Centro Criollo del Saber Bo. Borinquen | Community Center | General computer/Internet utilization | Municipal Government | Not Available | 11 |
| | Centro Criollo del Saber Bo. La Barra | Community Center | General computer/Internet utilization | Public/ Private Partnership | Not Available | 32 |
| | Centro Criollo del Saber Urb. Santa Elvira | Community Center | General computer/Internet utilization | Municipal Government | Not Available | 57 |
| | Centro Criollo del Saber Urb. Bairoa | Community Center | General computer/Internet utilization | Municipal Government | Not Available | 36 |
| | Centro Criollo del Saber Las Carolinas | Community Center | General computer/Internet utilization | Municipal Government | Not Available | 6 |
| | Biblioteca Pública Dr. Pedro Albizu Campos | Municipal Library | General computer/Internet utilization | Municipal Government | Not Available | 46 |
| | Centro Neurodigital Criollo | Community Center | General computer/Internet utilization | Public/ Private Partnership | Not Available | 259 |
| Barceloneta | Biblioteca Electrónica Municipal Sixto Electrónica | Municipal Library | General computer/Internet utilization | Public/ Private Partnership | 10-20 | 200 |

| Municipality | Program Name | Center Type | Training Focus | Support Organization | Target Population (average ages) | Community Impact (average #people / day) |
|---|---|---|---|---|---|---|
| Bayamon | Centro de Educacion digital La Morenita | Community Center | General computer/Internet utilization | N/A | 13-55 | 50 |
| | Centro de Educacion digital Dajaos | Community Center | General computer/Internet utilization | N/A | 8-55 | 40 |
| | Centro de Educacion digital Barrio Nuevo | Community Center | General computer/Internet utilization | N/A | 8-55 | 45 |
| | Biblioteca Dra. Pilar Barbosa | Municipal Library | General computer/Internet utilization | Municipal Government | 8-55 | 512 |
| Guayama | Biblioteca Electrónoca Municipal de Guayama | Municipal Library | General computer/Internet utilization | Municipal Government/ Dept of Education | 3-55 | 60 |
| | Casa de la Juventud | Community Center | General computer/Internet utilization - photo-journalism | Municipal Government | 13-29 | 35 |
| Humacao | Casa de la Juventud | Community Center | General computer/Internet utilization | Municipal Government | 13-29 | 30 |
| Lajas | Biblioteca La Parguera | Municipal Library | General computer/Internet utilization | Municipal Government | 13-60 | 60 |
| Manatî | Salón de los Poetas | Community Center | General computer/Internet utilization | Municipal Government | 10-55 | 30 |
| | Biblioteca Municipal | Municipal Library | General computer/Internet utilization | Municipal Government | 11-55 | 130 |
| Mayaguez | Casa de la Juventud | Community Center | General computer/Internet utilization - photo-journalism | Municipal Government | 13-29 | 25 |

| Municipality | Program Name | Center Type | Training Focus | Support Organization | Target Population (average ages) | Community Impact (average #people / day) |
|---|---|---|---|---|---|---|
| Orocovis | Centro Cibernético | Community Center | General computer/Internet utilization | Municipal Government | Starting at 12 | 80 |
| | Unidad Móvil de Educación Tecnológica | N/A | General computer/Internet utilization | Municipal Government | Starting at 12 | 60 |
| Rio Grande | Centro Cibernético | Community Center | General computer/Internet utilization | Public/ Private Partnership | Not Available | Not Available |
| San Juan | Casa de la Juventud | Community Center | 17 | Municipal Government | 13-29 | 25 |
| | Biblioteca Abelardo Díaz Alfaro | Municipal Library | General computer/Internet utilization | Municipal Government | Not Available | Not Available |
| | Biblioteca Electrónica Estudia Conmigo | Municipal Library | General computer/Internet utilization | Municipal Government | Not Available | Not Available |
| | Sala de Asistencia Tecnológica-Biblioteca Abelardo Díaz Alfaro | Municipal Library | General computer/Internet utilization | Municipal Government | People with disability and Elderly | Not Available |
| | Escuela Dr. Antonio S. Pedreira | School Facility | Non-traditional Education | Municipal Government | Not Available | Not Available |
| | Centros Tecnológicos Comunales in: Cupey, Las Monjas, Manuel A. Pérez, La Perla, Puerta de Tierra, Barrio Obrero, Bda. Figueroa, El Gandúl, Playita, Shangai, Campo Alegre, La Victoria, El Polvorín, La Marina, Villa Palmeras, Buen Consejo Jurutungo, Centro de Edad Avanzada de El Comandante, Centro de Educación Digital (PRT) en Río Piedras | Community Centers | General computer/ Internet utilization (some)<br>Educational programs<br>Outreach programs<br>Photo-journalism | Municipal Government | Not Available | Not Available |
| Santa Isabel | Univ.del Este | University Facility | General computer/Internet utilization | Public/ Private Partnership | 18-45 | Not Available |
| Toa Alta | Biblioteca Municipal | Municipal Library | General computer/Internet utilization | Municipal Government | 11-74 | 50% |

| Municipality | Program Name | Center Type | Training Focus | Support Organization | Target Population (average ages) | Community Impact (average #people / day) |
|---|---|---|---|---|---|---|
| Villalba | Centro Base Tecnología Informática | Community Center | General computer/Internet utilization | Public/ Private Partnership | 12-40 | 100 |
| | Centro Tecnología Informática Palmarejo | Community Center | General computer/Internet utilization | Oficina del Coordinador General para el Financiamiento Socioeconómico y la Autogestión | 11-50 | 15 |
| | Centro Tecnología Informática El Semil | Community Center | General computer/Internet utilization | Oficina del Coordinador General para el Financiamiento Socioeconómico y la Autogestión | 8-45 | 8 |
| | Centro Tecnología Informática Caonillas | Community Center | General computer/Internet utilization | Oficina del Coordinador General para el Financiamiento Socioeconómico y la Autogestión | 11-45 | 12 |
| | Centro Tecnología Informática Tierra Santa (Casa de la Juventiud) | Community Center | General computer/Internet utilization | Municipal Government | 13-29 | 30 |
| | Centro Tecnología Informática Cerro Gordo | Community Center | General computer/Internet utilization | Oficina del Coordinador General para el Financiamiento Socioeconómico y la Autogestión | 10-20 | 7 |

## D. Policy Recommendations to Promote Broadband Adoption

An examination of the broadband adoption and technology use across Puerto Rico reveals that there is a significant lag in the adoption and usage of broadband and IT across Puerto Rico. This lag is particularly acute across three demographic groups including: low-income residents, citizens with low levels of educational attainment, and senior citizens. Across these three groups, the core barriers to adoption are relevance of the benefits of the technology, affordability of the service and associated equipment, and sufficient digital literacy skills to be able to understand and use the technology.

Following the research and best practices of the federal government and other entities, including the Federal Communications Commission, and the Department of Commerce's BTOP Sustainable Adoption Grants, this Broadband Strategic Plan recommends the following normative recommendations for how to address these barriers across the most vulnerable populations in Puerto Rico.

### 1. Public Computing Capacity, Digital Literacy, and Workforce Development Programs

Puerto Rico private and public stakeholders should work together to leverage and expand public computing capacity across low-income communities. While the ultimate goal set in this Strategic Plan is to achieve universal adoption of broadband service across all households, establishing public computer centers in community centers, libraries, schools, churches or other community anchor institutions is an effective interim means to provide online access with limited resources and in short order to the maximum number of citizens.

In order for Puerto Rico non-adopters to find broadband valuable enough to subscribe, they need a basic knowledge of how to find and use substantive content. Digital literacy is an evolving concept. Though there is no standard definition, digital literacy generally refers to a variety of skills associated with using ICT to find, evaluate, create, and communicate information. According to the U.S. National Broadband Plan, it is the sum of the technical skills and cognitive skills people employ to use computers to retrieve information, interpret what they find, and judge the quality of that information.[27]

**Recommendation**:
Expand public computing capacity, digital literacy, and workforce development programs by leveraging existing community resources, support from national non-profit organizations, and public institutions such as the University of Puerto Rico campuses.

Researchers from the Social Science Research Council have found that community based organizations, such as libraries and non-profits, are key institutions in underserved and non-adopting communities – often providing Internet access, training, and support services even when those activities fall outside their traditional missions.[28] These organizations offer more than just free access to the Internet, they provide supportive environments for reluctant and new users to begin to explore the Internet, become comfortable using it, and develop the skills needed to find, utilize, and create content.[29] While the challenges and opportunities they face vary, these libraries and other community partners are critical to improving the digital proficiency in communities.[30] Table V.2 presents Puerto Rico's challenge. While Internet access at school and public community centers are comparable, only 3% of the Puerto Rico adults report accessing the Internet at the library, compared to 14% of all residents living in jurisdictions surveyed by Connected Nation.

**Table V.2 - Where Residents Access the Internet**

| Access Locations | Connected Nation Average | Puerto Rico |
|---|---|---|
| At home | 77% | 50% |
| Only access outside of home | 10% | 14% |
| At the library | 14% | 3% |
| At school | 6% | 7% |
| At a community center | 2% | 2% |
| No access at any location | 14% | 36% |

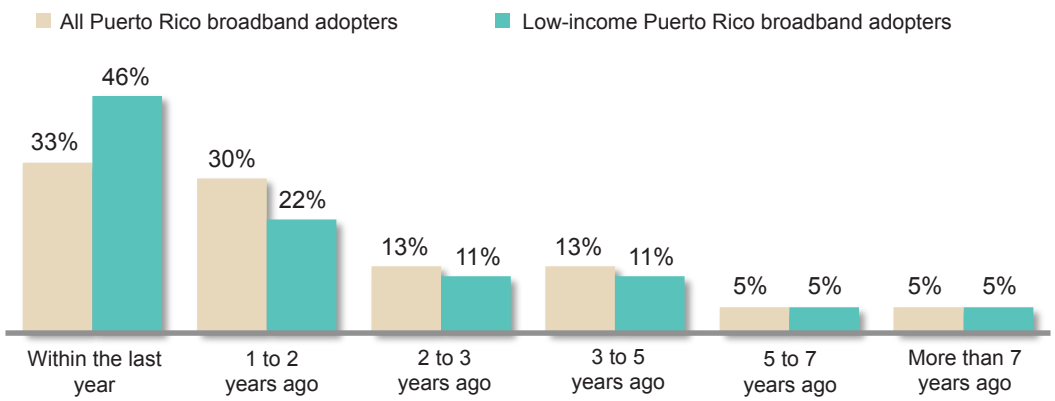
Where else do Puerto Rican residents access the Internet? Eleven percent report accessing the Internet at someone else's home; which is significantly higher than the Connected Nation average. In fact, more Puerto Rico Internet users report accessing the Internet at a friend or family member's house than they do anywhere else besides their own home. This statistic appears to affirm conclusions drawn by a study by the Social Science Research Council. Using qualitative research techniques to examine broadband adoption and use in context, particularly in low-income communities, their research examined the role that community plays in supporting digital literacy: non-adopters and new users often rely on the assistance of others to get online or get one-on-one support when they use the Internet.

This important social dimension to broadband adoption cannot be overlooked. The primary incentive for broadband adoption is communication – two-way communication through e-mail, social networking platforms, instant messaging, or video-chatting.[31] People find broadband relevant when the communities they care about are online, exchanging information and creating content.[32] Once online, individuals will stay online if they continue to find information and broadband applications that are useful and relevant to their lives and when the people around them do the same.[33]

The 2010 Connect Puerto Rico Residential Technology Assessment indicates that one-third of all Puerto Rico broadband adopters first subscribed to broadband within twelve months of being interviewed for the assessment (compared to the 15% Connected Nation average). Furthermore, nearly one-half of low-income Puerto Rico broadband adopters began subscribing within twelve months of being interviewed (Figure V.12). To ensure sustainable adoption among these new-adopters, greater efforts will be needed to expand digital literacy training and learning opportunities across vulnerable communities. New adopters may be behind in learning how to generate and share content, use social networking sites, and find resources aimed at their own interests.

Ultimately, broadband adoption and utilization are not about owning a specific piece of technology or subscribing to a service but about providing individuals and communities with the tools to build assets, to participate in their communities, and to increase their education and healthcare opportunities. Getting Puerto Rico's residents online is a crucial first step, but the goal must be to keep people online through sustainable efforts that promote utilization and help each user derive value from the Internet in their own way.

Figure V.12 - When Puerto Rico Residents First Subscribe to Broadband



Across Puerto Rico, this can be accomplished by leveraging existing private and public community assets, including those identified previously in this chapter. There is already a network of public computing centers that are serving the general public by providing free access to computers and the Internet. This capacity should be expanded and supported to ensure greater computing capacity, longer hours of operation, and fully leveraging those resources by providing digital literacy training, technology training, and workforce development training.

The University of Puerto Rico (UPR) can also be an important resource to leverage. The eleven campuses of the UPR are distributed across the island and have the necessary facilities to support public computing centers of this kind. Unlike K-12 schools, which have financial limitations that curtail their hours of operation, facilities across the UPR campuses have the necessary electric, workforce, and safety infrastructure to support a public computing center serving the general population on a 24 hour basis. Furthermore, the student body could be leveraged to provide outreach and digital literacy. These volunteer activities could be incentivized by instituting participatory credit time for students willing to teach technology oriented courses to members of their community outside of the University system. Outreach to communities surrounding the campuses can be accomplished by tapping into some of the community centers identified in the previous section as well as tapping in to other NGOs such as Boys and Girls Clubs, Aspira, and Centro para Puerto Rico, among others. The existing UPR broadband capacity can be leveraged to maximize teaching resources by simultaneously streaming the course to other areas of the island.

To ensure the most effective use of these resources and adjust programs and curricula to ensure greater impact across the community, all of these institutions should track their progress. Data should be collected on an ongoing basis measuring the number of citizens impacted, the hours of computer and capacity used, and student participation in training programs. Students who attend training courses should be tested for general technical knowledge before and after each course. After course completion and submission of tests and survey information, a certification will be awarded. Graduates of various training courses could then be eligible for programs that promote broadband and IT adoption by providing discounted offers to computers, consumer devices, and/or broadband service. A key metric that will need to be assessed is to what extent the training provided is encouraging broadband adoption in the home or via a personal mobile connection.

Mobile broadband is an effective and more affordable way to encourage participation in the Internet economy.

Leveraging ARRA funds, the U.S. Department of Commerce was able to fund a series of programs expanding Public Computing Centers and offering Digital Literacy plans at the local level under the Broadband Technology Opportunities Program (BTOP). One successful example of such programs is Every Citizen Online, a program managed by the non-profit Connect Ohio. The program brings together over 245 locations throughout the state, where BTOP resources were used to expand public computing capacity and facilitate a new and broader curriculum for digital training. The program is complemented with a traditional media outreach campaign targeting all citizens who have yet to adopt broadband usage. For more information on this program see http://connectohio.org/every-citizen-online

## 2. Mobile Broadband Usage

While the ultimate goal set by this Strategic Plan is to ensure that all Puerto Ricans have multiple access points to the Internet – in their schools, community institutions, places of work, homes, and in their pockets – so that they can fully leverage the power of online resources, promoting mobile broadband across low income segments of the population is an effective and more affordable way to encourage participation in the Internet economy.

Today, mobile smartphone devices and mobile tablets tend to cost less than desktop or laptop computers, especially if commercial offerings include financing for the customer device. Further, digital skills necessary to explore online resources are relatively easier to overcome through mobile devices than using more traditional computer technologies; and mobile broadband bundles that complement voice offers are generally less costly than home broadband options, making mobile broadband more affordable. In short, with lower barriers to adoption, mobile broadband solutions are fast becoming a key anchor to bring the disconnected online.

Mobile broadband service is often utilized as a complementary tool to access the Internet, rather than a substitute for fixed broadband access through a desktop or laptop computer. For the most part, broadband-connected individuals view mobile devices as an extension of their home broadband subscription; providing an additional, convenient, and portable access method. Thus, while mobile broadband empowers a low-cost alternative to online access, substituting mobile for fixed access can offer limitations – at least given today's technology. For example, they are not necessarily the appropriate means to research and write a term paper, or prepare and present a job application. Nonetheless, mobile broadband devices do offer a plethora of applications and usages that empower the user to take advantage of the online world. Further, mobile broadband service can be an effective conduit for previously disconnected citizens to start learning how to leverage online resources and become a bridge technology that may eventually be complemented with other forms of access to the Internet economy. Hence, promoting mobile broadband adoption to all citizens, particularly low income Puerto Ricans, can be the fastest means to overcome some of the key barriers to broadband adoption; including affordability of devices and service, relevance of the technology, and digital literacy limitations.[34] Puerto Rico's private and public stakeholders should work together to ensure that these opportunities are appropriately targeted across the more vulnerable populations.

The mobile broadband market in Puerto Rico is characterized by a healthy degree of competition, which has resulted in high mobile coverage penetration.[35] As mobile providers roll out their 4G service, it is important that low-income neighborhoods are not forgotten. The establishment of a public-private partnership to ensure that low-income communities are targeted by 4G build-out should be encouraged.

Further, efforts should be considered that would help reduce the cost of the service for low-income households. Pre-paid pricing packages for mobile voice services have proven to be a very effective marketing strategy to encourage low income citizens to adopt this technology. Mobile broadband providers should explore similar marketing strategies and other a la cart mobile broadband packages offering price-sensitive customers greater flexibility.

To complement such a strategy, efforts should be focused to help lower mobile broadband price points for low income populations. The FCC's Low Income Broadband Pilot program has this objective in mind. The pilot program will provide subsidies to low-income households for their broadband service. This pilot is expected to include projects targeting low-income households that use mobile broadband platforms, as well as fixed broadband platforms. Puerto Rico mobile providers should take advantage of this opportunity and work with the FCC to test the best means to leverage such programs across Puerto Rico.

Finally, schools can have an important role to play in this context. Mobile broadband connectivity is deemed an important component of the future K-12 education paradigm. Today's experts, working to define how technology should apply to education, are conceiving a world where each student is empowered with a wireless broadband device that will provide access to content and classroom interaction for the student in the classroom and outside of the school.

The FCC is currently implementing a pilot program to test how to best to implement this vision called Learning On-The-Go, which provides subsidies to finance a device for each student and financed the mobile broadband connection across 20 schools in the U.S.[36] This model, currently being assessed by education experts, would have a tremendous impact on rapidly helping to close the digital divide. Students under such a model will learn early on how to leverage the opportunities available to them online. As they do so, they will be able to teach their elders how to leverage these resources to advance their education, apply for a job, or otherwise look for opportunities enabled by the Internet.

**Recommendation**:
Aggressively promote mobile broadband usage, especially among low income and vulnerable populations, as an effective lower-cost and easier to access introduction to online resources.

## 3. Online Digital Literacy Curricula

There are multiple public, non-profit, and corporate portals that offer digital literacy training and work force development resources associated with ICT. Puerto Rico stakeholders should leverage these online resources to bring solutions to non-adopting citizens and communities. Examples of such public and private online portals abound, including the following:

- National Telecommunications & Information Administration digital literacy portal http://www.digitalliteracy.gov/
- Goodwill Community Foundation International online educational portal in English http://www.gcflearnfree.org/ and Spanish http://www.gcflatino.org/
- Aspira-Thinkfinity online educational content http://www.aspira.org/en/manuals/thinkfinity and online Youth Development Curriculum http://www.aspira.org/en/curriculo-para-el-desarrollo-de-liderazgo-en-la-juventud
- Connect Ohio, Every Citizen Online digital training portal - http://training.connectednation.org/landing?lang=es

**Recommendation**:
Leverage existing online digital literacy curricula.

## 4. Awareness and Outreach Campaign Showcasing the Benefits of Broadband

The private sector and non-profit community should partner to conduct an outreach and awareness campaign across Puerto Rico, aimed to showcase the benefits of broadband and online resources to citizens across the most vulnerable segments of society. Such outreach can be achieved through targeted marketing campaigns and Public Service Announcements aimed at showcasing the many benefits of broadband and the Internet to at-risk populations. Public and private partners should prioritize efforts to increase the relevance of broadband for low-income citizens as well as people with disabilities and older Puerto Ricans. Awareness and outreach plans should be customized to the targeted population. One size fits all will not work. Rather, each target audience needs to be addressed with particular, relevant messages, through the medium that conveys that message best.

Traditional media can be used for this purpose, as well as new tools that leverage popular commercial and TV outlets in Puerto Rico. For example, a network of booths providing live video streaming services in public institutions, such as safe commercial shopping malls and other public venues, can be used to raise awareness of the power of broadband. By interconnecting these public live video streaming venues, disparate points across the island could be virtually connected providing patrons free, real time connections with people in other parts of the island. As such, Vieques could become virtually connected with the center of San Juan, Ponce and beyond, allowing friends and family, or simply passersby to experience the power of broadband. Fully leveraged, this project could become an effective media tool to carry the message of the benefits broadband affords to the average Puerto Rico citizen. This momentum can be used to send a “connect to broadband” message to everyone.

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**Recommendation**:
Launch public-private targeted awareness campaigns promoting the benefits of online resources across vulnerable populations.

# Teleworking is a broadband-enabled solution benefiting both workers and employers and driving broadband expansion.

## 5. Promote Telework Across Puerto Rico Private and Public Sectors

Teleworking is a powerful example of the way broadband can affect our lives. Yet, across Puerto Rico teleworking is not a common practice. Connect Puerto Rico Business Technology Assessment Survey estimates that in Puerto Rico only 4% of employed adults report that they telework and 43% claim they would telework if allowed.[37] This suggests that there is great room for growth in teleworking across Puerto Rico. Important benefits can come to Puerto Rico through broadband-enabled telecommuting, including environmental benefits through reduction of the carbon footprint generated by commuting automobile traffic, reduction in commuting time and traffic congestion, or reduced need for office space and associated costs, such as electric power and water. Certain professions are natural fits for teleworking, and therefore enhanced productivity, such as statisticians, case workers, software developers, auditors, university students, and teachers.

Puerto Rico can accelerate the adoption of telecommuting practices by revising labor laws and policies that could be hindering the private and public sectors from allowing teleworking to become common practice. Further, as a key employer across the island, the Government of Puerto Rico can have an important impact on broadband usage and adoption by promoting teleworking practices throughout its workforce.

**Recommendation**:
Promote telework across Puerto Rico by revising labor laws and policies hindering its growth, and setting in motion plans to expand teleworking practices through the Puerto Rico government.

## 6. Leverage the Presence and Value of eGovernment Services

The government of Puerto Rico has invested heavily in developing online platforms through pr.gov supported services that provide to citizens, businesses, and other institutions access to government-related information and services. The digitalization of government-citizen transactions is important for Puerto Rico because it results in significant budgetary savings by lowering the cost of conducting business. Just as importantly, the expansion of eGovernment services across all levels of the Puerto Rico government structure will increase the value of the net to all Puerto Rico citizens and businesses, encouraging usage and access to the technology. Hence, accelerated expansion of the pr.gov portal is needed.

The power of eGovernment can also be leveraged by encouraging online citizen-government transactions in lieu of traditional means. Examples of such incentives include:

- Facilitate and eventually require that citizens apply for subsidized government services (public housing, educational, transportation, electricity, food, healthcare, etc.) electronically, via a broadband connection in their home, a public computing center, or in the government office itself.
- Encourage enrollment in local community digital literacy training centers for those citizens lacking basic IT skills.
- Offer a deduction or other benefits to citizens filing local and Puerto Rico taxes online.

**Recommendation**:
Leverage the presence and value of eGovernment services.

## 7. ICT Access and Use in the Classroom

As is discussed in Chapter VI of this Strategic Plan, the K-12 educational experience is a critical factor in overcoming the digital divide across Puerto Rico. It is imperative that the educational experience of Puerto Rico children today is adapted to fully leverage the IT and broadband technology of the twenty-first century in order to prepare Puerto Rico's future leaders, employment force, innovators and creators to compete and succeed in the global economy. It is imperative, therefore, that we overhaul and reinvent Puerto Rico's K-12 curriculum to ensure that broadband and online resources are fully leveraged to support student needs, and that graduates of the system have the necessary skills to succeed in the twenty-first century. We discuss in detail the goals and process of such transformation in Chapter VI. However, it is important to note that this transformation will be an essential strategy to quickly and effectively overcome the technology adoption gap across Puerto Rico.

**Recommendation**:
Accelerate ICT access and use in the K-12 classroom.

## 8. Promote Broadband Adoption Among Low Income Populations

Research shows that affordability of broadband services and associated computer or device equipment is a key barrier to broadband and technology adoption and usage, particularly across low income segments of the society. In order to overcome this barrier to adoption, efforts need to be made to lower the price point of the service and access technology to at-risk populations. This can be achieved through subsidies offered to targeted demographic groups providing discount for broadband service and/or IT equipment. These subsidies can be achieved if broadband providers and IT equipment vendors work in partnership with federal and Puerto Rico government resources. In particular, the private sector in partnership with public agencies including the Public Housing Authority, the Special Communities Administration, the Department of Labor, Economic Development, and the Department of Family Affairs should work together to establish programs geared to the most vulnerable across Puerto Rico offering basic entry broadband service at discounted prices.

An opportunity to complement these efforts exists through the FCC Low Income Broadband Pilot program, which is to be implemented in 2012. As part of the overall reform of the Low Income component of the Universal Service Fund (USF) program, the FCC is evaluating how to expand this program to include subsidies to low income households for broadband service.

The Lifeline USF program currently subsidizes voice-telephony services for households with earnings below a certain income benchmark across the entire nation. These subsidies are meant to ensure that all citizens, regardless of income, have access to the voice-telephony service. Puerto Rico low income citizens have directly benefited from this program in the past. In 2010, approximately $40 million was disbursed in Puerto Rico through this program.[38] The National Broadband Plan released by the FCC in 2010 called for the expansion of these subsidies to include broadband.[39] To achieve this goal, the FCC is implementing a pilot program aimed to test various policy options and obtain research information that can inform how best to structure a Low Income subsidy program for broadband service across the entire nation.[40]

The FCC has allocated a total of $25 million to fund a series of pilot programs across the nation in 2012. These funds will finance the administrative and research expenses associated with the pilot programs and provide the subsidy necessary to achieve a discount broadband offer to the targeted population. The discounted service will be available to households with income earnings below the income benchmark that currently applies for the Low Income, Lifeline subsidy program.

Broadband providers are encouraged to apply for this program and offer innovative models for how to effectively overcome the adoption barriers to broadband usage across low income demographics. The FCC is encouraging broadband provider applicants to include as part of their offering key components that will help overcome such barriers including a local digital literacy plan that will provide digital literacy and workforce development training, online digital literacy curricula, and a discounted offer for computer, notebook, or tablet devices.

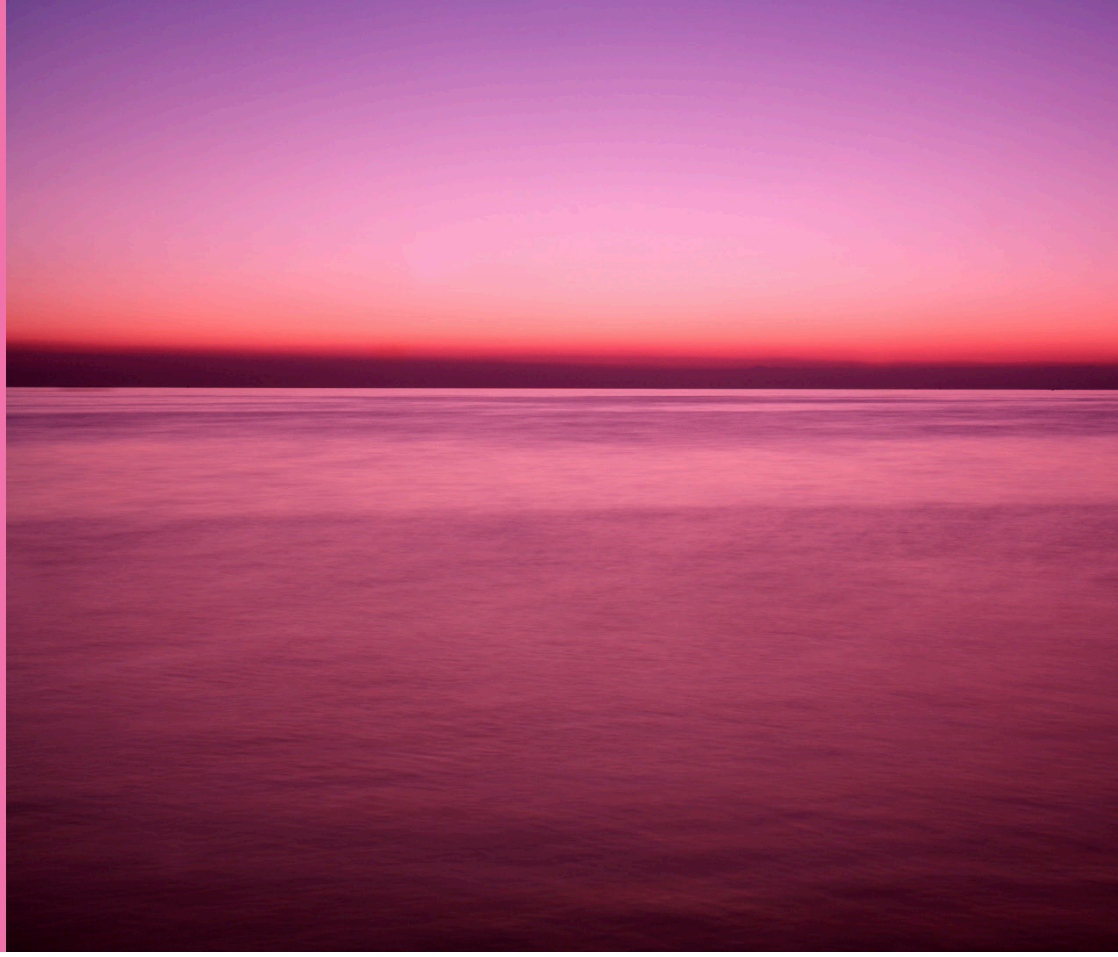
The FCC encourages broadband providers applying to the pilot program to partner with third parties succeeding in overcoming these barriers to adoption. In particular, the FCC encourages providers applying to the pilot program to partner with "successful BTOP/BIP grantees, those involved in "Connect to Compete," existing library programs or other entities currently providing broadband adoption and education services to low-income consumers in order to develop pilot projects that integrate federal universal service support into existing or planned adoption efforts."[41]

The Puerto Rico Broadband Taskforce strongly encourages multiple applications to this pilot program from various Puerto Rico stakeholders. To achieve this goal, the Puerto Rico Broadband Taskforce, in association with Connect Puerto Rico, is conducting educational outreach to key stakeholders regarding these pilot programs, and is working to encourage partnerships to support innovative and effective pilot applications. The expected time frame for submission of these applications will be in Q2 of 2012.

Beyond this important opportunity to help achieve discount offerings for broadband services to low-income households across Puerto Rico, the PR Broadband Taskforce will continue to research and encourage other models that will bring together private and public resources to effectively overcome the affordability challenge for broadband adoption across Puerto Rico.

**Recommendation**:
The private sector in partnership with public agencies including the Public Housing Authority, the Special Communities Administration, the Department of Labor, Economic Development, and the Department of Family Affairs should work to establish programs offering basic entry broadband service at discounted prices to the most vulnerable citizens in Puerto Rico.

**Recommendation**:
Work collaboratively with federal agencies to promote broadband adoption among low income populations.



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Note: This report indicates that U.S. broadband adoption rate is 68%. According to the National Broadband Plan, 98.9% of U.S. households have broadband available at basic speeds of 768 kbps download/200 Kbps upload (http://www.broadbandmap.gov/)

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# Chapter VI: Education

# A. Introduction

> *"Education is the key to America's economic growth and prosperity and to our ability to compete in the global economy. It is the path to good jobs and higher earning power for Americans. It is necessary for our democracy to work. It fosters the cross-border, cross-cultural collaboration required to solve the most challenging problems of our time."*[1]
>
> National Education Technology Plan, U.S. Department of Education

As the U.S. Department of Education recognizes, education is a key factor affecting economic growth, and the development of the knowledge base and technological advances needed to compete in a global economy. Education serves as a vehicle for strengthening the workforce and thus contributes to societal development and ensuring Puerto Rico's future competitiveness in a global market. It is the foundation for setting values and developing the skills and abilities to solve everyday challenges.

The broadband and IT revolution underway has perhaps nowhere greater impact than in the education sector. Broadband and IT has shifted basic education paradigms and is already transforming the way our children and young population learn and grow as well as the way educators facilitate the learning process. The K-16 of the twenty-first century will be markedly different from that of the twentieth century and it will afford new opportunities for its students. That transformation, however, will not take place on its own to ensure that all citizens, regardless of income level, place of dwelling, race, ethnicity or other factors have access to those opportunities.

Broadband-enabled education solutions, properly leveraged through the K-16 system, provide new opportunities to empower educators, parents, and students. Broadband expands teachers' instructional capabilities and boosts students' research and interactive opportunities beyond the confines of the physical classroom and the traditional school. It empowers students to learn and share with individuals beyond traditional circles and facilitates communication between educators and parents, which promotes engaged decision making regarding student needs and abilities. Online course material makes educational attainment more flexible and accessible to more people and can significantly expand the opportunities available to students within their local schools and universities, and help expand options available to students within confined budgetary conditions.

In turn, the expansion of broadband and IT usage across the K-16 system is a key demand driver for IT and broadband technologies. As these students learn through their school experiences the value of IT and online opportunities afforded by this technology, they will become active digital citizens. Today, those same students can help guide their parents and grand-parents on how this technology can impact their lives and livelihood, and help them overcome digital literacy barriers.

Technology is at the core of virtually every aspect of our daily lives. We must leverage it to provide engaging and powerful learning experiences and content.

The federal and Puerto Rico governments understand this challenge and have recognized that fully leveraging IT and broadband resources across the K-16 educational experiences requires a holistic approach and an ongoing transformational process.

The U.S. National Education Technology Plan (NETP) recognizes that "technology is at the core of virtually every aspect of our daily lives and work, and we must leverage it to provide engaging and powerful learning experiences and content, as well as resources and assessments that measure student achievement in more complete, authentic, and meaningful ways. Technology-based learning and assessment systems will be pivotal in improving student learning and generating data that can be used to continuously improve the education system at all levels. Technology will help us execute collaborative teaching strategies combined with professional learning that better prepare and enhance educators' competencies and expertise over the course of their careers."[2] The NETP presents a holistic approach to drive this transformational process across five intersecting areas:

i. **A new learning paradigm** - The NETP calls for a review of basic teaching paradigms and asks that we "focus what and how we teach to match what people need to know, how they learn, where and when they will learn, and who needs to learn. It brings state-of-the art technology into learning to enable, motivate, and inspire all students, regardless of background, languages, or disabilities, to achieve. It leverages the power of technology to provide personalized learning and to enable continuous and lifelong learning;"
ii. **Assessment** – The NEPT calls for the use of "data to drive continuous improvement" of our education practices;
iii. **Teaching** - The NEPT recognizes that to fully achieve this transformation, teachers need to be supported in learning how to use the technology to help their students achieve success and calls for "using technology to help build the capacity of educators by enabling a shift to a model of connected teaching. In such a teaching model, teams of connected educators replace solo practitioners, classrooms are fully connected to provide educators with 24/7 access to data and analytic tools, and educators have access to resources that help them act on the insights the data provide;"
iv. **Infrastructure** – The NEPT recognizes that "an essential component of the learning model is a comprehensive infrastructure for learning that provides every student, educator, and level of our education system with the resources they need when and where they are needed. The underlying principle is that infrastructure includes people, processes, learning resources, policies, and sustainable models for continuous improvement in addition to broadband connectivity, servers, software, management systems, and administration tools. Building this infrastructure is a far-reaching project that will demand concerted and coordinated effort."

# The Department of Education Technology Plan aims to ensure that students and teachers will be technologically literate and able to use technology tools.

v. **Productivity** – The NEPT understands that to "achieve our goal of transforming American education, we must rethink basic assumptions and redesign our education system. We must apply technology to implement personalized learning and ensure that students are making appropriate progress through our P–16 system so they graduate."[3]

Building upon the U.S. National Education Technology Plan, the Puerto Rico Department of Education's Technology Plan of 2010 (PRETP) sets in motion a holistic approach to jump-start this transformation across the island.[4] The PRETP's stated goal "ensures that students and teachers will be technologically literate and able to use technology tools to expand and improve the teaching and learning processes." The role of technology in education is summarized as follows:

> "By providing optimal conditions, such as a curriculum wholly permeated by crosswise integration of technology; on-going, sustained and intensive professional development; effective parental and community involvement in the educational process, access to technological educational resources, and decision making based on tangible data, students will be able to use technology effectively and ethically in learning, creating, solving problems, doing research, making decisions and communicating, thus taking on the responsibility of their own learning."[5]

To achieve this vision, the PRETP is structured around five key areas, including: "integration of technology in the curriculum, professional development, providing a technology-rich learning environment and support, community and parent involvement, data-driven decision making and accountability."[6]

The Puerto Rico Broadband Taskforce embraces the federal and Puerto Rico visions for a twenty-first century K-16 education and strongly supports efforts at the federal and local levels to continue testing new ideas and developing new models that enable this transformation. Building upon this work, as well as upon the research conducted by the Federal Communications Commission (FCC) in its 2010 National Broadband Plan review of the challenges faced in the education sector as ICT opens new opportunities,[7] the Puerto Rico Broadband Taskforce calls for a holistic approach across Puerto Rico for the expansion of broadband and IT in the education sector that includes the following goals:

**Strategic Goals for Puerto Rico - Education**

All K-16 institutions will have sufficient broadband capacity available to sustain always-on learning opportunities in every school, teacher's and administrator's office, classroom, and on each student's desk and backpack.

To enable this vision:

- Every K-16 institution should have access to 100 Mbps speed by 2015 and 1 Gbps speed by 2020.
- All students will have the means to access always-on online learning opportunities in and outside of the classroom. To enable this vision, all students will need to have wireless devices that are fast, robust, and safe and that can support the student's learning experience beyond the classroom.
- A technology curriculum will be developed for every stage of the K-16 learning experience that is adjusted to the changing technology environment and ensures students are developing the necessary IT-literacy skills to fully leverage online resources in a safe environment.
- Continued development of a teaching work force that has the necessary skills to fully leverage broadband and IT technology in and outside of the classroom.

This chapter reviews existing data to assess to what extent Puerto Rico meets these goals today, and proposes a series of recommendations aimed at complementing ongoing work of the Puerto Rico Department of Education.

## B. Broadband and Education Across Puerto Rico

### 1. Broadband Connectivity Across Puerto Rico K-12 Public Schools

In 2011, the broadband capacity under contract for Puerto Rico public schools was drastically below the connectivity goals stated by the FCC's National Broadband Plan, and fell well short of the capacity goals recommended by the PRBT, namely: access to 100 Mbps download capacity by 2015, and 1 Gbps by 2020. In all but one of the seven school regions of Puerto Rico, the median broadband capacity contract across all public schools in 2011 was 512 Kbps download and 1.5 Mbps upload maximum speeds. In the region of Arecibo broadband contracts tend to offer a more symmetric download/upload service, but are still drastically below stated goals (Table VI.1).

# The broadband capacity under contract across Puerto Rico public schools is drastically insufficient to meet the school connectivity goals of 1 Gbps.

**Table VI.1 - Broadband Service Across Puerto Rico Public Schools - By School Region**

| School Region | Total Number of Schools | Percentage of Rural Schools | Percentage of Schools Served by DSL | Percentage of Schools Served by Frame Relay | Percentage of Schools Served by Other Platform | Median Broadband Download Speed Contracted | Median Broadband Upload Speed Contracted |
|---|---|---|---|---|---|---|---|
| Arecibo | 202 | 63.4% | 48.5% | 50% | 1.5% | 1.5 Mbps | 1.5 Mbps |
| Bayamon | 192 | 45.8% | 65.1% | 34.9% | 0% | 512 Kbps | 1.5 Mbps |
| Caguas | 227 | 56.8% | 67% | 32.6% | 0.4% | 512 Kbps | 1.5 Mbps |
| Humacao | 209 | 61.2% | 63.6% | 35.9% | 0.5% | 512 Kbps | 1.5 Mbps |
| Mayaguez | 234 | 63.5% | 62% | 37.6% | 0.4% | 512 Kbps | 1.5 Mbps |
| Ponce | 234 | 54.7% | 55.1% | 44.4% | 0.4% | 512 Kbps | 1.5 Mbps |
| San Juan | 218 | 19.3% | 83.9% | 16.1% | 0% | 512 Kbps | 1.5 Mbps |

Source: Puerto Rico Department of Education, 2011.

None of the public schools in Puerto Rico were served by fiber-optic networks, the only technology today able to sustain symmetric broadband capacity of 1 Gbps, or even 100 Mbps. The technology platform most commonly used to provide broadband services across Puerto Rico public schools is DSL service and frame relay service. Both of these technologies are woefully inadequate to sustain the broadband connectivity vision laid out by the National Education Technology Plan where, ultimately, every administrator, every teacher, every classroom, and every student will have direct access to a safe online experience. This school capacity gap is endemic across the island and affects both rural and urban schools.

To address this from the policy perspective, we need to understand what drives this low broadband connectivity across Puerto Rico's public schools. Is it lack of faster broadband connectivity? Or is the broadband there, but not being leveraged?

Table VI.2 provides some insights into these questions. Contrasting the school connectivity information with Connect Puerto Rico's broadband inventory data available to residential customers across each municipality, suggests that there are municipalities where broadband is available at speeds as high as 10 Mbps, yet schools in those areas are not taking advantage of this opportunity. In short, while lack of high-capacity broadband backhaul infrastructure remains a key barrier to achieve more robust connectivity for schools across some parts of Puerto Rico, the challenge in Puerto Rico is not solely one of broadband inventory capacity. Many public schools are not contracting faster broadband capacity even when available.

| Table VI.2 - Broadband Service Across Puerto Rico Public Schools - By Municipality | | | | | | |
|---|---|---|---|---|---|---|
| Municipality | School Region | Number of Schools | Median Contract Download Speed | Median Contract Upload Speed | Highest Broadband Speed Available - Residential Market* | Median Household Income |
| Adjuntas | Ponce | 12 | 1.5 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $11,983 |
| Aguada | Mayaguez | 21 | 1.5 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $14,103 |
| Aguadilla | Mayaguez | 25 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up 0.4% | $13,956 |
| Aguas Buenas | Caguas | 18 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $14,751 |
| Aibonito | Caguas | 14 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $15,487 |
| Anasco | Mayaguez | 12 | 1 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $15,244 |
| Arecibo | Arecibo | 34 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $16,564 |
| Arroyo | Caguas | 10 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $14,815 |
| Barceloneta | Arecibo | 12 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $16,124 |
| Barranquitas | Caguas | 16 | 1Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $14,751 |
| Bayamon | Bayamon | 68 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $25,294 |
| Cabo Rojo | Mayaguez | 16 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $15,809 |
| Caguas | Caguas | 39 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $22,951 |
| Camuy | Arecibo | 15 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $14,985 |
| Canovanas | Humacao | 16 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $21,934 |
| Carolina | San Juan | 45 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $28,262 |
| Catano | Bayamon | 13 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $18,144 |
| Cayey | Caguas | 23 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $19,040 |
| Ceiba | Humacao | 10 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $18,461 |
| Ciales | Arecibo | 13 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $13,564 |
| Cidra | Caguas | 20 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $21,293 |
| Coamo | Ponce | 19 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $15,028 |
| Comerio | Caguas | 16 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $12,927 |
| Corozal | Bayamon | 15 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $14,077 |
| Culebra | Humacao | 2 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $19,868 |
| Dorado | Arecibo | 12 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $25,473 |
| Fajardo | Humacao | 9 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $19,803 |
| Florida | Arecibo | 12 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $16,246 |
| Guanica | Ponce | 12 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $11,870 |
| Guayama | Caguas | 24 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $17,214 |
| Guayanilla | Ponce | 11 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $14,243 |
| Guaynabo | San Juan | 23 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $33,279 |
| Gurabo | Caguas | 16 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $27,416 |
| Hatillo | Arecibo | 15 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $16,246 |
| Hormigueros | Mayaguez | 21 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $19,834 |
| Humacao | Humacao | 24 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $18,354 |
| Isabela | Mayaguez | 19 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $13,028 |
| Jayuya | Ponce | 14 | 1.5 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $15,556 |
| Juana Diaz | Ponce | 21 | 1.5 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $16,496 |
| Juncos | Humacao | 15 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $17,694 |
| Lajas | Mayaguez | 12 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $14,500 |
| Lares | Arecibo | 18 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $12,199 |
| Las Marias | Mayaguez | 8 | 1.5 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $13,847 |
| Las Piedras | Humacao | 18 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $17,680 |

| Municipality | School Region | Number of Schools | Median Contract Download Speed | Median Contract Upload Speed | Highest Broadband Speed Available - Residential Market* | Median Household Income |
|---|---|---|---|---|---|---|
| Loiza | Humacao | 10 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $19,460 |
| Luquillo | Humacao | 14 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $19,672 |
| Manati | Arecibo | 17 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $16,564 |
| Maricao | Mayaguez | 6 | 1 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $10,932 |
| Maunabo | Humacao | 11 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $15,225 |
| Mayaguez | Mayaguez | 21 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $14,059 |
| Moca | Mayaguez | 17 | 1.5 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $12,841 |
| Morovis | Bayamon | 16 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $13,646 |
| Naguabo | Humacao | 13 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $15,250 |
| Naranjito | Bayamon | 15 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $14,275 |
| Orocovis | Bayamon | 16 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $13,713 |
| Patillas | Humacao | 12 | 1 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $14,860 |
| Penuelas | Ponce | 15 | 1.5 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $14,872 |
| Ponce | Ponce | 76 | 512 Kbps | 1.5 Mbps | 6 Mbps down/ 1.5 Mbps up | $16,902 |
| Quebradillas | Arecibo | 10 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $11,943 |
| Rincon | Mayaguez | 7 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $16,067 |
| Rio Grande | Humacao | 16 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $20,850 |
| Sabana Grande | Mayaguez | 10 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $15,497 |
| Salinas | Caguas | 21 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $13,118 |
| San German | Mayaguez | 05 | 1.5 Mbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $15,016 |
| San Juan | San Juan | 130 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $23,478 |
| San Lorenzo | Humacao | 20 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $17,477 |
| San Sebastian | Mayaguez | 24 | 1 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $12,115 |
| Santa Isabel | Ponce | 12 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $17,605 |
| Toa Alta | Bayamon | 18 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $25,133 |
| Toa Baja | Bayamon | 23 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $23,297 |
| Trujillo Alto | San Juan | 20 | 512 Kbps | 1.5 Mbps | 6 Mbps down/1.5 Mbps up | $30,825 |
| Utuado | Ponce | 16 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $13,509 |
| Vega Alta | Arecibo | 12 | 512 Kbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $16,608 |
| Vega Baja | Arecibo | 24 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $16,530 |
| Vieques | Humacao | 8 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $16,220 |
| Villalba | Ponce | 15 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $15,455 |
| Yabucoa | Humacao | 21 | 1.5 Mbps | 1.5 Mbps | 10 Mbps down/768 Kbps up | $16,894 |
| Yauco | Ponce | 27 | 512 Kbps | 1.5 Mbps | 768 Kbps down/200 Kbps up | $14,314 |

* Residential broadband inventory includes all terrestrial platforms except for mobile service.
Source: Public school broadband connectivity, Puerto Rico Department of Education, 2011. Residential broadband capacity, Connect Puerto Rico, June 2011. Median household income, American Community Survey, 5 year estimates, 2006-2010.

The percentage of Puerto Rico residents who access online education (38%) resources is significantly lower than the Connected Nation average (52%).

## 2. The Education Digital Gap In Puerto Rico

To fully achieve the benefits of broadband and IT in the education sector, it is necessary that each K-16 student has 24/7 robust and safe online educational resources. Achieving universal, robust and safe access for each student and teacher within the confines of the school, community college, or university is not enough. The educational paradigm of the twenty-first century calls for an always-on, much broader access to online educational resources and experiences, which must include access in the home.[8]

To meet the education technology goals, all households must have access to broadband and the willingness and necessary tools and knowledge to connect to a broadband network from their homes, or from mobile devices. As has been described in detail in Chapter III of this Strategic Plan, the digital gap across the Puerto Rico residential market is acute. In 2010, only 31% of all Puerto Rico households subscribed to a broadband service, representing a significant lag with other developed nations. Further, the average speed of these residential subscriptions is relatively slow and insufficient to meet the increasing demand for broadband capacity driven by the ever-increasing expansion of bandwidth-intensive online applications.[9]

As online education applications rapidly extend educational opportunities outside of the classroom, a vicious cycle expanding the gap across the digital have- and have-nots is exacerbated. Students with access to broadband at home may develop an advantage over those students who can only access these resources at their public schools and libraries, furthering the effects of the digital divide. Data indicates that the residential digital gap across Puerto Rico is already driving this vicious cycle.

According to Connect Puerto Rico's 2010 Residential Technology Assessment,[10] 38% of Puerto Rico's residents utilize online education applications; a percentage that is significantly less than the 52% average reported by residents living in jurisdictions surveyed by Connected Nation.[11] In Puerto Rico, this includes 36% of residents who used the Internet to conduct research for schoolwork, 12% of residents who utilized the Internet to communicate with teachers, and 7% who pursued online classes (Table VI. 3).

**Table VI.3 - Percentage of All Residents who Utilize Online Education Applications**

| Among all residents | Connected Nation Average | Puerto Rico Average |
|---|---|---|
| **Use any e-Education application** | **52%** | **38%** |
| Research for schoolwork | 39% | 36% |
| Communicate with teachers | 32% | 12% |
| Take online classes | 20% | 7% |

Among Puerto Rico households with children, usage of online education applications increases dramatically, but is still significantly lower utilization than reported among other U.S. jurisdictions surveyed by Connected Nation. Connect Puerto Rico's research indicates that in 2010, 58% of Puerto Rico's households with children utilized online education applications; in comparison, 73% of households with children surveyed by Connected Nation in 2010 reported utilizing online education resources (Table VI. 4). Interestingly, while Puerto Rico's utilization of the Internet to complete research for schoolwork is consistent with the Connected Nation average, other applications such as communicating with teachers online and taking online classes remains significantly less than the Connected Nation average. For example, more than one-quarter of households with children (27%) located in jurisdictions surveyed by Connected Nation report taking classes online; while only 8% of Puerto Rico's households with children report doing so.

**Table VI.4 - Percentage of Households with Children who Utilize Online Education Applications**

| Among households with children | Connected Nation Average | Puerto Rico Average |
|---|---|---|
| **Use any e-Education application** | **73%** | **58%** |
| Research for schoolwork | 58% | 55% |
| Communicate with teachers | 50% | 12% |
| Take online classes | 27% | 8% |

This gap is not solely driven by Puerto Rico's lower residential broadband adoption rates. Analysis of broadband-connected households delivers interesting results. When compared to the Connected Nation average, broadband-connected households in Puerto Rico are actually more likely to utilize the Internet to complete research for schoolwork (Table VI.5). However, broadband-connected households are significantly less likely to communicate with their teachers or take online classes. These findings could suggest that, rather than Puerto Rico's residents being hesitant to adopt and utilize online education resources, instead, Puerto Rico educational institutions are lagging in their offering of online content and applications. For example, students with a home broadband subscription do not rely on a Puerto Rico based education provider for online research tools, as these services are provided by numerous web-based services. However, services that would commonly be delivered by Puerto Rico based educational institutions (online classes or teacher-parent and teacher-student communication) are not being offered.

**Table VI.5 - Percentage of Broadband-Connected Households who Utilize Online Education Applications**

| Among broadband-connected households | Connected Nation Average | Puerto Rico Average |
|---|---|---|
| **Use any e-Education application** | **65%** | **64%** |
| Research for schoolwork | 49% | 60% |
| Communicate with teachers | 42% | 22% |
| Take online classes | 26% | 16% |

This gap persists among Puerto Rico's broadband-connected households with children. Whereas eight out of ten broadband-connected households with children located in jurisdictions surveyed by Connected Nation report utilizing an e-Education application (including 57% who communicate with teachers and 31% who take online classes), only 68% of similar households in Puerto Rico report doing so (including 16% who communicate with teachers and 13% who take online classes) (Figure VI.6).

**Table VI.6 - Percentage of Broadband-Connected Households with Children who Utilize Online Education Applications**

| Among broadband-connected households with children | Connected Nation Average | Puerto Rico Average |
|---|---|---|
| **Use any e-Education application** | **80%** | **68%** |
| Research for schoolwork | 63% | 62% |
| Communicate with teachers | 57% | 16% |
| Take online classes | 31% | 13% |

Broadband can be an important tool to help educators, parents, and students meet major challenges in education. Such opportunities will be fully leveraged only if all parents and students have the capacity, knowledge, and willingness to connect to broadband in their homes. If the digital gap is not closed, Puerto Rico's education system may be at risk of falling behind. Chapter V of this Strategic Plan discusses in depth the broadband adoption gap across Puerto Rico and proposes a series of recommendations to help close this gap. Such efforts must be built in coordination and collaboration with efforts to close the digital gap across Puerto Rico K-16 educational institutions.

## 3. Educational Technology Reforms Underway

Recognizing the importance of investment in education, the Government of Puerto Rico has launched an aggressive plan to modernize the island's public schools through the 21st Century Initiative. This initiative is a comprehensive, island-wide school modernization program that is investing $756 million to transform over 100 public schools to benefit students, parents, educators, and communities. The initiative is based on a unique public-private partnership to leverage the government's investment in creating a modern school environment and a better educational model - improving the lives of tens of thousands of students and teachers in the process. This 21st Century Initiative is one key step necessary to address the challenges of a modern, twenty-first century education system. These structural reforms are complemented through multiple efforts across the Department of Education, higher-education community, and private stakeholders to tackle concomitant reform challenges necessary to fully leverage broadband and ICT to empower our children for a better future.

### *a. Reforming K-12 Educational Technology Usage in Puerto Rico*

At the K-12 level, the Puerto Rican government is currently developing and implementing plans to provide resources for:

- The integration of technology into the curriculum,
- An assurance of continuous professional development opportunities for teachers,
- Offering parental and community involvement and capacitation on matters related to technology so that they are digital citizens,
- Providing greater access to technological resources in all schools, every classroom, and for each student in the system,
- Assuring that students are critical thinkers capable of using technology in a creative and responsible manner for problem solving.

The Puerto Rico Department of Education (PRDE) has been developing and implementing a series of initiatives and projects directed to two major objectives: Reinforce and revamp the technology infrastructure in schools and all the dependencies of the agency and promote the integration of technology to the curriculum through the continuous training of teachers and administrative personnel and the provision of access to technology to teachers, students, and their parents.

The Internet service and maintenance of the network infrastructure is included in the PRDE 2012 eRate funding application. This federal program pays up to 90% of the total Internet and telephone services, basic maintenance of network infrastructure, and internal connections required for schools. The PRDE has developed a plan to gradually expand the Internet bandwidth of all the schools in Puerto Rico. In 2012, a total of 692 schools will be upgraded to 3 Mbps. These schools were selected based on the usage demonstrated in the monitoring reports and their inclusion in academic integration projects.

Moreover, in 750 schools up to three classrooms with 25 computers will be connected with a terminal server that will enable teachers and students to access materials and information and participate in collaborative projects with students from others schools in Puerto Rico and around the globe. Access to other areas of these schools will be granted through the installation of additional drops and access points. Through the eRate application the remaining schools will be included in a similar effort. These schools will be able to take advantage of projects like the Intel Teach Program, Operación Éxito, and other important initiatives designed to enhance the academic achievement of students. This effort will also help maximize the Electronic Libraries Initiatives that is already implemented in more than 167 schools around the island.

The 21st Century Schools program is an effort of the current administration to remodel more than 100 schools. This effort is directed toward the renewal of the physical and the academic strategies in the school in order to change the whole approach of education, moving it forward to the new concepts of the twenty-first century. As part of this new strategy, emphasis is on Internet access through the whole school and the use of mobile devices (laptops, netbooks, and tablets) that will help support strategies of collaboration and the use of open spaces. These schools will have 10 Mbps bandwidth and will be the first ones that offer Internet access to the surrounding community.

On the other hand, the Technology and Curriculum Unit is in charge of the initiatives in the Department of Education that integrate the use of technology into the curriculum and instruction in order to improve and enhance efforts toward academic achievement and accountability. These efforts are expected to ensure the implementation of powerful instructional practices in the delivery of course content, assessment, and state standards and expectations. Some of these projects include:

- CeL (Cursos en Línea / Online Courses) – CeL is an innovative project that offers distance courses in various subject matters to students from 10th to 12th grade.
- CITeD (Centros de Innovaciones Tecnológicas para la Docencia / Technology Innovation Centers for Educators) – These centers provide support in areas related to the use of technology in the educational process.
- CENIT (Centro de Iniciativas Tecnológicas / Technological Initiative Centers) – These centers contribute to the development of the infrastructure and the academic content areas through professional development activities and the provision of technological resources.
- EE (Editorial Electrónica / Electronic Press) – Creates and develops multimedia productions to satisfy the need for reference materials to supplement and enrich the curriculum.
- TEEE (La Televisión como Estrategia Educativa Efectiva / Use of the television as Effective Educational Strategy) – This strategy integrates the use of the television as a resource to enhance the teaching learning process.
- PVAD (Plataforma Virtual de Alfabetización Digital / Digital Literacy Virtual Platform) – The primary purpose of this initiative is to develop competencies related to digital literacy in teachers and 8th grade students as required by federal mandate.

### *b. The Role of Higher Education*

Higher education is to be viewed as a focal point impacting all facets of the development of digital literacy. It is the role of higher education institutions to provide students, alumnae, and faculty with effective access to technological information resources and training to strengthen their information competencies.

Higher education trains the future work force of Puerto Rico, offering training on discipline-specific technological knowledge. It is through higher education that teacher candidates are trained; it is the teacher candidates who will go on to educate K-12 students as digital users and serve as facilitators for parent and community literacy on technological matters. At the same time, higher education institutions serve as providers of professional development initiatives related to information technology for current teachers. Many higher education systems make use of their community service initiatives to offer their surrounding communities technological centers and develop activities geared at achieving an increased awareness of the need for digital citizenship. Finally, universities offer access to the Internet across their campuses to assure that learning through technology surpasses the physical limits of the classroom. Thus, it is necessary to provide broadband access for all research centers, meeting and study areas, libraries, and laboratories. Finally, it is through the higher education system that continuous technological knowledge and advances are achieved (Figure VI.1).

Figure VI.1 - Higher Education's Impact on Developing an Information Literate Community

Hence, it is necessary to implement a new approach to research and development (R&D) in education focusing on identifying innovative best practices in integrating technologicaly driven learning experiences, and transferring existing and emerging technology innovations into education. Thus an enhanced broadband infrastructure further promotes the development of R&D proposals for education to be funded externally, while strengthening current initiatives underway. This in turn implies an opportunity to further develop science and technology programs at the higher education level, while impacting the K-12 system with a more technology literate faculty. By promoting aggressive broadband expansion across Puerto Rico, we will open the possibility to adopt the NETP model of learning powered by technology, with goals and recommendations in five essential areas: learning, assessment, teaching, infrastructure, and productivity.

***c. Reform of Teacher Accreditation***

Higher education in Puerto Rico is regulated by the accreditation of the Middle States Commission on Higher Education (MSCHE). To comply with accreditation requirements, institutions must meet 14 standards of various natures, many of which emphasize technology integration to the curriculum.

Specifically, accreditation requirements on technology include:

- Assurance that, upon degree completion, students are proficient in technological competencies appropriate to their discipline.
- Evidence that institutions have articulated expectations of student learning outcomes for information literacy and technological competence.
- Evidence that institutional support resources include the necessary technological infrastructure for instruction, the delivery of optimal student support services, and administrative processes.
- Evidence that institutions are providing learning opportunities that afford students with the ability to understand the economic, legal, and social issues surrounding the use of information and information technology (i.e., digital citizenship).
- Evidence that institutions are providing both students and instructors with the knowledge, skills, and tools needed to use the information, new technology, and media for their studies, teaching, or research.
- Evidence that institutions are offering periodic updating or retraining as information technologies emerge.

The integration of technology for instruction and assessment is also a key element of the requirements outlined by the National Council on the Accreditation of Teacher Education (NCATE). It is the accrediting agency's expectation that institutions that offer Teacher Preparation Programs are committed to preparing candidates who are able to use educational technology. As such they must provide the necessary instruction and assess students' knowledge, skills, and dispositions for integrating technology in their practice and facilitate student learning through the integration of technology. It is also required that the field experiences offered at K-12 schools have the necessary infrastructure so that candidates can use technology to support teaching and learning. Faculty offering instruction to teacher candidates must also be technologically literate and integrate technology into their own teaching. Finally, it is expected that Teacher Preparation Programs have adequate information technology resources to support both their faculty and candidates.

All of the aforementioned technological requirements for the K-16 environment rely primarily on fast and reliable broadband access. The Puerto Rican K-16 education system needs to be revamped by the broadband-enabled learning revolution to meet its responsibilities along with accreditation requirements. By doing so, the children, college students, community, and professionals seeking development experiences, can benefit from the advantages afforded by advances such as the use of digital textbooks. This is an opportunity to acquire knowledge through lessons personalized to students' learning styles and aptitudes while offering real-time data and feedback to parents and teachers. By immersing the people of Puerto Rico in this technology agenda, teachers, students, parents, and the community at large will not only have state-of-the-art technology at school, but they will have access at the community and at home. What does this mean? That access to digital literacy will not be limited to the classroom, it will be present in every aspect of a learner's life, thus reinforcing continuous learning.

## C. Policy Recommendations to Accelerate Adoption and Usage of Broadband and ICT Solutions In Education

### 1. Promote a Collaborative Effort Across Government Agencies and Private Stakeholders

Making the vision of the National and Puerto Rico Education Technology Plans a reality will take time, many iterative stages, and involve multiple Puerto Rico government agencies, private stakeholders, and coordination with federal agencies. Implementing this vision includes reforms in teacher accreditation plans, revisions of K-16 technology curriculum, a complete reevaluation of the role of the textbook in the learning process, development of electronic curricula and content, a revamping of electricity and broadband infrastructure across all schools to ensure a level of connectivity, energy backup sufficient to meet the IT needs of the twenty-first century school, innovative approaches to ensure that all students have adequate devices to access all of these resources, etc.

The challenge is great; the opportunity even greater.

Leading this process in Puerto Rico is the Department of Education and the process set in place in its Education Technology Plan of 2010. Other government agencies are part of this process, as well as private stakeholders, including the broadband provider community and companies in the IT sector across Puerto Rico. The Puerto Rico Broadband Taskforce extends a collaborative hand to the Department of Education as it implements this program. Specifically, the Puerto Rico Broadband Taskforce can support this initiative by helping coordinate and plan for the expansion of broadband capacity supporting our schools' IT needs.

**Recommendation**:
Promote a collaborative effort across government agencies and private stakeholders

## 2. Leverage the Demand for Broadband Across Education Institutions to Promote Competition and Investment in Broadband Service

Demand for broadband capacity across the approximately 1,500 public schools and higher-education institutions in Puerto Rico constitutes a key segment of the overall demand for broadband across Puerto Rico community anchor institutions. The purchasing power of this collective, managed by the Department of Education, should be leveraged to help promote greater competition in the broadband market and drive increased investment in backhaul and last mile broadband capacity.

For example, where broadband capacity is lacking at the local level, school districts should be empowered to seek partnerships with other local high-capacity demand institutions, including local civic leaders, government entities, public safety agencies, libraries, hospital or clinics, in a coordinated effort to aggregate local demand needs for increased broadband capacity and service. By aggregating demand within a local community, these institutions will be able to demonstrate to interested broadband providers existing pent-up demand and help justify private investments to bring greater capacity backhaul service to that community. That increased backhaul capacity can in turn benefit the whole community.

**Recommendation**:
Leverage the demand for broadband across education institutions to promote competition and investment in broadband services

## 3. Develop Plans to Achieve a Computer-Per-Teacher and Device-Per-Pupil Goal

These devices should have appropriate software and resources for research, communication, multimedia content creation, and collaboration for use in and out of school. This goal, set forth by the National Education Technology Plan, presents a great challenge for Puerto Rico. As Chapter III of this Strategic Plan documents, with only 31% of homes subscribing to broadband in 2010, the residential broadband adoption rate in Puerto Rico is significantly lagging behind many other developed economies, including all states across the U.S. According to research conducted by Connect Puerto Rico, an estimated 443,000 children in Puerto Rico do not have access to broadband in the home.[12] The challenge set forth by the NETP is, hence, all the more necessary in Puerto Rico. Key aspects that need to be addressed to meet this challenge are the financial constraints of many Puerto Rico families who today live under the poverty level, and will not be able to afford the necessary equipment to achieve these goals.

There are numerous initiatives at the U.S. federal level to help overcome this challenge. The FCC's Learning On-The-Go pilot program of 2011 is testing a model whereby the FCC funds a broadband-enabled device (a computer or tablet) for each student, connected to the Internet via a secure school portal.[13] With this pilot program, currently underway across 20 schools in the U.S., the FCC hopes to develop policies that will help achieve this goal. Similarly, the U.S. Department of Education is assessing plans to make this goal viable.

Puerto Rico stakeholders, including the Department of Education, the ICT community, and the Broadband Taskforce, should work together to assess this challenge across Puerto Rico and develop plans to complement federal initiatives.

**Recommendation**:
Develop plans to achieve a computer-per-teacher and device-per-pupil goal

## 4. Ensure K-16 Institutions Have Appropriate Legal and Procedural Frameworks to Perform Effective Network Management

The integration of a successful technology plan throughout any academic scenario opens a myriad of possibilities to strengthen learning by access to greater information resources, new learning modalities, and ample opportunities for enriching the cultural and global knowledge base of a community. Just as well, it sets forth a challenge to academic institutions offering open access to all students, teachers, and administrators. Information technology administrators need to balance the desire for access and peer-to-peer connectivity with available bandwidth constraints, the need to assure academic integrity, and ensuring that copyright laws are respected.

The Higher Education Opportunity Act (HEOA) of 2008, effective as of July 1, 2010, set forth several regulations regarding unauthorized sharing on institutional networks.[14] This implies that institutions of higher education are to develop and implement technological plans that effectively dissuade the "unauthorized distribution of copyrighted material" by users through the implementation of technological deterrents. Specifically, institutions must develop written policies that are periodically assessed. While providing for the authority of each institution to determine the manner and content of said policies, each must contemplate the following "technology-based deterrents": bandwidth shaping, identification of the largest bandwidth users, programs that respond to the Digital Millennium Copyright Act (DMCA). Care must be taken to guarantee that regulations include actions to be taken against those who violate institutional dispositions, and that when policies are approved they are amply distributed among the student population.

**Recommendation**:
Ensure K-16 institutions have appropriate legal and procedural frameworks to perform effective network management

## 5. Digital Technology Curricula

In order to improve and enhance efforts toward academic achievement and accountability, the Department of Education's Technology and Curriculum Unit is working to integrate the use of technology into the curriculum and instruction of the K-12 system. These efforts are essential to ensure that teachers and students have the tools necessary to fully leverage online resources to enhance the educational experience and that students graduate with the necessary knowledge to succeed in the twenty-first century economy. This reform should aim to achieve an enhanced Digital Technology Curricula that leverages the wealth of online content development by non-for-profits and private corporations alike. Particular emphasis should be given to the integration of technology in the curricula and learning tools of STEM programs, ensuring they are available in both Spanish and English. These efforts should also assess the possibility of using Puerto Rico as a testing ground for models that use online resources to enhance inclusion of Hispanic students in the education system.

**Recommendation**:
Continue integrating the use of technology into the curriculum and instruction of the K-12 system, with particular emphasis given to STEM, bilingual programs

## 6. Expand Resources to Train the Teacher

The Puerto Rico Education Technology Plan of 2010 sets forth accelerated plans to expand resources to train Puerto Rico teachers the necessary digital literacy skills and educational strategies to fully leverage the opportunities offered by online learning. It is imperative that this process continues at a fast rate giving all Puerto Rico teachers an opportunity to benefit from this transformation. We can achieve broadband connectivity at all schools at great capacity of 100 Mbps or 1 Gbps, but if teachers don't have the technical knowledge and educational vision to know how to use these resources, Puerto Rico students will not be able to reap the benefits of this opportunity. To achieve this goal it is imperative to continue revising, creating, and implementing standards and learning objectives using technology for all content areas.

**Recommendation**:
Expand resources to train the teacher to ensure they are able to fully leverage ICT solutions in the classroom

## 7. Launch Pilot Programs to Assess the Efficacy of Online Education Modules

Will online education modules be effective for all subject matters? Is it appropriate at all age levels or only once students reach a certain maturity? How should we leverage the plethora of existing, free or low cost educational and tracking resources available online today for both teachers and students? Examples of such content abound and include the Khan Academy curricula, Intel Corporation's educational content, and many more. What other resources will be needed? Are there lessons to be learned from existing higher-education online courses that can be applied to the high school or below experience? How can higher-education institutions help expand these resources within K-12? These and many other questions need to be assessed in order to effectively leverage online training and courses in the K-12 system. Pilot programs can bring together appropriate stakeholders to assess these questions and ultimately accelerate expansion of these new educational opportunities.

**Recommendation**:
Launch pilot programs to assess the efficacy of online education modules

# Endnotes

[1] U.S. Department of Education, (2010). *National education technology plan 2010*. Retrieved from website: http://www.ed.gov/sites/default/files/netp2010.pdf

[2] Ibid.

[3] Ibid.

[4] Puerto Rico Department of Education, (2010). *Commonwealth of Puerto Rico department of education technology plan, 2010-2014*.

[5] Ibid.

[6] Ibid.

[7] Federal Communications Commission. (2010). *National Broadband Plan*. Retrieved from website: http://www.broadband.gov/plan/11-education/

[8] Ibid.

[9] See Chapter 3 for a detailed analysis of the digital gap across the residential sector in Puerto Rico.

[10] For full results: Connect Puerto Rico, (2010). *Connect Puerto Rico residential technology assessment results*. Retrieved from website: http://www.connectpr.org/sites/default/files/connected-nation/Puerto Rico/files/PR_RTA_2010Q1_FINAL.PDF

[11] In 2010, Connected Nation conducted random digit dial (RDD) telephone surveys of 15,647 adults age 18 and older across thirteen jurisdictions, including Alaska, Florida, Illinois, Iowa, Kansas, Michigan, Minnesota, Nevada, Ohio, Puerto Rico, South Carolina, Tennessee, and Texas.

[12] [Web log message]. (2011, September 29). Retrieved from http://www.connectpr.org/es/blog/post/over-443000-children-puerto-rico-lack-access-broadband-internet

[13] Federal Communications Commission, (2011). *E-rate deployed ubiquitously 2011 pilot program*. Retrieved from website: http://www.fundsforlearning.com/docs/2011/07/DA-11-1181A1.pdf

[14] EDUCAUSE, (2010). *Higher education opportunity act*. Retrieved from website: http://www.educause.edu/Resources/Browse/HEOA/34600

# Chapter VII: e-Health

# A. Introduction

A key goal of the Puerto Rico Broadband Taskforce is to ensure that Puerto Rico's broadband infrastructure is ubiquitous and offers ample capacity to meet the needs of applications and use patterns of all citizens, businesses, and institutions. Today, a key industry increasingly using broadband and information technology to effectively deliver services is the Healthcare sector. The Puerto Rico Broadband Taskforce is committed to ensuring that all Healthcare sector stakeholders, including healthcare institutions, doctors, pharmacists, clinical laboratory and diagnostic facilities, public or private major financial contributors and, last but not least, Puerto Rico patients, have access to and are effectively using broadband and Health IT solutions; resulting in more cost-effective care services, and greater patient information about their healthcare experience. The goal of this chapter is to assess the broadband needs of the Healthcare sector, and the state of the broadband infrastructure currently available to meet these needs. Armed with this information, the Plan aims to identify the gap remaining across Puerto Rico to meet this challenge, and to propose solutions to work to close this broadband gap across the island.

To accomplish these goals, the Puerto Rico Broadband Taskforce has partnered with the Puerto Rico Health Information Network (PRHIN), which is represented in the Puerto Rico Broadband Taskorce Healthcare Services Committee. PRHIN is a public, private partnership comprised of multiple stakeholders in the Healthcare sector including the Department of Health of Puerto Rico, and representatives of doctors, hospitals, pharmacies, clinics and, importantly, patients. PRHIN has been working since 2010 to develop the necessary tools through the Federal Health Information Exchange (HIE) project to ensure the effective and safe management of health information records among Puerto Rico stakeholders.[1]

The PRHIN includes the Health IT Regional Extension Center (REC) of Puerto Rico and the US Virgin Islands, which aims to provide accessible and effective solutions, technical resources, and educational programs to facilitate the transformation of primary care practices in Puerto Rico and US Virgin Islands (USVI) through the adoption and meaningful use of health information technology. A key goal of this program is to support and accelerate healthcare providers' efforts to become meaningful users of Electronic Health Records (EHR).

## Health IT refers to a set of broadband-enabled solutions that offer the potential to improve the overall quality, safety, and efficiency of healthcare delivery.

The PRHIN and the REC of Puerto Rico are part of a nationwide effort to identify and overcome challenges to the expansion of health information solutions that are inherent to the Healthcare sector. The goal is to ensure that healthcare providers and the patients they serve are fully leveraging the benefits of health information technology that broadband technology is increasingly providing. As discussed in detail below, the PRHIN is part of a nationwide initiative aimed to trigger the necessary transformations within the Healthcare sector to achieve this reality. This Strategic Plan complements the work that Puerto Rico and U.S. healthcare provider stakeholders are undertaking by addressing a critical piece of the puzzle: ensuring that all healthcare providers and the patients they serve have access to broadband that meets the capacity, latency, and quality of service specifications necessary to utilize Health IT effectively.

This Strategic Plan is aligned with the goals and strategies identified in PRHIN Strategic Plan. It complements that Plan by focusing on the measuring and building strategies to close the broadband infrastructure gap affecting the Healthcare sector across Puerto Rico.[2] This e-Health strategy also builds upon the work of the Federal Communications Commission (FCC). In its 2010 National Broadband Plan, the FCC recognizes the importance of Health IT in helping deliver improved and more cost-effective healthcare services "by dramatically improving the collection, presentation and exchange of healthcare information, and by providing clinicians and consumers the tools to transform care. Technology cannot heal, but when appropriately incorporated into care, technology can help healthcare professionals and consumers make better decisions, become more efficient, engage in innovation and understand both individual and public health more effectively."[3]

Healthcare is one of the prime areas in which a high-speed broadband network can facilitate new models of service delivery; however, a ubiquitous and robust broadband infrastructure is necessary to fully leverage the benefits of Health IT. High-speed broadband access enables information-driven health practices that dial-up cannot provide. Broadband supports the use of Electronic Health Records (EHR), a more effective means of exchanging accurate patient information between healthcare providers. Broadband also empowers healthcare providers to deliver telemedicine services (medical diagnostic and treatment services), removing geographic and time constraints for isolated communities by enabling video consultation and patient monitoring. These technologies permit communications between patient and medical staff with both convenience and fidelity, as well as the transmission of medical, imaging and health informatics data from one site to another.

Furthermore, the use of mobile networks and adoption of tools such as smartphones – coupled with the burgeoning demand for consumer applications on mobile devices – is empowering patients to take control of their own health. User-friendly telemedicine applications designed to measure blood pressure, control diabetes, and transmit diagnostic information to physicians and other healthcare providers are increasingly becoming available for consumers. Demand for these broadband enabled services and applications are driving bandwidth demands. As a result, provision and improvements in telemedicine and other Health IT initiatives will rely on increasing bandwidth capacity, more storage and processing capabilities, and higher levels of security to protect patient information.

To ensure that Puerto Rico patients and the healthcare providers serving them will be able to fully leverage the benefits of Health IT, the Puerto Rico Broadband Taskforce sets the following goals and standards:

## Strategic Goals for Puerto Rico - Healthcare

All Puerto Rican healthcare providers and patients should have access to broadband that meets the capacity, latency, and quality of service specifications necessary to utilize healthcare information technology and provide telemedicine services effectively.

e-Health Goals:

- By 2015, create a nationwide e-care network that will ensure interconnectivity between all stakeholders, including patients, healthcare providers, and payers – public and private.
- By 2015, ensure broadband network capacity available to healthcare providers:
  - 4 Mbps to all healthcare providers
  - 10 Mbps to nursing homes and rural healthcare providers
  - 25 Mbps to clinics and large physician practices (5-25 physicians)
  - 100 Mbps to hospitals
- By 2020, ensure 1 Gbps to academic and large medical centers

## 1. The Impact of Health IT in Healthcare Delivery

The Healthcare sector has unique challenges. It inherently generates mountains of information, yet at the same time is duty bound to keep these mountains hidden for the sake of individual privacy. For companies charged with managing and working with this information, high-speed Internet access and technology innovations are crucial. On a daily basis, doctors must keep up with the latest research; patient records have to be easily accessible and accurate; and images, test results, and prescriptions have to be delivered promptly, without errors, to practitioners, pharmacies, and insurance providers. In healthcare, errors and delays are not only costly, but also may be hazardous to a patient's health.

There is a developing set of broadband-enabled solutions that can play an important role in the transformation of the Healthcare sector. These solutions, most often grouped under the name health information technology (Health IT), offer the potential to improve healthcare outcomes while simultaneously controlling costs, extending the reach of the limited pool of healthcare professionals, and enabling providers to better manage patient care through secure use and sharing of health information.[4] Furthermore, as a major area of innovation and entrepreneurial activity, the Health IT industry can serve as an engine for job creation and global competitiveness.[5]

Health IT includes the use of EHRs instead of paper medical records to maintain health information. Many providers are converting to EHRs which can be easily updated and shared on secure, internal networks. EHRs help ensure that appropriate medical information is available, reduces medical errors and healthcare costs, and improves coordination among healthcare facilities.[6] As a result, EHRs will ultimately enable significant improvements in the quality of healthcare for patients and reduction of healthcare delivery costs. A keen example of the impact of EHRs on a patient's quality of life comes from the testimony of chronic patient Gregorie Stokes III regarding how the WebDMEMR EHR system has drastically improved his ability to get quality healthcare service in Puerto Rico.[7] After more than 20 years struggling to collect and present his vast health history to new healthcare providers, Mr. Stoke reports that "you can imagine my relief to finally meet a physician [in Puerto Rico] with an Electronic Medical Record capability accessible to me and my numerous physicians across the multiple systems of healthcare, public and private, inside and outside Puerto Rico."[8]

Recognizing these potential benefits, and the need for government coordination and encouragement to make it a reality across the U.S., the Health Information Technology for Economic and Clinical Health (HITECH) Act seeks to improve American healthcare delivery and patient care through an investment in Health IT.[9] The provisions of the HITECH Act are specifically designed to work together to provide the necessary assistance and technical support to providers, enable coordination and alignment within and among states, establish connectivity to the public health community in case of emergencies, and ensure that the workforce is properly trained and equipped to be meaningful users of EHRs. Combined, these programs build the foundation for every American to benefit from EHRs, as part of a modernized, interconnected, and vastly improved system of care delivery.[10] The Office of the National Coordinator for Health Information Technology (ONC) at the Department of Human and Health Services is overseeing this process.

Two key programs of this initiative are the State Health Information Exchange Cooperative Agreement Program and the Health Information Technology Extension Program. The State Health Information Exchange Cooperative Agreement Program establishes health information exchange (HIE) capability among healthcare providers and hospitals in each state or territory.[11] This program is designed to encourage breakthrough innovations for health information exchange that can be leveraged widely to support nationwide health information exchange and interoperability. The Health Information Technology Extension Program is a grant program to establish Health Information Technology Regional Extension Centers to offer technical assistance, guidance, and information on best practices to support and accelerate healthcare providers' efforts to become meaningful users of Electronic Health Records.[12] Leveraging federal grant funding, the PRHIN has partnered with ONC to implement the HIE project across the island.

In addition to EHRs, broadband facilitates efficiency in healthcare delivery and creates opportunities for collaboration between doctors, healthcare specialists, and patients located anywhere in the world. Telemedicine, for example, is a term used to describe the use of medical information exchanged from one site to another via electronic communication to improve patients' health status.[13] Telemedicine includes network-based technologies like video-conferencing and digital stethoscopes, which allow specialists to consult with patients regardless of geographic location – reducing travel time and hazards – while test results from a hospital emergency room or laboratory can be sent to a radiologist or doctor in seconds, making rapid diagnosis a reality. Because of the increased efficiency and capability, the healthcare industry has found the perfect partner in high-speed broadband technology.[14]

Indeed, this technology saves lives, as exemplified by Phoenix, AZ neurologist Bart Demaerschalk and a stroke victim in a rural health clinic 200 miles away.[15] Within minutes of receiving an emergency call, Dr. Demaerschalk had set up a video conference, empowering him to look at the patient, ask her questions, go over her brain scan and confirm the diagnosis – all made possible by rural broadband access. Equipped with live video feed via broadband, the doctor was empowered to give the patient a much more thorough evaluation than if it was just over the phone, and ultimately made the right decision for her to be rushed to the hospital to be administered drugs.

Similar results were experienced when the Puerto Rico Department of Health conducted the 2002 telemedicine pilot study that installed a system between the municipality of Vieques and the Tertiary Centro Medico emergency and radiology department in San Juan.[16] By utilizing image transmission and video conferencing, the remote Vieques facility could send radiology images to be read at the San Juan facility. The project realized significant savings in patient travel expense and an increase in the turn-around time of results, especially for specialized services located only in metropolitan centers. Before, most patients requiring radiology services were escorted via helicopter to a specialist in San Juan.

From rural Arizona to remote Puerto Rico, these examples point to a major problem facing remote or isolated communities: while the nearest hospital is often many miles away, a hospital where experts can diagnose and treat specific disorders are even farther away. In these situations, experts frequently use phone calls to make judgments on patients' status; but now with advances in video technology, the potential exists for them to make much more thorough diagnoses – as long as the appropriate broadband infrastructure is in place to support the technology.[17]

Take Naguabo, for example. In this municipality of 26,720 residents there are only 16 doctors serving the community.[18] This works out to approximately 1,670 patients per doctor; compared to San Juan, where there are 119 patients for every doctor.[19] Broadband can help bridge the healthcare provider gap in Naguabo, a community where high-speed broadband is available across much of the population. Connect Puerto Rico's June 2011 broadband availability analysis indicates that more than three-quarters (77%) of Naguabo's households have access to advertised broadband download speeds of at least 10 Mbps.[20] That available capacity can be leveraged by doctors, remote clinics, and patients to improve the quality of healthcare service in this community. Other communities across Puerto Rico have acute shortages of medical specialists and could similarly benefit from telemedicine solutions.[21]

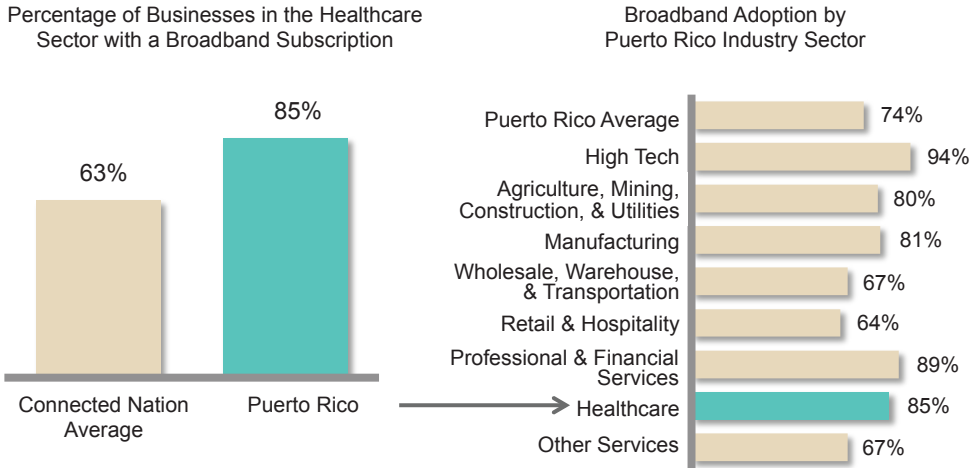
# According to the 2010 Connect Puerto Rico Business Technology Assessment, 85% of the businesses in Puerto Rico's Healthcare sector subscribe to broadband.

## B. Broadband Adoption Among Healthcare Providers Across Puerto Rico

Health IT will not reach its true potential without full access to broadband services. Research remains scarce on Puerto Rico's healthcare providers' broadband connectivity needs and the ability of the island's infrastructure to meet those needs. However, in 2010, as part of the Puerto Rico Business Technology Assessment, Connect Puerto Rico surveyed businesses in the Healthcare sector to determine technology adoption levels.[22] The results were surprising.

According to the 2010 Connect Puerto Rico Business Technology Assessment, 85% of the businesses in Puerto Rico's Healthcare sector subscribe to broadband. In comparison, only 63% of all businesses in the Healthcare sector located in jurisdictions surveyed by Connected Nation report subscribing to broadband, a difference of 22 percentage points.[23] Furthermore, out of all of the industry sectors operating in Puerto Rico, the Healthcare sector reported the third highest broadband adoption rate (Figure VII.1).

Figure VII.1 - Broadband Adoption in the Healthcare Sector



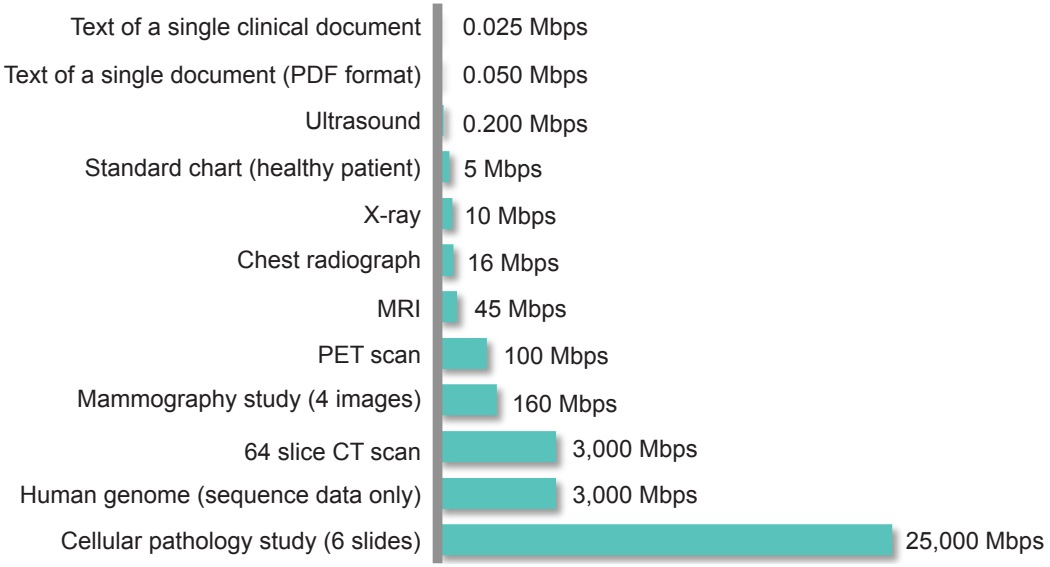
This data indicates that Puerto Rico healthcare providers are subscribing to broadband at higher rates than their counterparts in other U.S. jurisdictions surveyed by Connected Nation. This is a positive outcome. It may well be driven by the relatively large degree of patients in Puerto Rico who qualify for Medicare or Medicaid coverage, and the need for electronic billing under these programs. That being said, as data presented in the next segment indicates, the broadband speeds that these healthcare providers receive is significantly below what their counterparts elsewhere receive and significantly below standards needed to support new Health IT services. The broadband speeds available to the majority of healthcare providers are insufficient to sustain many Health IT solutions, indicating that, while broadband penetration is high in the Puerto Rico Healthcare sector, it is not being fully leveraged to unleash the full benefits of Health IT.

## 1. The Healthcare Sector's Broadband Capacity Needs

Having access to broadband is not sufficient to ensure that healthcare providers can fully leverage the benefits of Health IT innovations. It is essential that access be of sufficient capacity to enable the real-time high-capacity necessary to support Health IT solutions. Healthcare providers' broadband needs are largely driven by the rapidly increasing amount of digital health-related data that is collected and exchanged. Although some delivery settings currently function at lower connectivity and quality, those levels are straining under increasing demand and are unable to support needs likely to emerge in the near future. But how fast is fast enough?

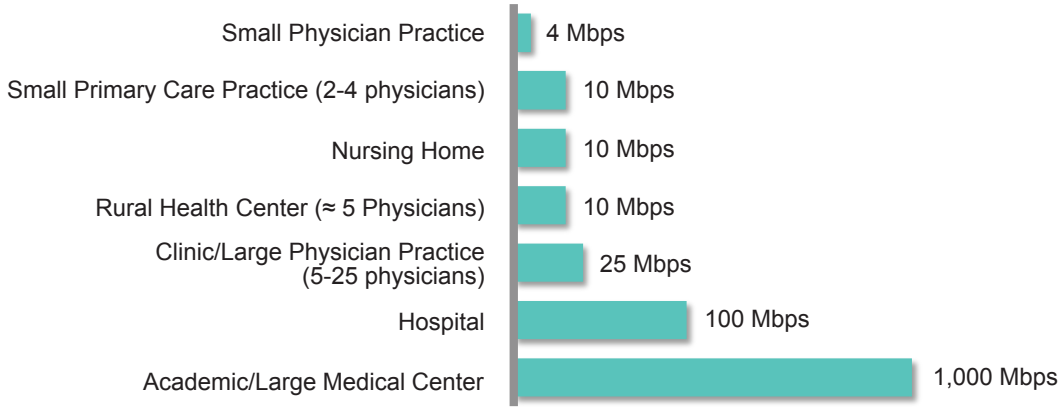
A single video consultation session can require a minimum of a symmetric 2 Mbps connection with a good quality of service.[24] There is a wide range of requirements to support EHRs and medical imaging, and over the next decade, physicians will need to exchange increasingly large files as new technologies such as 3D imaging become more prevalent; stimulating demand for more and better broadband, because these applications have specific requirements for network speeds, delay, and jitter.[25] Figure VII.2 provides examples of file sizes for different types of health data file types that healthcare providers may encounter.[26]

Figure VII.2 - Health Data File Sizes (Mbps - Not to Scale)




Health IT infrastructure must meet current demands of the healthcare provider as well as grow to meet its future needs. The connectivity needs of different health delivery settings vary depending on their type (e.g., tertiary care center versus primary care physician practice) and their size.[27] Figure VII.3 shows an estimate of the required minimum connectivity and quality metrics to support deployment of Health IT applications today and in the near future at different types of health delivery settings.[28]

Figure VII.3 - Recommended Bandwidth Speeds By Location Category (Mbps - Not to Scale)

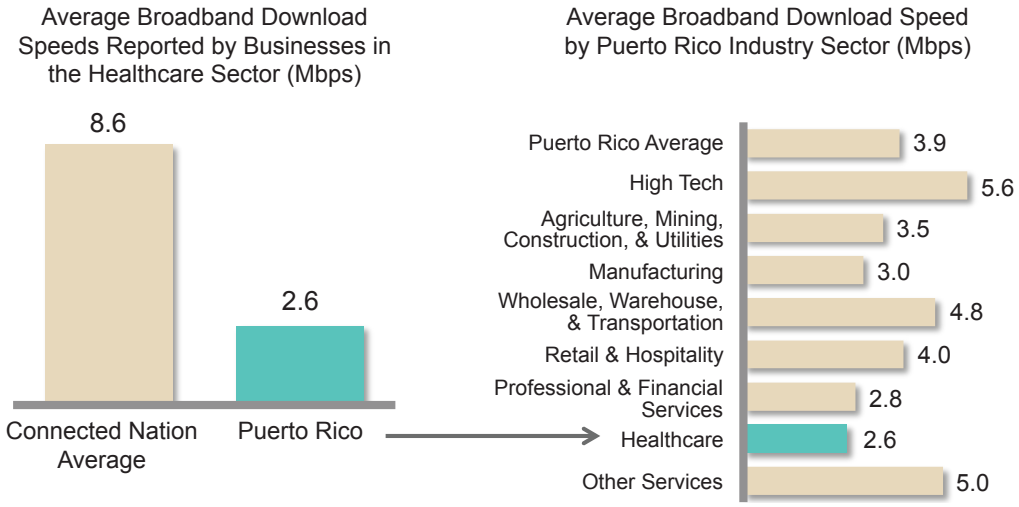


## 2. Broadband Speeds Used by Puerto Rico Healthcare Providers

There is little doubt that Health IT initiatives such as EHR, e-prescribing, telemedicine, and health monitoring have the potential to offer tremendously improved quality of care – as well as significant cost savings – in the delivery of care for providers and patients alike. However, based on the suggested bandwidth requirements listed in Figure VII.2 and Figure VII.3, Puerto Rico's Healthcare sector faces a broadband connectivity gap (Figure VII.4).

The 2010 Connect Puerto Rico Business Technology Assessment indicates that the average advertised download speed reported among businesses in the Healthcare sector is 2.6 Mbps, significantly lower than the 8.6 Mbps average reported by businesses in the Healthcare sector located in jurisdictions surveyed by Connected Nation in 2010. Furthermore, among Puerto Rico's business sectors, the Healthcare sector reported slower speeds than any sector (Figure VII.4). This lack of adequate infrastructure could prevent Puerto Rico's health workers from delivering healthcare efficiently.

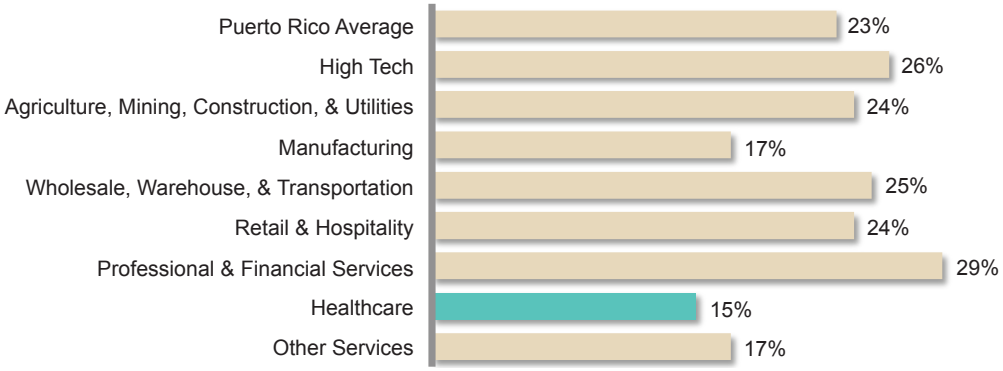
Figure VII.4 - Average Broadband Download Speeds (Mbps)




Understanding the state of broadband access and connectivity for the Healthcare sector is a new but important area of analysis, especially as the need for better data continues to grow. Of particular importance for both Internet providers and policy makers is the ability to understand consumer demand and satisfaction with their broadband subscription. Businesses in Puerto Rico's Healthcare sector present an interesting case study.

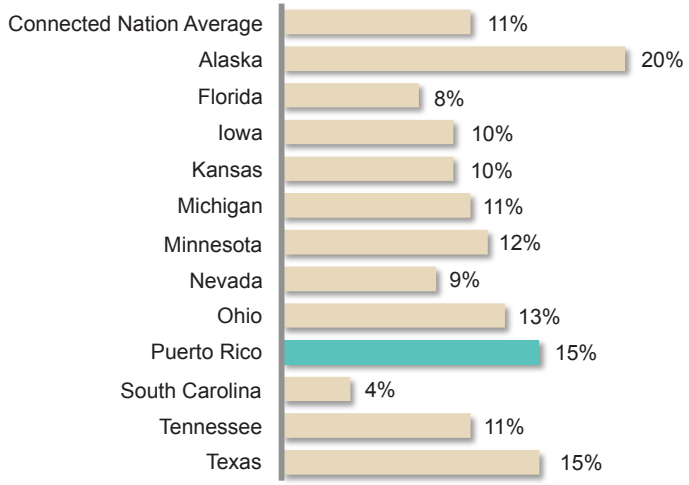
When asked if their business could use more bandwidth, only 15% of businesses in Puerto Rico's Healthcare sector reported that they did, despite their low bandwidth (Figure VII.5). At first glance, this statistic appears to indicate a perceived lack of need, especially when compared to other industry sectors in Puerto Rico.

Figure VII.5 - Percent of Puerto Rico Broadband-Connected Businesses That Say They Need More Bandwidth by Industry Sector



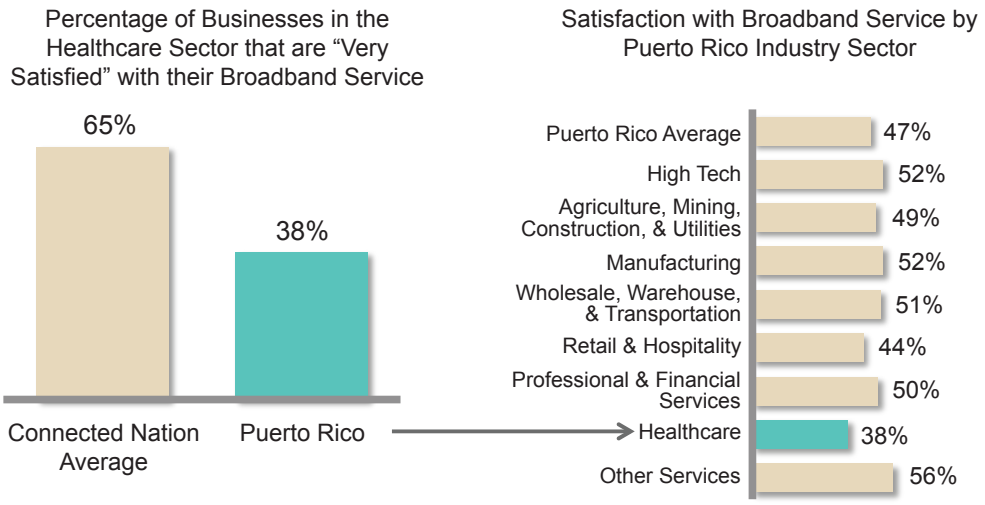

However, Connected Nation's 2010 research in eleven states reveals that, in general, the Healthcare sector reports low levels of need for increased bandwidth, and the Puerto Rico Healthcare sector actually ranks near the top of the list in terms of needing more bandwidth (Figure VII.6).

Figure VII.6 - Percent of Broadband-Connected Businesses in the Healthcare Sector That Need More Bandwidth by Location



In addition to asking businesses about their perceived need for more bandwidth, Connect Puerto Rico inquired upon business satisfaction regarding their broadband service. As figure VII.7 shows, just 38% of Puerto Rico businesses in the Healthcare sector report being "Very Satisfied" with their broadband service, compared to nearly two-thirds (65%) of all businesses in the Healthcare sector surveyed by Connected Nation in 2010. Furthermore, within Puerto Rico, the Healthcare sector reports the lowest level of broadband service satisfaction (Figure VII.7).

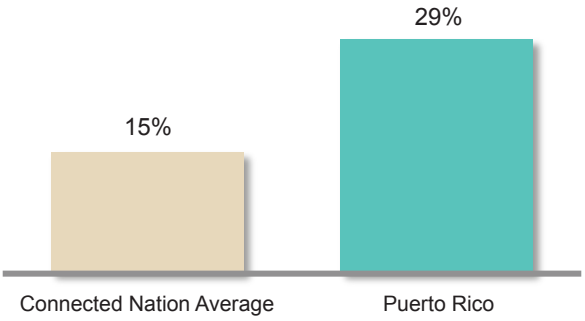
Figure VII.7 - Percent of Broadband-Connected Businesses That Say They Are "Very Satisfied" With Their Broadband Service




Puerto Rico's Healthcare sector is characterized by high levels of broadband adoption, a lack of perceived need for increased bandwidth, and a low level of broadband service satisfaction. While conflicting in nature, this data may indicate a lack of industry experience with broadband applications, especially when it comes to the infrastructural needs of Health IT applications.

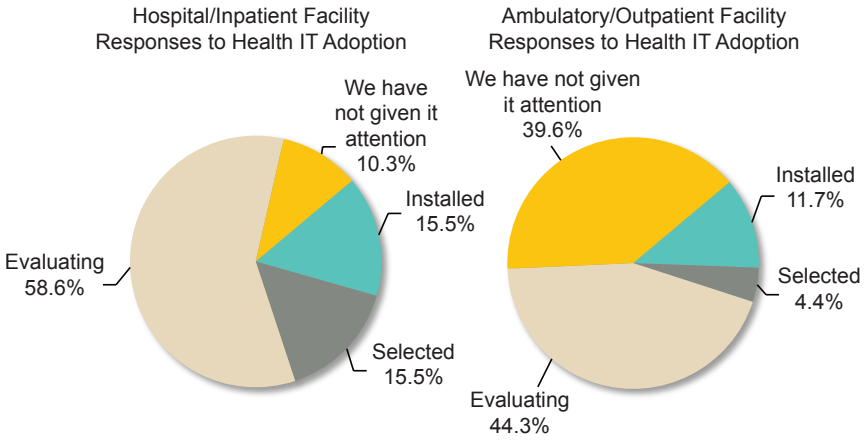
Perhaps supporting these findings is the comparatively short amount of time that businesses in Puerto Rico's Healthcare sector have been online. Connect Puerto Rico's findings indicate that 29% of broadband-connected businesses in Puerto Rico's Healthcare sector report first subscribing to broadband two years or less prior to the survey taking place (August 2010). In comparison, only 15% of all businesses surveyed by Connected Nation report subscribing to broadband for two years or less, indicating that these businesses have much more experience utilizing broadband (Figure VII. 8).

Figure VII.8 - Percent of Broadband-Connected Businesses in the Healthcare Sector That Have Been Using Broadband for Two Years or Less




Indeed, the Strategic Plan of the Puerto Rico Health Information Network confirms the conclusion that the Healthcare sector lacks sufficient experience in utilizing Health IT applications.[29] According to the research presented in the Plan, it wasn't until mid-2010 that local vendors and developers of Health IT applications began to heavily promote their offerings. In 2010, as part of their responsibilities under the State Health Information Exchange Cooperative Agreement Program, the Puerto Rico Health Information Network also conducted a survey in order to identify the status of interoperable Health IT adoption on the island. While the vast majority of respondents reported having some form of broadband in their workplace, survey results evidenced a general lack of awareness about national health information exchange initiatives. Furthermore, it was found that the number of providers and organizations, inpatient and ambulatory, who have selected and installed a Health IT solution are largely a minority. According to the survey, while approximately 59% of inpatient facilities were evaluating Health IT options, less than one-third of inpatient facilities had selected or installed a Health IT solution (Figure V.II 9). Among outpatient facilities, nearly two-fifths had not even given any attention to Health IT applications.

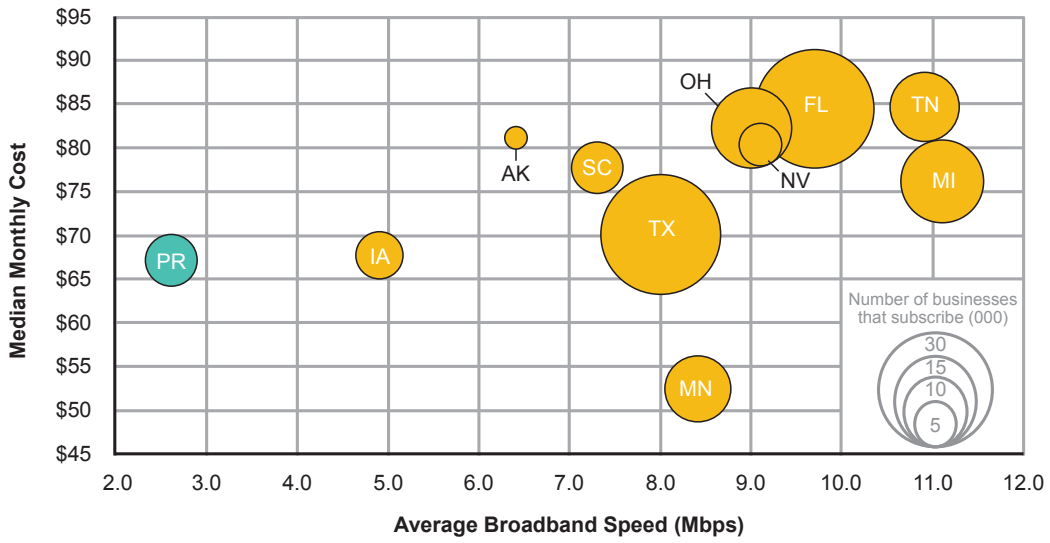
Figure VII.9 - Inpatient/Outpatient Facility Responses to Healthcare IT Adoption



## 3. The Need for Increased Capacity

For the benefits of Health IT solutions to be realized, meaningful use of these applications must be attained. However, adequate infrastructure required for Health IT applications is first needed. According to the FCC's National Broadband Plan, smaller providers can achieve satisfactory Health IT adoption with a download speed of at least 4 Mbps for single physician practices and 10 Mbps for two-to-four physician practices, even though these solutions may not provide business-grade quality-of-service guarantees.[30] Based on this requirement, Puerto Rico definitely faces a connectivity gap. As Figure VII.10 indicates, although businesses in Puerto Rico's Healthcare sector pay a similar monthly price for broadband service, the average advertised speed is significantly lower; and at 2.6 Mbps, hardly fast enough to support current Health IT applications.

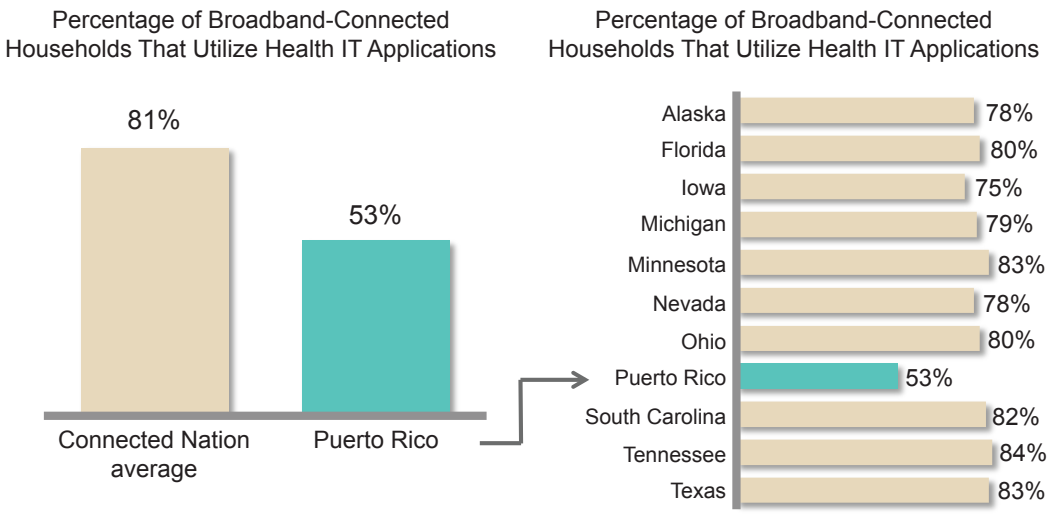
Figure VII.10 - Among Broadband-Connected Businesses in the Healthcare Sector Located in Jurisdictions Surveyed by Connected Nation, the Advertised Average Broadband Speed and Median Monthly Cost




Furthermore, Connect Puerto Rico's 2010 Residential Technology Assessment appears to confirm that Puerto Rico's Healthcare sector is straining under the current capacity (Figure VII.11).[31] Among the 31% of Puerto Rico residents with a home broadband subscription, 53%, (or approximately 485,000 residents) utilize their broadband subscriptions to access Health IT applications. This includes 49% who access health or medical information, 10% who communicate with their health insurance company, and 11% who communicate with their doctors or other healthcare professionals.

In comparison, among all jurisdictions surveyed by Connected Nation in 2010, 81% of broadband-connected households utilize their connection to access Health IT applications.[32] This includes 73% who search for health or medical information, 41% who communicate with their health insurance company, and 34% who communicate with their doctors or other healthcare professionals.

Figure VII.11 - The Percentage of Broadband-Connected Households that Utilize Health IT Applications




Thus, in regards to Puerto Rico's broadband infrastructure for the Healthcare sector, three gaps remain: education, adequate infrastructure, and utilization. Proper education and awareness measures need to be taken in order to encourage adoption of Health IT applications in the Healthcare sector. Furthermore, Puerto Rico's bandwidth constraints are preventing healthcare providers from achieving full utilization of video consultation, remote image diagnostic, and EHR technology. These gaps must be filled to accelerate the benefits of broadband and to support needs likely to emerge in the near future.

## C. Policy Recommendations To Accelerate e-Health Opportunities Across Puerto Rico

The previous section describes the state of broadband adoption and usage across Puerto Rico healthcare providers and identifies significant gaps in broadband infrastructure serving the healthcare community and Health IT usage that remain a challenge in Puerto Rico. Available data indicates that Puerto Rico healthcare providers are lagging behind in the adoption of Health IT solutions, and that the broadband capacity serving them today is drastically insufficient to support increasingly available Health IT solutions. Consumers and patients, on the other hand, are also lagging behind the adoption and usage of broadband technology that will ultimately enable, among other things, full leverage of these Health IT solutions to ensure better healthcare and, ultimately, higher quality of life.

It is imperative that this gap be closed – and fast. Health IT is in its infancy. As emerging Health IT applications become more prevalent and the importance of bandwidth capacity grows, it will be critical that Puerto Rico's healthcare providers have the infrastructure that they need. In this section we outline a series of strategies that will help achieve these goals across Puerto Rico. Building upon the experience of the PRHIN and other healthcare IT experts, this section analyzes the key challenges preventing full penetration of Health IT solution across Puerto Rico, and proposes a series of strategies to overcome these challenges.

### 1. Drastically Enhance Broadband Capacity Available to Healthcare Providers

Chapter 3 of this Strategic Plan outlines in detail the state of Puerto Rico's broadband infrastructure, and identifies a significant broadband access gap across the island. Data presented in this chapter indicates that this gap is affecting the ability of healthcare providers to fully leverage Health IT opportunities. It is imperative that the access gap be closed across the island to serve all citizens and institutions and, in particular, to provide access via robust speeds for healthcare providers. Elsewhere in this Strategic Plan we discuss the challenges and strategies to promote increased investment in broadband capacity. We do not reiterate those strategies here, but do emphasize that serving the broadband needs of hospitals, clinics, laboratories, diagnostic centers, and payers into the system is imperative for Puerto Rico to contain the costs of healthcare delivery and improve health statistics across the island.

This Strategic Plan sets the following target speeds for broadband access available to all healthcare institutions across the island:

**Strategic Goals for Puerto Rico - Healthcare**

All Puerto Rican healthcare providers and patients should have access to broadband that meets the capacity, latency, and quality of service specifications necessary to utilize healthcare information technology and provide telemedicine services effectively.

e-Health Goals:

- By 2015, create a nationwide e-care network that will ensure interconnectivity between all stakeholders, including patients, healthcare providers, and payers – public and private.
- By 2015, ensure broadband network capacity available to healthcare providers:
  - 4 Mbps to all healthcare providers
  - 10 Mbps to nursing homes and rural healthcare providers
  - 25 Mbps to clinics and large physician practices (5-25 physicians)
  - 100 Mbps to hospitals
- By 2020, ensure 1 Gbps to academic and large medical centers

As broadband providers continue investing in broadband capacity to meet these goals, more data will be necessary to assess the level of connectivity available to healthcare providers. Part of the broadband mapping efforts undertaken by the Office of the CIO include the collection of data documenting the type and speeds of broadband contracted by community anchor institutions, including healthcare providers. To ensure comprehensive, up to date information, it is imperative that healthcare providers actively cooperate with this initiative, which aims to understand the current state of broadband use across the industry and assess development as broadband services are expanded. To do so, all healthcare providers are invited to provide data about their broadband connectivity by submitting an online survey available at http://www.connectpr.org/policy

**Recommendation**:
Continue ongoing efforts to document information regarding broadband service capacity used by healthcare providers across Puerto Rico.

## 2. Overcome the Usage Lag of Health IT Solutions by Puerto Rico Healthcare Providers

Data indicates that a large percentage of Puerto Rico healthcare providers are lagging behind in the adoption and usage of Health IT solutions. It is imperative that the gap be closed to ensure a viable Healthcare sector and to meet federal requirements for continued funding under various programs.

Barriers to Health IT adoption and the broadband capacity necessary to sustain these solutions include financial constraints as well as lack of perceived need. These two factors, affordability and relevance, are in fact inherently one and the same. Healthcare providers that don't appreciate the efficiencies enabled by Health IT solutions are less willing to invest in the IT systems and broadband capacity necessary to sustain them. In short, too many healthcare providers across Puerto Rico still don't see these expenses as investments that will rapidly result in lower overall costs of healthcare delivery.

To overcome the lack of perceived relevance, the PRHIN and, in particular, the Regional Extension Centers, has launched awareness campaigns aimed to educate healthcare providers about the benefits of these tools and the potential funding consequences of not adopting solutions such as capacity to manage Electronic Health Records. The Puerto Rico Broadband Taskforce believes these outreach efforts are essential and recommends that resources be allocated to continue funding such efforts.

**Recommendation**:
Overcome the usage lag of Health IT solutions by Puerto Rico healthcare providers. Continue allocating resources to awareness campaigns aimed at educating healthcare providers about the benefits of Health IT.

## 3. Reinforce Public-Private Partnerships to Overcome Governmental Barriers to Health IT Expansion

Ensuring a vibrant Healthcare sector is a core objective of the Government of Puerto Rico. The current Government and the Puerto Rico Legislature have made significant accomplishments in promoting and expanding Health IT solutions across Puerto Rico. Key milestones include the establishment of the Puerto Rico HIT Coordinator, and the PRHIN, and the office of the Chief Medical Information Officer (CMIO) within the Department of Health. In 2011, the first HIE/HIT legislation was signed into law, enabling the PRHIN to begin to release technical and educational materials aimed to integrate healthcare information processes across the region and defining the role of PRHIN as a key one-stop source of HIE/HIT governance in Puerto Rico.

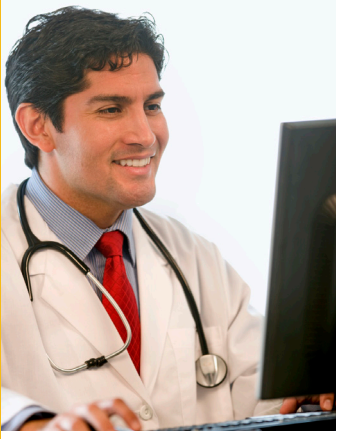
Much work has been done to date, but much work remains to ensure the ability to overcome legal and institutional stumbling blocks in the sector. One example includes the need for legal clarity regarding privacy law as it affects a patient's healthcare records. This is a challenge that all nations are facing as a result of the Health IT transformation underway. The legal precedent that exists is typically insufficient to offer clear and robust guidelines on how this information can and cannot be used. Rapid approval of legislation that will clearly define and ensure the privacy rights of patients to their health information is essential to ensure the rapid unleashing of solutions such as EHRs. Patients, healthcare providers, insurance and payer systems need clear legal guidelines of how information will be used, processed, and protected in order to ensure a functional system.

Overcoming these legal barriers will not only crucially help to promote the penetration of Health IT solutions, such as EHR, it will also help solidify a sound broadband policy for Puerto Rico. As healthcare providers increasingly use these IT solutions, demand from a key sector consuming high-capacity broadband will expand, significantly contributing to the overall sustainability of the sector. Such increased demand will, in turn, affect the economics of broadband built-out to offer ever more robust and fast networks. As in any market, as demand grows and is sustained, supply follows.

To accelerate the penetration of Health IT solutions across the Puerto Rico health system, private and public stakeholders should work to establish pilot programs offering telemedicine services across remote areas of Puerto Rico. Two such pilots could be radially implemented in Vieques and Culebra. A telemedicine pilot program providing remote medical assistance from the San Juan Medical Center to citizens of Vieques and Culebra could offer immediate benefits to thousands of citizens currently underserved by healthcare services and help healthcare providers, public institutions, payer systems, and patients learn how best to implement and benefit from such remote e-Health solutions.

Hence, while promoting Health IT solutions is not the core objective of this Strategic Plan, the Puerto Rico Broadband Taskforce stands in support of the efforts of the Puerto Rico HIT Coordinator and the PRHIN as they strive to overcome legislative and governmental barriers to full implementation of HIE and HIT resources.

**Recommendation**:
Reinforce public-private partnerships to overcome governmental barriers to Health IT expansion.



# Endnotes

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[3] Federal Communications Commission. (2010). *National Broadband Plan*, p. 200. Retrieved from website: http://www.broadband.gov/plan/10-healthcare/

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[7] WebDMEMR is an abbreviation for "Web Based Disease Management Electronic Medical Record."
An electronic medical record (EMR) is an application used by healthcare providers to store, organize, and access all patients' clinical data from a particular hospital or practice. An electronic health record (EHR) is a patient centric application where long-term and aggregate health information from one or more encounters in any healthcare delivery setting is stored. In contrast to an EMR, which only stores data from a particular hospital or practice, and EHR allows a patient to store data from any healthcare delivery encounter. WebDMEMR is a web-based application that enables both EMR and EHR functionality for any location in the world, provided an Internet connection is available. WebDMER's EHR function enables patients to share past data with the physicians of their choice. For more information, visit: http://webdmemr.com/default.aspx

[8] Testimonial of Mr. Gregorie Stoke, "Client recommendation for American Telemedicine – President, staff and WebDMEMR."

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[13] American Telemedicine Association, (n.d.). *Telemedicine defined*. Retrieved from website: http://www.americantelemed.org/i4a/pages/index.cfm?pageid=3333

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[18] Puerto Rico Health Information Network, (2011). *Physicians report by city in Puerto Rico*

[19] Ibid.

[20] Per Connect Puerto Rico's June 2011 NTIA submission.

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Note: Fifteen of Puerto Rico's 78 município's are served by less than twenty doctors, making travel to specialists at hospitals in other regions often necessary.

[22] Connect Puerto Rico, (2010). *Connect Puerto Rico business technology assessment results*. Retrieved from website: http://www.connectpr.org/survey-results/business
Note: In 2010, Connect Puerto Rico conducted the Business Technology Assessment, a random digit dial phone survey of 814 Puerto Rican businesses. This provides a margin of error for the territory-wide sample of ±5.1%.

[23] Connected Nation, (2011). *Broadband and business: Leveraging technology to stimulate economic growth*. Retrieved from website: http://www.connectednation.org/sites/default/files/broadband_and_business_-_connected_nation.pdf
Note: In 2010, Connected Nation conducted a series of random digital dial phone surveys of 9,650 businesses in 11 U.S. states (Alaska, Florida, Iowa, Kansas, Michigan, Minnesota, Nevada, Ohio, South Carolina, Tennessee, and Texas) and Puerto Rico. This provides a margin of error for the entire sample of ±1.6%.

[24] Letter from Chuck Parker, Executive Director, Continua Health Alliance, to Marlene H. Dortch, Secretary, FCC, GN Docket Nos. 09-57, 09-51 (Nov. 16, 2009) (Continua Nov. 16, 2009 *Ex Parte*) Attach. at 13. Retrieved from website: http://fjallfoss.fcc.gov/ecfs/document/view?id=7020348541
Note: Bandwidth thresholds are actual (i.e., not advertised) speeds.

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[26] Federal Communications Commission. (2010). *National Broadband Plan*, p. 210. Retrieved from website: http://www.broadband.gov/plan/10-healthcare/

[27] Ibid.

[28] Ibid.
Note: Mbps recommendations reflect compilation of the record. Numbers are guidelines, not precise measures.

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Note: Connected Nation Average data comes from similar phone surveys conducted in thirteen jurisdictions served by Connected Nation in 2010. Connected Nation conducted random digit dial (RDD) telephone surveys of 15,647 adults age 18 and older living in Alaska, Florida, Illinois, Iowa, Kansas, Michigan, Minnesota, Nevada, Ohio, Puerto Rico, South Carolina, Tennessee, and Texas. These surveys were designed to measure technology adoption, how individuals use technology, and barriers to technology adoption among adults.

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