Five Year Plan *of* Action

smart island

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SECTION 1

Executive Summary

Puerto Ricans are strong and resilient. We persevere through all kinds of challenges, working together in the wake of natural disasters and preserving our rich culture as only we can. Far too often, though, Puerto Rico is left without critical resources available in the rest of the United States. While new technologies replace the old elsewhere, we contend with aging and damaged infrastructure that cannot support our needs.

Many Puerto Ricans have been left on the wrong side of a digital divide. Nearly thirty percent of Puerto Ricans report having no internet access at home. Hurricanes Irma and María in 2017 and the following earthquakes in 2020 caused widespread damage to Puerto Rico's existing telecommunications infrastructure. This situation, combined with the COVID-19 pandemic, has shown us the importance of reliable and affordable broadband access that can withstand unexpected events and provide continuous communication capabilities.

The Puerto Rico Broadband Program (PRBP) was created by the Hon. Governor Pedro R. Pierluisi through Executive Order 2022-040 on July 11, 2022 in response to Puerto Rico's need for resilient, equitably distributed broadband infrastructure and the social supports required to access it knowledgeably and safely. Through disbursement of federal and local funds, the PRBP is tasked with coordinating the construction of broadband infrastructure in Puerto Rico and authorizing programs that support residents in their use of the Internet.

In a collaborative effort with federal and local government agencies, community organizations, and industry partners, the PRBP's vision is to **ensure all Puerto Ricans, regardless of their background or location, have access to the resources and opportunities necessary to thrive in the digital world and fully participate in modern society.**

To achieve this vision for Puerto Rico, the Five-Year Action and Digital Equity Plans follow four broadband pillars:

1) **Connectivity** to resilient infrastructure,
2) **Quality** and speed for demanding use,
3) **Accessibility** at an affordable price, and
4) **Knowledge** of technology and digital tools.

This strategic five-year action plan integrates all funding sources available to the PRBP—including the Puerto Rico Broadband Infrastructure Fund (PRBIF), the Infrastructure Investment and Jobs Act's (IIJA) Broadband Equity, Access, and Deployment (BEAD) Program, Digital Equity Act Programs, the American Rescue Plan Act's Capital Projects Fund, and the FCC's Affordable Connectivity Program Outreach Grant and provides a comprehensive strategy for addressing current needs of residents through these four Pillars: **Connectivity, Quality, Accessibility and Knowledge.** While Puerto Rico's Digital Equity Plan focuses closely on pillars three and four, Accessibility and Knowledge, BEAD initiatives will address pillars one and two, Connectivity and Quality.

1.1 Plan Development

This plan serves as a roadmap to Puerto Rico's broadband strategy and planning of preparation to invest in the Puerto Rico Broadband Infrastructure Fund. The creation of a Five-Year Broadband Action Plan is also a requirement of the BEAD Program administered by the National Telecommunications and Information Administration (NTIA). This plan will help to unlock federal funds allocated to Puerto Rico under that program. To gather information for this unprecedented investment, the PRBP launched an outreach and data collection process that engaged community stakeholders and the public. In response to federal funding requirements, the PRBP coordinated processes and efforts to address both BEAD and Digital Equity requirements in all stakeholder engagement, collecting feedback on both broadband deployment and digital equity and inclusion.

Outreach, awareness, and data collection activities conducted by the PRBP throughout its first year included:

- The **Smart Island Summit,** which convened over 300 stakeholders
- **Regional** listening sessions and additional municipality meetings
- **Meetings** with service providers, telecom unions, universities, and industry leaders
- An **interview series** with organizations representing covered populations and underrepresented communities
- A **Digital Inclusion Survey** of key organizations
- A **Digital Equity Phone Dial Survey** of unserved and underserved residents
- A **Connectivity Survey** and optional Speed Test
- **Monthly public service events** during the Fortaleza por Puerto Rico series, and
- **Radio, newspaper,** and **social media** updates.
- Meetings with **Digital Equity Advisory Subcommittee**

1.2 *Current State of Broadband and Digital Inclusion*

The PRBP has identified **assets** available to support Puerto Rico's broadband deployment and inclusion activities. See Section 3 for a full discussion of available resources. Key takeaways from data collection and analysis include:

Funding & Partnerships

- **Existing federal infrastructure programs** including the FCC's Uniendo a Puerto Rico program, the USDA's ReConnect program, and FEMA's disaster recovery programs are supporting the path to universal service in Puerto Rico.
- The **Puerto Rico Broadband Infrastructure Fund** has and will continue to support expansion efforts and it will be a major driver of activities described in this plan.
- 72% of Puerto Rican households qualify for the **Affordable Connectivity Program,** and **increased enrollment** can be attributed to outreach efforts across Puerto Rico.
- The Puerto Rico Broadband Program is supported by **many local partners,** including government agencies, service providers, education representatives, government-owned health clinics, public safety officials, nonprofits, and community organizations.

Providers & Infrastructure Projects

- Many providers have moved from aerial fiber optic cables in favor of **underground installation,** especially in high-population areas.
- An ongoing **total renovation of Puerto Rico's electrical grid** will support hardened and resilient broadband infrastructure.
- The PRBP's planning is complemented by an **ongoing effort for additional conduits** along several major roadways.
- **Continued collaboration** with municipalities and the Highway and Transportation Authority **will support expedited permitting** for broadband deployment.

Data collection and outreach identified needs in Puerto Rico's broadband infrastructure and obstacles for deployment, including:

- Most of the telecommunications infrastructure is heavily **dependent on commercial wireless services** powered by towers and rooftop antennas, prone to be decimated by hurricanes.
- **Data collection efforts continue** to fully understand service throughout Puerto Rico, especially where data as reported to the FCC does not reflect the reality of residents.
- The **cost of Internet service and devices** and lack of knowledge of technology are significant barriers for residents.
- Puerto Rico's **tropical climate, frequent severe weather,** and **diverse topography** pose challenges for infrastructure construction and maintenance.
- **Permitting** can be a slow process, as often multiple agencies and municipal governments must evaluate environmental assessments and grant approval for projects.
- Puerto Rico's economy has been impacted by **labor shortages** across industries due to significant outmigration in recent years, lower salaries compared to other states, skill mismatches, and an aging population.
- **Heavy reliance on imports for materials** has made many construction projects vulnerable to disruptions and cost variations.

The PRBP will address major obstacles first while ensuring all residents, especially members of covered populations and those in underrepresented communities, have paths for connection and use of high-speed Internet. For a full discussion of needs, gaps, and barriers, and measures to address them, see Sections 3 and 4.

1.3 Priorities, Goals, and Strategies

In response to these needs, the PRBP has developed a comprehensive strategy to achieve connectivity, quality, accessibility, and knowledge for all residents through reliable, affordable high-speed Internet. As the FCC has mandated two providers through the Uniendo Puerto Rico fund to fulfill universal service commitments to all municipalities by 2028, Puerto Rico is in a unique position to plan an implementation strategy that supplements current plans and addresses digital equity needs. With approximately $1.2 Billion available to Puerto Rico across all funding sources, the PRBP plans to prioritize the following:

1. Providing gigabit service to all community anchor institutions,
2. Installing hardened and resilient infrastructure, and
3. Supporting digital equity for all residents.

The table below connects plan goals with the key strategies and supporting activities that the PRBP will undertake to achieve them. See Section 5 and the Digital Equity Plan for additional details on Puerto Rico's implementation strategy.

Figure 1: Plan Goals with PRBP Activities

Goal	Key Strategies and Support Activities
Competition among ISPs	· Include in all projects, mechanisms for the participation of small and medium-based enterprises based in Puerto Rico
Resilient broadband infrastructure	· Continue implementation of Infrastructure Hardening Grant Program · Launch multi-use underground and fiber conduit project · Launch Submarine Cable and Carrier Neutral Landing Programs · Launch Public Safety Telecommunication Hardening Program · Launch Government Data Sites Hardening Program
Eliminated barriers to new broadband infrastructure	· Work closely with government agencies, the Legislative body, and key stakeholders to ensure utility pole and conduit access, environmental permitting, "dig once" regulations, and access to public rights-of-way
Sustained and skilled broadband workforce	· Understanding and addressing workforce shortages · Collecting and analyzing data across the telecommunications workforce required to deploy BEAD and other telecommunications projects. · Define the full scope of occupations needed to deploy BEAD and other telecommunications projects. · Convene broadband industry partners to coordinate deployment needs · Launch Broadband Workforce Training and Career Pipeline Programs · Collaborate with academic institutions
Low-latency broadband speeds of 100/20 Mbps or more	· Enforce service provider commitments to FCC · Enable alternative ISPs through multi-use underground fiber and conduit project · Continue implementation of expanded wireless broadband through the Public Wi-Fi Infrastructure Program · Launch Quality of Service Recurrent Monitoring Program

Symmetrical gigabit service to community anchor institutions	· Launch multi-use underground and fiber conduit project · Support coverage within public housing units
Accessible, affordable broadband subscriptions and Internet-enabled devices Inclusive and accessible online public resources Digital literacy and digital skills for all residents Online security and privacy awareness	Refer to the Digital Equity Plan for more information on Puerto Rico's strategies for addressing the digital divide, including: · Multipurpose Community Technology Centers · Internet Community Centers · Digital Navigators · Technical Assistance Advisors · Device and Service Subsidies · Outreach for Affordable Connectivity Program Subsidies · Digital Equity Support Activities · Online security and privacy awareness education · Use of technology education

This historic investment in broadband infrastructure and digital equity will drive economic growth, empower communities, and improve the quality of life for Puerto Ricans through the transformative power of high-speed Internet and the knowledge to use it. Residents will be able to communicate in times of emergency and have greater access to the digital resources that support our daily lives. Further, these efforts will enable entrepreneurship and attract investment. Investing in broadband expansion and digital equity will make a transformative impact in Puerto Rico, driving progress and fostering a more inclusive and connected future for Puerto Rico.

SECTION 2

Overview of the Five-Year Action Plan

2.1 Vision

The Internet is essential infrastructure that supports how Puerto Ricans work, learn, receive health care, participate in democracy, and communicate with one another. Access to high-speed Internet is required for full participation in modern life and the 21st century economy. High-speed Internet access is no longer a luxury but rather a necessity for all Puerto Ricans.

Amidst catastrophic weather events, Puerto Rico has faced significant challenges providing and maintaining high-speed Internet for all residents. The devastating effects of Hurricane María in 2017, earthquakes in 2020, and Hurricane Fiona in 2022 caused lasting damage to Puerto Rico's existing telecommunications infrastructure, leaving many residents without Internet access for months. The lack of access to critical information and services during emergencies and in their aftermath has demonstrated the urgent need for a comprehensive and resilient broadband network in Puerto Rico.

Those events, along with the COVID-19 pandemic, crystallized what many have known for a very long time: broadband plays a fundamental role in today's society; it is central to Puerto Rico's health and prosperity and full participation in the modern economy to improve Puerto Rico's telecommunications infrastructure.

All Puerto Ricans can benefit from improved access to reliable and affordable high-speed Internet regardless of their age, race, or income, the language they speak, resources they have at their disposal, or specific challenges they may face in their daily lives. Successful broadband deployment efforts must provide access to reliable and resilient high-speed Internet to all residents, regardless of their location or socioeconomic status to bridge the digital divide. Internet connectivity is a necessary element for

eradicating the divide, but connectivity alone will not enable island-wide broadband adoption. Many people require equipment, digital skills, financial resources, and more to realize the Internet's and their own potential. Those who lack these resources face substantial barriers even in places where fast broadband connections are physically available. Digital equity and literacy are key for civic and cultural participation, employment, lifelong learning, insertion into Puerto Rico's economy and access to essential services.

Given Puerto Rico's unique deployment and affordability challenges, the Puerto Rico Broadband Program's vision is to:

Ensure all Puerto Ricans, regardless of their background or location, have access to the resources and opportunities necessary to thrive in the digital world and fully participate in modern society.

The Program will advance this vision through four key pillars:

1) **Connectivity** to resilient infrastructure,
2) **Quality** and speed for demanding use,
3) **Accessibility** at an affordable price, and
4) **Knowledge** of technology and digital tools.

These four pillars guide the Puerto Rico Broadband Program's (PRBP) planning efforts and capture key priorities. Through this initiative, the PRBP will establish a robust, sustainable, and equitable broadband infrastructure network that can withstand future natural disasters. This infrastructure is the foundation to effectively support Smart Island applications in Puerto Rico. Smart Island applications span both the public and private sectors, allowing governments, institutions and businesses to apply technology to improve their effectiveness and success. Puerto Rico's Telecommunication Infrastructure must provide Business to be able to host data an operate through on-premises services and or cloud services. Smart metering, remotely operated control devices, and smart sensors must be viable options to deliver improved utility and transportation services, and to provide businesses and the public more resilient information technology infrastructure. The Smart Island Initiative will facilitate improvements in broadband infrastructure and services, among other necessities.

Improved broadband infrastructure will also serve the diverse needs of residents and businesses. Digital equity outreach, programming, and adoption will encourage residents to utilize new broadband infrastructure, effectively supporting Puerto Rico's economic and social development. The PRBP is looking forward to continued collaborative, commonwealth-wide efforts between federal and local government agencies, private sector partners, and community organizations to bring high-speed Internet access to all Puerto Ricans.

Finally, our plans and initiatives for a robust island-wide broadband infrastructure will ensure that necessary and affirmative steps are taken to assure that minority businesses, women's business enterprises, and labor surplus area firms become mayor catalysts for economic growth and job creation.

2.2 Goals and Objectives

Following NTIA guidance, the Puerto Rico Broadband Program has established broad, short-term and long-term goals for broadband deployment and digital equity in Puerto Rico. These goals describe achievable outcomes supporting residents and fulfilling Puerto Rico's vision for all residents and businesses to thrive in the digital world.

The goals described below are supported by specific and obtainable objectives. These measurable, time-based objectives will help the PRBP evaluate progress and follow a clear path to reliable, high-speed connectivity and broadband adoption for all residents and businesses, aligned with the PRBP's four pillars: **connectivity and resilience, quality and speed, accessibility, and knowledge.**

2.2.1 Connectivity and Resilience

Puerto Rico's priorities will be to create resilient infrastructure along key routes that connect community anchor institutions while providing access to hardened infrastructure for multiple use cases, including middle mile networks, last mile networks, utility communications, and wireless backhaul.

Past broadband deployment on Puerto Rico, discussed further in Sections 3 and 4, has been significantly impacted by storms and deterioration. Puerto Rico will be prioritizing efforts to ensure that all new infrastructure is strategically planned, and all existing infrastructure is made more resilient through additional hardening to withstand the test of time, while also adopting scalable technologies. To achieve connectivity and resilience for all, the PRBP will focus on the following goals and objectives:

GOAL 1:
Broadband Resilient Infrastructure Island Wide

Objectives:
Within four years:

- All municipalities will have resilient fiber optic cable along key routes, supplemented by resilient microwave routes where required by complexities in topography, available for multiple uses including middle mile networks, last mile networks, utility communications, government and emergency communications, community anchor institutions, and wireless backhaul.[1]
- Key infrastructure points such as wireless towers, points of presence, and major equipment shelters will be resilient against expected environmental challenges and power failures. This includes appropriate structural reinforcement, back-up power, and redundant connections to other network infrastructure.
- Puerto Rico will have multiple, geographically diverse undersea fiber optic cable landing stations, including adding on the west, south, and east coasts of Puerto Rico.
- Ensure that the network built can easily scale speeds over time to meet the evolving connectivity needs of households and businesses and support the deployment of 5G, successor wireless technologies, and other advanced services.

[1] See Section 3 for more information on community anchor institutions.

GOAL 2:
Address barriers for building new broadband infrastructure.

Objective:

- The PRBP will work closely with central government agencies, municipalities, and other key stakeholders to ensure clear, consistent, and expeditious processes for utility pole and conduit access, environmental permitting, environmental requirements, "dig once" regulations, and access to public rights-of-way.

GOAL 3:
Promote competition among Internet Service Providers, including small and medium enterprises.

Objective:

- Throughout the implementation of the Infrastructure Investment & Jobs Act (IIJA) funding, new government funded infrastructure will be available for use by multiple service providers. Whenever feasible, all projects will include mechanisms for the participation of small and medium enterprises and minority businesses based in Puerto Rico. The government's efforts to promote competition and improve the quality of broadband Internet service are essential to Puerto Rico's economic development. Broadband Internet is a key driver of economic growth. By promoting competition and improving the quality of broadband Internet service, the government is helping to create a more competitive and prosperous economy in Puerto Rico.

GOAL 4:
Sustain a skilled broadband workforce to meet deployment needs.

Objectives:

- Understanding and addressing workforce shortages
- Collecting and analyzing data across the telecommunications workforce required to deploy BEAD and other telecommunications projects.
- Define the full scope of occupations needed to deploy BEAD and other telecommunications projects.
- All broadband industry partners will convene to coordinate deployment needs by 2024.
- Industry-driven training programs with work-based learning opportunities will be planned for implementation between 2024 and 2025.
- Puerto Rico will create career exploration opportunities for K-12 students to support long-term talent development as well community colleges and university opportunities.
- Puerto Rico will develop local workforce by training workers in other similar industries who can be quickly certified in new roles related to broadband.

[2] According to the National Digital Inclusion Alliance, a digitally literate person: Possesses the variety of skills – technical and cognitive – required to find, understand, evaluate, create, and communicate digital information in a wide variety of formats; Is able to use diverse technologies appropriately and effectively to retrieve information, interpret results, and judge the quality of that information; Understands the relationship between technology, life-long learning, personal privacy, and stewardship of information; Uses these skills and the appropriate technology to communicate and collaborate with peers, colleagues, family, and on occasion, the general public; and Uses these skills to actively participate in civic society and contribute to a vibrant, informed, and engaged community. Source: National Digital Inclusion Alliance State Digital Equity Plan Toolkit. Accessible at: https://www.digitalinclusion.org/state-digital-equity-plan-toolkit/

2.2.2 Quality & Speed

All residents must be able to rely on high-speed, quality service regardless of where they access the Internet in Puerto Rico. By monitoring service offerings and the residential broadband consumer demographic, Puerto Rico aims to improve the availability of information for consumers and the public regarding their broadband services. Additionally, the standardized QoS metrics will assist ISPs in identifying areas for improvement, while providing consumers with a basis for selecting reliable and reputable service providers. Ultimately, this initiative seeks to promote accountability, transparency, and equitable access to high-quality telecommunications services throughout Puerto Rico.

Quality high-speed Internet is critical for remote working, distance learning, and telehealth—only some of the many opportunities in the digital world made available with a reliable Internet connection. High-speed, reliable Internet eliminates problems like buffering, failed uploads, poor-quality video calls, and a host of other poor connectivity issues. Resilient, storm-hardened infrastructure suited to the various geographies of Puerto Rico will support quality and speedy connections for homes, businesses, offices, and more. The PRBP will consider additional efforts that support and upgrade all broadband infrastructure to the highest possible speeds. To ensure all residents have fast and quality service, the PRBP will focus on the following goals and objectives:

GOAL 1:
Access to low-latency broadband at speeds of 100/20 Mbps or more.

Objectives:

- All Broadband Serviceable Locations in Puerto Rico will have access to broadband at speeds of 100/20 Mbps or more and latency of 100 milliseconds or less by 2027.
- Over time, Puerto Rico programs for new or upgraded broadband infrastructure will require or prefer projects capable of 1000/500 Mbps service or greater and service via fiber optic technology wherever feasible.

GOAL 2:
Community anchor institutions access to symmetrical gigabit service.

Objective:

- Throughout the BEAD deployment time frame, routes for fiber optic cable will prioritize connection to community anchor institutions and will retain high-speed service for their essential community work.
- In addition to administrative offices, classrooms and other areas of schools will be connected to high-speed Internet and Wi-Fi enabled to support online educational services for every student.
- Coverage will be made available to public housing buildings and within units.

2.2.3 Accessibility

The Puerto Rico Broadband Program is committed to making high-speed Internet accessible and affordable to all, especially residents for whom the cost of Internet services has been a significant burden or barrier.

Pervasive barriers for low-income households include high-cost broadband subscriptions and expensive devices. Opportunities that require reliable Internet remain inaccessible for low-income households when cost continues to be the primary limitation. Most low-income households do not find necessary connecting their household to Broadband service since they have it already available in their mobile devices. Affordability is a top priority informing infrastructure planning and collaboration with Internet service providers in Puerto Rico. To ensure all residents can access the Internet and devices at an affordable price, the PRBP will focus on the following goals and objectives:

GOAL 1:
Broadband subscriptions will be accessible at affordable prices.

Objectives:

- Relationships with Internet service providers will support development of affordable options for low-income households and facilitate sharing of adoption rate data.
- Service affordability measures will be integrated into infrastructure planning.
- Enrollment in the FCC's Affordable Connectivity Program will increase throughout Puerto Rico in alignment with the targets outlined in the Digital Equity Plan.
- Whenever feasible, affordability programs will include mechanisms for the participation of small and medium enterprises based in Puerto Rico.

GOAL 2:
Internet-enabled devices will be accessible and affordable.

Objectives:

- Puerto Rico will support device distribution through partnerships with device refurbishment organizations.
- By 2025, all Puerto Ricans will have access to affordable devices that meet their individual needs and technical support for maintenance and repair.
- By 2025, affordable adaptive accessories will be available for covered populations and residents with special needs.

GOAL 3:
Online public resources will be inclusive and accessible to all Puerto Ricans, regardless of ability.

- Online government services will be fully inclusive and accessible for all civic and social services.

2.2.4 Knowledge

For all residents to access online health care, school, work, and public services safely and effectively, the

Puerto Rico Broadband Program will work to increase the number of digitally literate residents in Puerto Rico.[2]

Even with an affordable connection and Internet-enabled device, many people require additional support to access the Internet and participate fully in online opportunities. As residents gain access to affordable high-speed service and digital devices, the PRBP will support programming for digital literacy that provides individuals of various skill levels with the knowledge and training they need to take advantage of the digital world's possibilities. To ensure all residents are empowered to utilize technology, the PRBP will focus on the following goals and objectives:

GOAL 1:
Support digital literacy and digital skills for all residents.
Objectives:

- Continual updates will be made to the existing digital literacy programs and best practices inventory.
- Puerto Rico will support the development of a commonwealth-wide, culturally relevant digital navigator program through partnership with local government agencies, non-profits, libraries, schools, and technology centers to incorporate any existing programs or resources.

GOAL 2:
Promote the importance of online security and privacy.

Objective:

- Puerto Rico will initiate partnerships with the Puerto Rico Innovation & Technology Service and across other government agencies and community organizations to create educational information about online scams, online phishing, and other cybersecurity threats.

GOAL 3:
Outreach efforts to communicate all advances in Connectivity in Puerto Rico
Objective:

- Puerto Rico will partner with the Tourism Company, Invest Puerto Rico and the Destination Marketing Organization to promote abroad all advances in Telecommunications and Connectivity in Puerto Rico.

In addition to improving the quality of life for residents and businesses, better connectivity and resources will attract the Puerto Rican diaspora to return to Puerto Rico for educational, business, and professional opportunities. By showcasing advancements in technology and infrastructure, broadband efforts can entice skilled professionals and entrepreneurs to establish themselves on Puerto Rico, ultimately contributing to the growth of the local economy. With access to high-quality education and a thriving business environment, returning Puerto Ricans can help to create a self-sustaining and prosperous community. Initiatives in this strategic plan have the potential to serve as a beacon of progress and a source of pride for the people of Puerto Rico, inspiring others to invest in Puerto Rico's future.

[2] According to the National Digital Inclusion Alliance, a digitally literate person: Possesses the variety of skills – technical and cognitive – required to find, understand, evaluate, create, and communicate digital information in a wide variety of formats; Is able to use diverse technologies appropriately and effectively to retrieve information, interpret results, and judge the quality of that information; Understands the relationship between technology, life-long learning, personal privacy, and stewardship of information; Uses these skills and the appropriate technology to communicate and collaborate with peers, colleagues, family, and on occasion, the general public; and Uses these skills to actively participate in civic society and contribute to a vibrant, informed, and engaged community. Source: National Digital Inclusion Alliance State Digital Equity Plan Toolkit. Accessible at: https://www.digitalinclusion.org/state-digital-equity-plan-toolkit/

SECTION 3

Current State of Broadband and Digital Inclusion

The Puerto Rico Broadband Program has taken a holistic view of ongoing broadband deployment and digital inclusion efforts to inform planning. Through unprecedented opportunity provided by federal and local broadband and digital equity programs, the PRBP has inventoried the current state of broadband activity and collated ongoing digital equity and inclusion work across Puerto Rico.

Throughout this section, the PRBP highlights efforts already underway to provide connectivity and resilience, quality and speed, accessibility, and knowledge to all residents. Additionally, this section presents personnel, structural, financial, and inclusion resources, analyzes the current state, and offers paths forward to address outstanding needs. These efforts ensure the government can leverage and coordinate all resources available to successfully provide high-speed Internet for all residents.

3.1 Existing Programs

This section illustrates the capacity of the Puerto Rico Broadband Program and planned expansion to continue supporting broadband deployment throughout Puerto Rico. Recognizing the challenge of coordinating efforts in unison with additional funding sources, the PRBP has documented resources available including current employees, contractor support, and existing infrastructure programs. Coordination between federal and local entities will continue throughout the implementation phases of federal programs, including the Broadband, Equity, Access, and Deployment (BEAD) Program, State Digital Equity Program, and others described below.

3.1.1 Puerto Rico Broadband Program, Office of Management and Budget

In July 2022, the Hon. Pedro R. Pierluisi, Governor of Puerto Rico, established the Puerto Rico Broadband Program via Executive Order 2022-040.[3] The Program, hosted by Puerto Rico's Office of Management and Budget (OMB), is tasked with the deployment of local and federal funds for broadband infrastructure deployment and related digital inclusion efforts on Puerto Rico. The PRBP is overseen by an Executive Committee including representatives from the Office of Management and Budget, Telecommunications Bureau, the Department of Treasury, the Puerto Rico Innovation and Technology Service, and the Auxiliary Secretary of the Governor on Innovation, Information, Technology and Data.

The Puerto Rico Smart Island Initiative encompasses all planning and implementation conducted by the Puerto Rico Broadband Program. The Smart Island Initiative promotes the goals and objectives described in Section 2, emphasizing the vision for a "smart island" equipped with the technology to support full participation in the digital world. Amidst stakeholder engagement and infrastructure planning throughout its first year, the PRBP has conducted a series of ongoing activities supporting achievement of program goals.[4] Figure 2 below details ongoing activities conducted by the PRBP.

Figure 2: PRBP Activities

Activity	*Description*	*Intended Outcomes*
Fortaleza por Puerto Rico	PRBP has joined the Office of the Governor and government agencies in monthly events across Puerto Rico to identify connectivity needs and inform communities about broadband subsidy resources.	Feedback collected at these events has and will continue to inform broadband planning. Events help residents gain access to Affordable Connectivity Program information and enrollment steps.
Affordable Connectivity Program Training	PRBP has hosted training sessions for trusted community leaders on the Affordable Connectivity Program.	Community leaders have been equipped with broadband subsidy enrollment information to share alongside the services they provide.
Broadband Advisory Council	PRBP has convened its broadband advisory council of key stakeholders to review planning strategies and coordinate government initiatives.	The council has and will continue to provide feedback on infrastructure planning.
Digital Equity Committee	PRBP established a Digital Equity Committee with representatives of covered populations to inform digital equity strategies.	The digital equity committee has and will continue to provide advice for effective digital inclusion programming.

[3] Puerto Rico Department of State, https://www.estado.pr.gov/ordenes-ejecutivas
[4] For more information on stakeholder engagement conducted by the Puerto Rico Broadband Program, see Section 5.

Labor and Workforce Committee	PRBP established a Labor and Workforce Committee with higher education and workforce leaders to inform labor strategies.	The labor committee has and will continue to provide specialized knowledge for workforce strategies.
Individual Visits to Municipalities	The PRBP and/or its contracted personnel will visit the 78 municipalities in Puerto Rico to validate data, coordinate with local governments and inspect Internet facilities.	This activity will help identify more specific needs and promote a full environment of collaboration and communication with local governments.
Smart Island Summit	Funded by BEAD, we developed the Smart Island Summit. The Summit was created to bring together municipalities, industry leaders, academics, and advocates to discuss issues related to broadband access, adoption, and deployment. It was a full-day event at the Puerto Rico Convention Center in San Juan. It had a participation of 300 people and speakers and panels that talked about the importance of knowledge, and connectivity where feedback was excellent. For the event, we developed a brochure that describes the objectives of the program and connected it to a survey for planning our program data.	The purpose was to facilitate a collaborative effort among these stakeholders to address challenges and opportunities related to broadband connectivity, education and develop strategies to improve high-speed Internet access and adoption. We also shared surveys that the outreach funds require to obtain more accurate data to determine necessities for better implementation.
Listening Sessions	The PRBP had listening sessions with stakeholders such as municipalities, organizations, community leaders & covered populations, among other groups, since January 2023.	Introducing the PRBP initiatives while understanding the community needs with their feedback, so the program can align program efforts.
Surveys	Targeting different groups, like community leaders, organizations, general population	General population (digital & Phone): measure connectivity, digital skill set & home speed Community Leaders (In-Person): understand their community broadband adoption & knowledge Organizations (Digital & Phone): Understand current efforts that organizations are making towards closing the digital divide

The PRBP focuses on establishing robust, sustainable, and equitable broadband infrastructure that can withstand future disasters and support Puerto Rico's economic and social development. Figure 3 details the roles of each of the current four PRBP team members supporting the Smart Island Initiative, as well as plans to expand the team to 14 employees during implementation of federal funds, including the BEAD Program.

Figure 3: PRBP Team Organization

Position	*Description of Role*
Director	
Broadband Director	Will lead strategic decisions and oversee broadband infrastructure programming full-time
Program Administrative Assistants	Assists Director and PRBP with daily office management
Communications & Outreach	
Outreach Project Manager	Leads communications and PRBP-hosted outreach events
Outreach Project Coordinator	Supports communications and PRBP-hosted outreach events
Outreach Planner	Supports digital equity and inclusion initiatives
Infrastructure & Planning	
Infrastructure Senior Project Manager	Will manage strategy and operations for broadband deployment
Broadband Project Manager	Will assist with management of broadband projects and funding requirement implementation
Infrastructure Coordinator	Will provide contractor guidance and support broadband implementation
GIS Coordinator	Will support the development of mapping resources and infrastructure design
Legal and Compliance	
Grant Program Leader	Will support grant recipients and the grant development process
Legal Advisor	Will provide legal guidance and compliance recommendations
Administrative Senior Project Manager	Will provide oversight of federal and local broadband program funds
Finance Advisor	Will assist with fund management and compliance
Finance Associate	Will assist with accounting tasks and financial reports

The PRBP has procured external contractor assistance for efficiency and subject matter expertise. Current contractors have supported the development of this plan and program design across funding sources, in addition to providing publicity and outreach support throughout PRBP's first year. Planned contractor services will assist in implementing and administering federal funds, including the BEAD Program. Figure 4 describes current and planned contractor services reporting to the PRBP.

Figure 4: PRBP Planned Contractor Services

Position	*Description of Role*
Communications & Outreach	
Communications, Press, Publicity, and Outreach	Third-party contractors have supported production and publicity of PRBP's branding, the Smart Island Initiative, and public engagement materials.
Infrastructure & Planning	
Infrastructure Advisor	Third-party contractor has provided technical and stakeholder assistance for infrastructure planning, including liaison services between industry providers and government partners.
GIS Manager	Third-party contractor has provided GIS and mapping services for the FCC's Broadband Data Collection challenges and infrastructure design planning.
Planning and Program Design	Third-party contractor, with experience advising state broadband offices, has provided PRBP planning and program design support for federal and local funds.
Digital Equity Planning Support	Third-party contractor, previously engaged with the Government of Puerto Rico, has provided digital equity initiative support, including a covered populations survey, review of digital inclusion programs, and support on Puerto Rico's digital equity asset inventory.
Legal and Compliance	
Compliance Support	Will provide reporting, monitoring, and subgrantee management support
Grant Administration	
PRBIF Administrator	Third-party contractor, in addition to planning support, is serving as Grant Administrator for local Puerto Rico Broadband Infrastructure funds, supporting applications, evaluations, and compliance.
ACP Fund Administrator	Will provide oversight for ongoing ACP outreach enrollment activities
BEAD Fund Administrator	Will provide oversight for ongoing BEAD-funded activities
CPF Fund Administrator	Will provide oversight for Capital Projects Fund activities

In addition, the Puerto Rico Broadband Program and the Office of Management and Budget (OMB) have collaborated with various government agencies, including the Office of the Governor and the Puerto Rico Innovation and Technology Service. Engineering specialists, telecommunications experts, and technology professionals previously engaged with the Government of Puerto Rico have lent their expertise to broadband planning and provided timely assistance to the PRBP's staff in gathering information about broadband needs among the population and Community Anchor Institutions and the infrastructure efforts to cover the needs identified. This process of collaboration across Puerto Rico's government agencies will continue throughout program implementation.

As outlined throughout this Five-Year Action Plan, the PRBP will implement a comprehensive plan for connecting residents, investing federal and local funding. Figure 5 identifies the funding currently available for broadband deployment and digital equity activities. Section 5 details PRBP's planned activities for those funds.

Figure 5: PRBP Funding Currently Available

Source	*Purpose*	*Total*
Puerto Rico Broadband Infrastructure Fund	Deployment of resilient infrastructure and improved connectivity in public spaces	$400,000,000
U.S. Department of the Treasury Capital Projects Fund	Expansion and upgrades of broadband infrastructure	$158,310,000
Broadband Equity, Access, and Deployment (BEAD) Funds	Infrastructure planning, digital inclusion initiatives, and deployment projects	$334,614,151
State Digital Equity Planning Grant	Identification of barriers to digital equity and strategies for addressing them	$781,987
Affordable Connectivity Program Outreach Grant	Increase enrollment in the Affordable Connectivity Program	$740,000

3.1.2 Existing Infrastructure Programs

During development of new program strategies, the PRBP inventoried existing infrastructure programs through a third-party contractor to ensure all plans are coordinated with projects currently underway on Puerto Rico.

Projects administered by the Federal Government in recent years have focused on supporting Puerto Rico's disaster recovery, providing resilient infrastructure options, and utilizing fiber-to-the-premises technology. The PRBP has taken a similar approach in awards from local funds to provide resilient infrastructure and create opportunities for residents to access free Wi-Fi in public spaces. The following section presents the status of three recent federal broadband deployment programs in Puerto Rico, as well as the activities PRBP has already begun with local broadband infrastructure funding.

Federally Administered Infrastructure Programs

The Federal Government has launched multiple initiatives to spur private investment in broadband infrastructure, with each initiative advancing a different broadband technology. These efforts underway are enhancing resiliency and redundancy in telecommunication networks in Puerto Rico.

Uniendo a Puerto Rico

In 2018, the Federal Communications Commission (FCC) established the Uniendo a Puerto Rico (Bringing Puerto Rico Together) Fund to provide high quality, resilient deployment and restore gains eliminated by devastating Hurricanes Irma and María in 2017.

In Stage I, in 2018, the FCC provided $51.2 million to Puerto Rico to repair and restore essential voice and broadband communications networks to existing customers. The FCC also declined to recover funds from previously awarded emergency funding that met telecommunications needs and repair costs immediately after the storms.

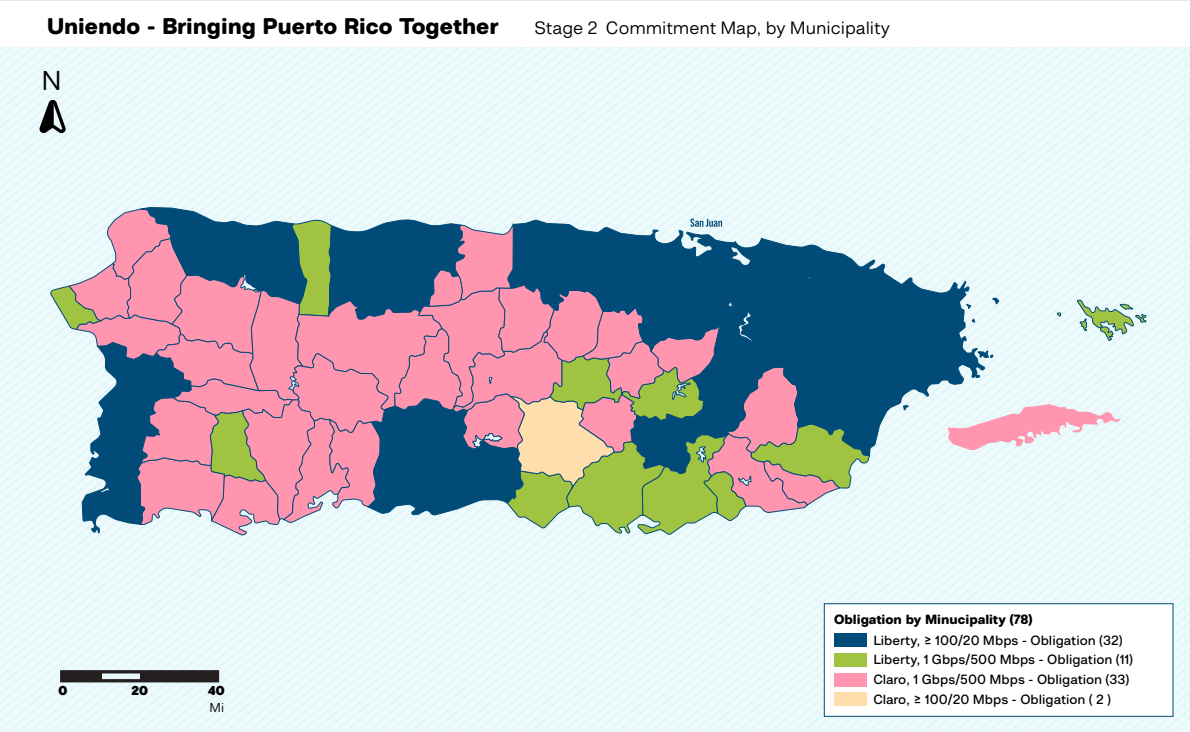
In Stage II, in 2019, the FCC allocated $127.1 million in fixed broadband support.[5] In the competitive process for long-term support, preference was given to buried fiber and resiliency solutions, including fixed wireless connections to end user locations, microwave backhaul, satellite, and high-wind rate composite poles over traditional poles. Figure 6 below details Uniendo fixed support awards.

Figure 6: Uniendo Fixed Support Awards

Service Provider	*Award ($M)*	*Municipalities*	*Locations*
Liberty	$71.54	43	914,000
Claro	$55.56	35	308,000

Providers Liberty and Claro committed to providing at least 100/20 Mbps service to more than 2/3 of their awarded locations and gigabit service to at least 30% of their awarded locations. All locations must be serviced with committed speeds by 2028, with interim deployment milestones in the preceding three years. Commitments include a minimum monthly usage allowance of 200 GB and a maximum roundtrip broadband and voice latency of 100 milliseconds. Figure 7 below highlights deployment obligations of each service provider by municipality.

Figure 7: Uniendo Deployment Obligations - Map



[5] Uniendo a Puerto Rico Fund and the Connect USVI Fund, Order, WC Docket Nos. 18-143, 10-90, 14-58, 34 FCC Rcd 9109 (Sept. 30, 2019) (PR-USVI Stage 2 Order). https://docs.fcc.gov/public/attachments/FCC-19-95A1_Rcd.pdf.

Stage II authorized an additional $233.9 million in mobile broadband support to three carriers over a three-year period. Carriers were required to restore 100% of network coverage to pre-hurricane levels by June 2023. Up to 75% of mobile awards could be used to expand and harden existing 4G LTE networks, and 25% was designated for deployment of 5G networks in restored areas. Figure 8 below details Uniendo mobile support awards.

Figure 8: Uniendo Mobile Support Awards

Service Provider	*Award ($M)*
Liberty	$97.8
T-Mobile	$59.6
Claro	$76.6

USDA ReConnect

In 2022, the United States Department of Agriculture (USDA) awarded a grant to VPNet, Inc. in Puerto Rico during the third funding round of the ReConnect Program.[6] ReConnect funds are awarded to projects with financially sustainable business models that bring high-speed broadband to rural homes, businesses, farms, ranches, and community facilities, such as first responder facilities, healthcare sites, and schools. VPNet was awarded $8.7 million to serve municipalities Patillas and Arroyo. The rural development project will connect 1,200 homes and seven public schools using a fiber-to-the-premises network.[7]

FEMA Disaster Recovery Programs[8]

The 2017 hurricane season brought devastation to Puerto Rico with Hurricanes Irma and María. Between the two hurricanes, FEMA Individual Assistance Program estimated 1,067,618 homes were damaged. Due to the severity of the impact caused by Hurricane María, the President declared a major disaster in Puerto Rico and ordered federal assistance to supplement local recovery efforts. The Federal Emergency Management Agency (FEMA) and the Central Recovery and Reconstruction Office of Puerto Rico (COR3) are working together to ensure that the Government of Puerto Rico successfully undertakes the recovery efforts with efficiency, effectiveness, and transparency, while capitalizing on opportunities to build back in a way that makes Puerto Rico better, stronger, and more resilient.

The supplemental federal disaster grant assistance offered to state, local, and non-profit organizations through programs led by FEMA and others are fundamental to Puerto Rico's recovery and reconstruction efforts. FEMA is leading two projects: Road to Recovery and Road to Resilience. $8.8 billion in Road to Recovery projects are focused on the rebuilding and restoration of Puerto Rico's infrastructure, including roads and bridges, public utilities, water control facilities, public buildings, parks, and recreational facilities, connected to the Damage Inventory. Figure 9 shows locations of FEMA Road to Recovery Hurricane and Earthquake projects throughout Puerto Rico.

[6] https://www.rd.usda.gov/newsroom/news-release/biden-harris-administration-provides-759-million-bring-high-speed-internet-access-communities-across-4
[7] USDA, "ReConnect Program FY 2022 Funding Opportunity Announcement Awardees," USDA, September 2022, https://www.usda.gov/reconnect/round-three-awardees.
[8] Central Office for Recovery, Reconstruction and Resiliency (COR3), "Transparency Portal," Government of Puerto Rico, July 10, 2023, https://recovery.pr.gov/es.

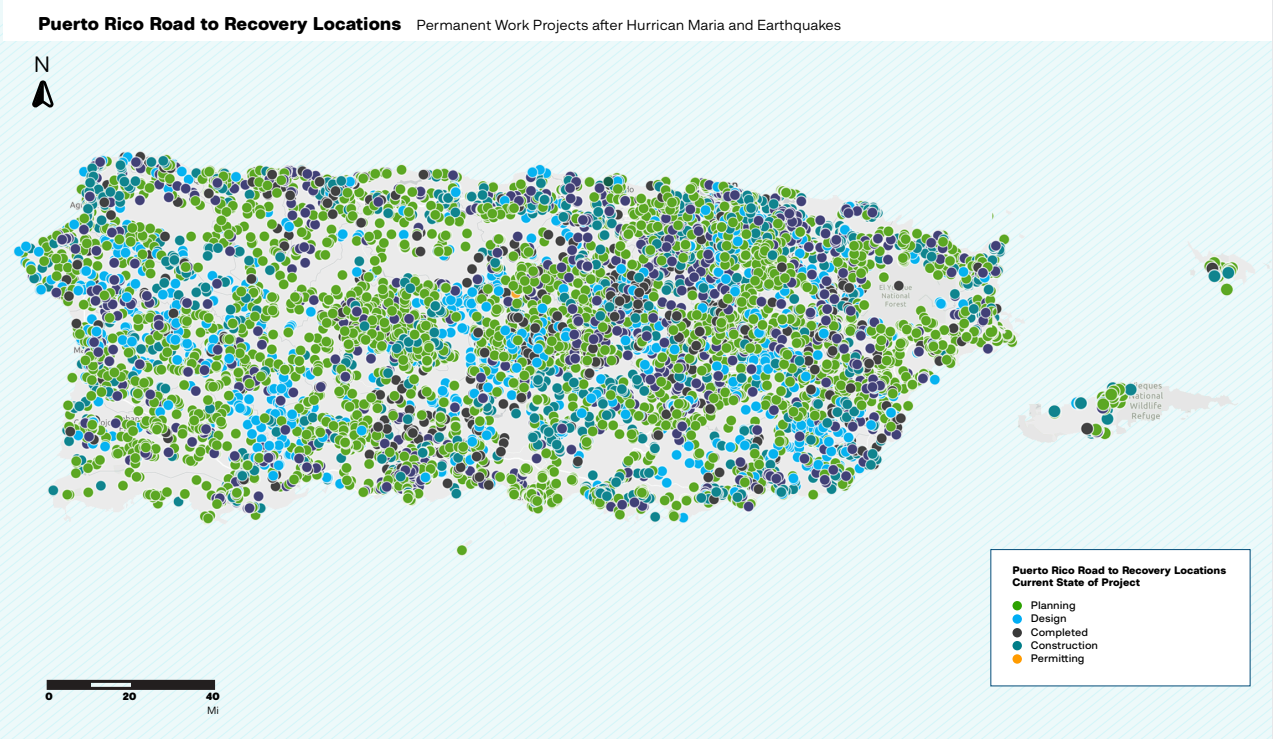
Connecting Minority Community Programs (Ana G. Méndez and Sagrado Corazón)

The Connecting Minority Communities Pilot Program is a $268 million grant program to Historically Black Colleges and Universities (HBCUs), Tribal Colleges and Universities (TCUs), and Minority-Serving Institutions (MSIs) for the purchase of broadband internet access service and eligible equipment or to hire and train information technology personnel. Puerto Rico received a nearly $3 million award from the National Telecommunications and Information Administration's Connecting Minority Communities program for the Universidad del Sagrado Corazón and Universidad Ana G. Méndez to bridge the digital divide at institutions of higher education.[9]

Middle Mile (Liberty)

Liberty Communications of Puerto Rico, LLC was recently awarded $9,303,468.52 as part of the National Telecommunications and Information Administration's Middle Mile Grant Program. This project, with a total project cost of $18,986,670.45, will fund 63 miles of new middle mile infrastructure in geographies where the applicant has been awarded Uniendo a Puerto Rico Fund ('Uniendo') from the Federal Communications Commission (FCC) for last-mile services.[10]

Figure 9: FEMA Road to Recovery Locations - Map



$2.4 billion in Road to Resilience projects was allocated through the Hazard Mitigation Grant Program (HMGP) of FEMA. These efforts are led by municipalities and are aimed at reducing risk to life and property

[9] https://www.whitehouse.gov/briefing-room/statements-releases/2023/06/26/fact-sheet-biden-harris-administration-steadfast-in-support-of-puerto-ricos-renewal/
[10] https://broadbandusa.ntia.gov/funding-programs/enabling-middle-mile-broadband-infrastructure-program/funding-recipients#P

by reducing impacts caused by natural disasters . Priority projects improve infrastructure resilience through mitigating risk of floods, effects of climate change, and coastal erosion. The program promotes the use of renewable energy, repairing structures damaged by seismic activity, preventing landslides, developing emergency systems, and enhancing community resilience.

Road to Recovery and Road to Resilience projects are both fundamental to universal broadband infrastructure and digital equity initiatives. While Road to Recovery and Road to Resilience are not necessarily broadband projects, the infrastructure and services they support are complementary to any broadband projects. FEMA is rebuilding the infrastructure, roads, and bridges that serve as the rights of way for broadband fiber deployment. Public parks and public plazas are among identified community anchor institutions and are therefore essential for broadband access, availability and resilience. Emergency management systems and the first responders who use them are critical assets for broadband infrastructure and sustainable resources to the community. Figure 10 below summarizes disaster-related funds.[11]

Figure 10: Disaster-Related Funding

Reconstruction Projects	*Total Project Cost($B)*	*Purpose*
Road to Recovery	$8.8	Infrastructure, public utilities, aqueduct/sewer, buildings, roads/ bridges, parks, recreation
Road to Resilience	$2.4	Infrastructure resilience through risk mitigation of natural disasters, development emergency systems, and community resilience.

Puerto Rico Broadband Infrastructure Fund

In the Government's Certified Fiscal Plan and Budget for Fiscal Year 2020-2021, $400,000,000 was allocated for the Puerto Rico Broadband Infrastructure Fund (PRBIF).[12] The PRBIF is intended to support expansion efforts in unserved and underserved areas through grants that fund a portion of the deployment costs in these communities. These appropriated funds incentivize private sector investments in broadband build-out and improve access to faster speed offerings.

PRBIF programs complement federally funded broadband programs to accelerate growth and support expansion efforts in broadband access. To date, the Puerto Rico Broadband Program has launched two programs through the PRBIF.[13] Figure 11 below describes current PRBIF programs.

[11] Ibid Central Office for Recovery, Reconstruction and Resiliency (COR3).
[12] Telecommunications Bureau, "Registry of Towers," Government of Puerto Rico Labor Relations Board, accessed July 10, 2023, https://jrtpr.pr.gov.
[13] Telecommunications Bureau, "Registry of Towers," Government of Puerto Rico Labor Relations Board, accessed July 10, 2023, https://jrtpr.pr.gov.

Figure 11: Current and Future PRBIF Programs

Program	*Allocated Funds ($M)*	*Status*	*Intended Outcomes*	*Obligation*
Public Wi-Fi and Wireless Broadband	$50	Phase I Launched	Deployment and operation of public Wi-Fi hotspots and additional infrastructure supporting fixed and mobile wireless broadband service	Recipients must provide operations, maintenance, and upgrades for at least 10 years.
Resilient Power and Hardening	$30	Phase I Launched	Design and implementation of resilient power and hardened infrastructure to key telecommunications facilities	Recipients will receive grant reimbursements following completion of awarded projects.
Submarine Cable Resiliency Program	$70	Planning	Add resilient and redundant submarine cable capacity to Puerto Rico	Recipient will own and operate resilient submarine cable infrastructure
Off-Island Submarine Cable connectivity	$34	Planning	Add additional paths to other off-island connection points to ensure connectivity in the event of a disaster.	Recipient will own and operate resilient submarine cable infrastructure
Support for Underground Fiber Program	$100	Planning and Conceptual Design	Add resilient and redundant underground cable capacity to Puerto Rico	Recipient will own and operate resilient underground cable infrastructure
Support for the FCC ACP Outreach Grant	$.760	Planning and Procurement	Increase ACP enrollment in Puerto Rico	Recipients will engage in ACP outreach activities
Communication and Educational Campaigns	$1.5	Planning	Programs aimed at removing the digital divide for the general population.	Recipients will engage in community outreach activities
Quality of Services Monitoring	$8	Planning and RFP Preparation	Improve the availability of information for consumers and the public regarding their broadband services.	Vendor will provide services specified in the scope of work
Quality of Services Public Serving Government Agencies Infrastructure	$30	Planning	Ensure resilient telecommunications for key governmental agencies	Recipients will enable resilient telecommunications capabilities for government agencies
Carrier Neutral Landing Stations	$51	Planning	Landing stations to connect to the submarine cable to the land-based network.	Recipient will own the facilities and ensure neutrality in allowing competitive providers with access.
Multipurpose Community Technology Centers	$64	Planning	Regional Multipurpose Community Technology Centers where the community can receive education and technical help with technology and telecommunications needs.	Recipients will own and operate the centers.

3.2 Partnerships

Puerto Rico's partners, both new and existing, are engaged in the development and implementation of this strategic plan for broadband deployment and digital inclusion. Figure 12 below provides an overview of partners, their current role as applicable, and projected function in broadband equity, access, deployment, and adoption.

Figure 12: PRBP Partners in BEAD

Partners	*Description of Current or Planned Role in Broadband Deployment and Adoption*
Puerto Rico Government	Office or Personnel Management (OPM) in cooperation with state agencies support BEAD, Digital Equity and ACP Outreach Program. They provide state matching funds, oversight, financial stewardship, strategy, and management of public-private partnership agreements for broadband deployment and adoption.
Department of Economic Development (DDEC)	Trusted messenger agency partner in the Workforce Development Program. Agency will promote broadband development through financial incentives to individuals.
Office for Socioeconomic and Community Development (ODSEC)	Trusted messenger agency partner in ACP outreach and ACP adoption as well as all outreach efforts focusing on special communities in Puerto Rico.
Department of Education (PRDE)	Trusted messenger agency partner in ACP outreach and ACP adoption. Integrating broadband as a tool to assist in primary and secondary education.
Department of Housing (Vivienda)	Trusted messenger agency partner in ACP outreach and ACP adoption. Developing quality and resilient broadband on public housing
Public Housing Organizations / Multi-tenant units	Important presence offering venues for eligible (ACP) individuals/households, including covered populations for broadband adoption.
Telecommunications Regulatory Board of Puerto Rico (NET)	Trusted messenger partner in ACP outreach and adoption. Facilitate ISPs in ACP enrollment.
Department of Public Safety (DSP)	Will help in the integration of their own telecommunications network regarding public safety and emergency management-interoperability
The Puerto Rico Permit Management Office (OGPe)	Will help to expedite processes regarding the telecommunication permits approval process
The Puerto Rico Department of Transportation and Public Works (DTOP)	Will help with permitting process regarding the necessary excavations in infrastructure deployment.
Puerto Rico Highway Authority (ACT)	Will help with the planning process for the construction of fiber in major highways.

Partners	*Description of Current or Planned Role in Broadband Deployment and Adoption*
Education	
Higher education (colleges / universities)	Thought leaders, content creators for distance learning, workforce development, human capital development. Potential evaluation partners. Anchor broadband tenants for broadband deployment and adoption.
Technical colleges	Thought leaders and content creators for on-line dual enrollment classes, GED classes, and workforce development for broadband adoption and use.
K-12 education	Future workforce for "digital natives", content creators for remote learning, homework, and potential on-line dual enrollment with technical colleges and/or universities for broadband adoption and use.
Childcare	Likely the most untapped resource. Young "digital natives" will have access to early childhood digital learning. Parents, guardians, caregivers have a natural place to access the Internet in a familiar, frequented environment for broadband adoption and use.
Libraries	Centerpiece for on-line learning, research, and quality people support to assist with digital literacy and use of digital tools and applications for 21st century on-line needs, e.g., job applications, eCommerce, on-line banking, government assistance, Internet research, etc. for broadband adoption and use.
Healthcare	
Hospitals / medical providers	Leaders in telehealth. Hospitals and medical providers provide medical resources, specialists, and scarce resources for diagnosis, monitoring and treatment, for broadband adoption and usage.
Health Clinics	Health Clinics are local to the consumer and can partner with hospitals and other medical providers to serve the local resident's medical needs for broadband adoption and use.
Public Safety	
EMT	EMT's are first responders in emergencies. Their need for real-time communication of complex data makes them consumers of broadband adoption and use.
Police	Police are first responders in emergencies. Their need for real-time communication of complex data makes them consumers of broadband adoption and use.
Fire	Fire are first responders in emergencies. Their need for real-time communication of complex data makes them consumers of broadband adoption and use. Their station can serve as a community venue for making Internet access available to residents.
Corrections (jails / prisons)	Corrections facilities serve one of the covered populations who often lack broadband for communicating with family, legal team, or others. The Correctional Officials reporting requirements are significant - requiring broadband adoption and use.
Non-profits	Non-profits are key trusted partners and messengers, working with covered populations. They are key constituents in ACP Outreach and Broadband adoption.
Broadband Service Providers (ISP's)	Designers, builders, operators, and sustainers of broadband deployment and sustainability.

Partners	*Description of Current or Planned Role in Broadband Deployment and Adoption*
Community Based	
Faith-based	Faith-based organizations are local to the community and some of the most trusted messengers. They are advocates and their venues can serve as gathering places in support of shared broadband access and adoption.
Community centers	Community centers are central to the Puerto Rican culture. People gather at community centers for social and life cycle events. These are excellent opportunities for affordable broadband access and adoption.
Technical centers (computer centers)	Former computer centers, now "technical centers" are fully equipped facilities with devices, comfortable working environment and prime candidates for affordable broadband access and adoption.
Public plazas	From the oldest traditions to the present, public plazas are gathering places. Public plazas are natural settings for offering public affordable or free Wi-Fi broadband access and adoption.
Transportation hubs (airport, bus station, RR)	Transportation hubs have a high volume of daily traffic and waiting rooms. These publicly funded hubs serve to cover all populations, including vulnerable and covered populations with affordable, broadband access and adoption.
Shelter Facilities	Shelter facilities offer services to covered populations, emergency respite from natural disasters and are imperative as broadband sites that afford broadband access and adoption to people at their greatest time of need for on-line communications for safety, commerce, living, sustenance, and recovery.

3.3 Asset Inventory

To understand the state of broadband deployment and digital equity in Puerto Rico, PRBP conducted a comprehensive assessment of existing hard assets, including towers, buildings, and other infrastructure components, as well as soft assets, including support programs and technical assistance. The following section describes the current state of broadband deployment and digital equity in Puerto Rico, with emphasis on the resources that can be readily leveraged by PRBP.

3.3.1 Broadband Deployment

In Puerto Rico, the inventory of hard assets regarding telecommunications has changed significantly since Hurricanes María and Irma decimated most utilities and above-ground infrastructure on Puerto Rico. Communications in Puerto Rico have been and continue to be heavily dependent on commercial wireless services.

Below is a matrix illustrating Puerto Rico's telecom landscape:

Provider	Wireless/ Mobile	ISP/WISP (Residential / Business)	Broadband Provider (Business to Business)	Data Centers, Cloud Services	Newcomers* (incremental demand)
Liberty (AT&T)	X	X	X		
Claro	X	X	X		
T-Mobile	X				
Worldnet		X	X		
Aeronet		X			
Optico Fiber		X			
Hughes Net		X			
Telefonica		X	X		
Neptuno Networks			X		
Dish (Boost)	X				X
PREPA Networks			X	X	
Netwave				X	
AllComm Solutions			X	X	
Critical Hub				X	
Everynet/Sigfox					X
Other providers: Osnet, VPNet, XairNet, IP Solutions, VMWare FiberX, DM Wireless	X	X	X	X	

**"Newcomers" are companies currently implementing Long Range Wide Area Networks for IOT (Internet of Things) purposes (or in the case of "Dish Networks," a new business-to-business services offer in the market). Those are expected to generate incremental infrastructure demand.*

Wireless services depend highly on towers and rooftops for wireless antennas and equipment to provide the last mile connections to the subscribers for these services. Connectivity for these tower assets rely heavily on fiber, copper, and microwave backhaul to ensure last mile connectivity and bandwidth is available.

Notwithstanding the microwave backhaul, which relies on relays along the path with exposed dishes on the towers themselves, the primary technologies are fiber and Hybrid Fiber Coax (HFC) provided by a few entities on Puerto Rico. Of these transport mediums, most of these are aerial, meaning they are attached to electrical towers and poles and suspended between these structures in a daisy-chain setup. Any damage causing failure of these support structures, and/or airborne debris severing the transport

medium causes a loss of service beyond the damage point, thus effecting any other asset downline from the damaged section.

3.3.1.1 Tower Sites Infrastructure

There are hundreds of tower sites registered in Puerto Rico per the Telecommunications Bureau (NET).[14] The main providers of towers and tower space are:

- Crown Castle (over 350 tower sites)
- American Tower (over 200 tower sites)
- SBA (~150 tower sites)
- Phoenix Tower (over 50 tower sites)
- Vertical Bridge
- Blue Sky Tower
- Innovatel
- Various other small developers & owners

Towers are used by the following telecom operators:

- Liberty Communications
- CLARO de Puerto Rico
- T-Mobile
- AeroNet Communications
- Neptuno Network
- WorldNet
- VPNet communications
- Various other WISPS
- Various government agencies

3.3.1.2 Fiber Optic Infrastructure

In recent years, Puerto Rico has been investing in expanding and upgrading its telecommunications infrastructure, with a focus on increasing resilience and reliability. While aerial fiber optic cables may still be used in certain areas due to their lower upfront cost, there has been a shift towards underground installation, particularly in critical infrastructure and high-population areas, to ensure better resilience and long-term reliability.

With regards to Fiber and Hybrid Fiber-Coax (HFC) telecom suppliers, there are few in Puerto Rico with enough market-share to become critical components to the communications fabric in Puerto Rico. The main carriers of Fiber and HFC are:

[14] Telecommunications Bureau, "Registry of Towers," Government of Puerto Rico Labor Relations Board, accessed July 10, 2023, https://jrtpr.pr.gov.

- Optico Fiber
- HUB Networks (Formerly PREPANET)
- Liberty Puerto Rico (Acquired all other Cable operators and AT&T in Puerto Rico)
- CLARO de Puerto Rico (Formerly Puerto Rico Telephone Company PRTC)
- FiberX
- Worldnet Communications
- Data Access
- AeroNet Wireless

3.3.1.3 Infrastructure by Provider

HUB Networks

Hub Networks is a 100% owned subsidiary of the Puerto Rico Power Authority (PREPA), a government owned public corporation, and mainly runs on substations and associated Rights-of-Way across Puerto Rico controlled by PREPA and operated by LUMA. HUB Networks operates its own fiber transport around Puerto Rico and also owns one of the few subsea landing stations for undersea fiber serving Puerto Rico. HUB Networks is considered a Carrier of Carriers, as it does not sell nor offer retail services. The main customers for HUB Networks are the other telecom carriers as well as many government agencies on Puerto Rico.

HUB Networks owns and operates over 640 miles of fiber optic infrastructure (backbone). The majority is based on 96-fiber cables. At this point in time, HUB Networks is not after the retail Internet market. Its business model is oriented to the commercial/business development side, including leasing fiber to other ISPs. It has a total of 60 employees.

Main submarine cables landing in Puerto Rico get into HUB787 POP in Isla Verde: ARCOS-1, SAM, Taino Caribe, Antillas, etc. HUB787 has local loop fiber is not interconnection with Punta Las Marías cable landing station (Telsius), and AT&T's Miramar cable landing station/POP (Americas cable). Its backbone portion is mainly aerial. Distribution is a mix, but the majority is underground. HUB787's network uptime is around 97% and is extremely reliable (99.999%).

Its infrastructure is based on CISCO, Cambium (wireless transport), and Fortinet (security/firewalls). It has plans to develop the old Ultracomm's Humacao Earth Station (formerly PRT's "Telepuerto de Humacao") into what they call HUB939. It would be another POP/Cable station serving the south-east side of Puerto Rico. The company's plans include developing three more cable stations around Puerto Rico; one in the south, one in the west, and one in the east. HUB787 is not formally handling anything related to LUMA's Scada facilities. However, there are few instances in which it is helping them with circuits/ interconnections.

Liberty Puerto Rico

The company today has nearly 14,000 miles of fiber between fixed and mobile networks. In terms of capacity, the fixed network now has twice the capacity compared to the times before the acquisition of AT&T PR's assets.

Liberty has over 19,300km of HFC cable and FTTH network deployed in Puerto Rico, connecting 1.16mn homes (homes passed) as of December 2021. This network is used to offer "market-leading" 600Mbps broadband speed plans, according to the company.

CLARO Puerto Rico

Claro Puerto Rico, as part of the most recent deployment of its fiber-optic network throughout Puerto Rico, has reached more than 430,000 homes and businesses. Its fiber-optic network consists of more than 10,870 miles (17,500 kilometers) of cable deployed across Puerto Rico. The company had an aggressive expansion that culminated last December with approximately 300,000 homes passed with an Internet connection of up to 1,000 megabytes. CLARO was the main winner in Puerto Rico of the recent spectrum auction of the 3.5 GHz band (CBRS), which adds capacity to the existing network, and is essential for the development of 5G wireless service in Puerto Rico.

3.3.1.4 Submarine Fiber Optic Cable Systems

Hemisphere's main Submarine FO Cable systems land in Puerto Rico. The top cable landings in Puerto Rico are:

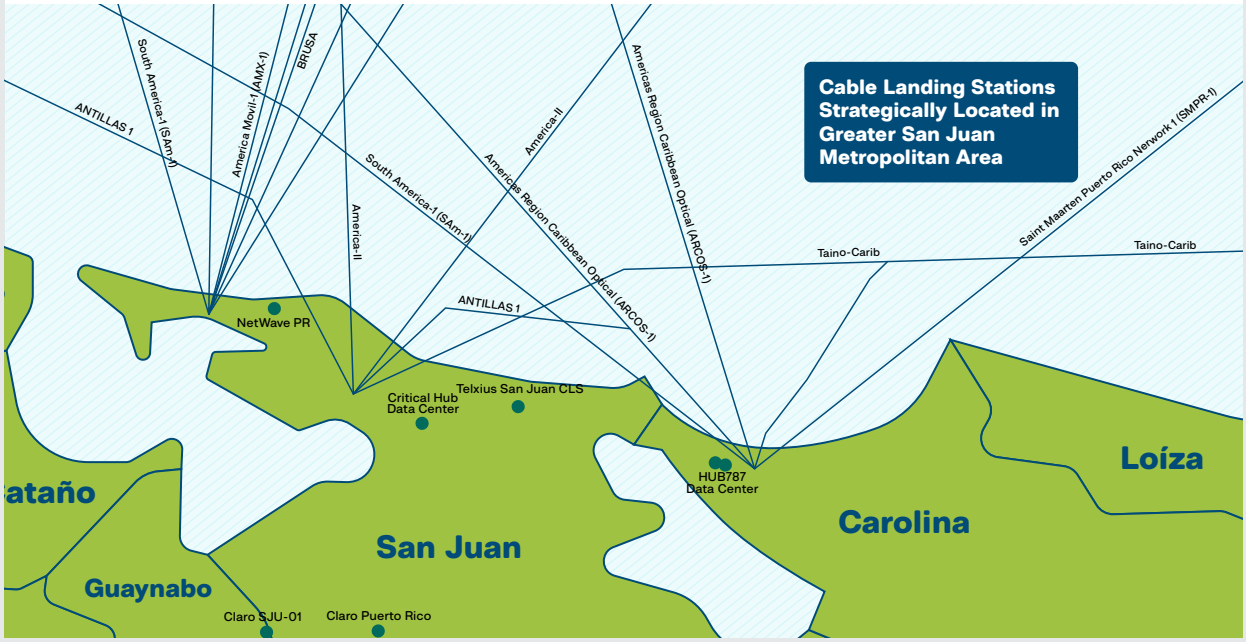
- ARCOS (Americas Region Caribbean Optical)
- PCCS (Pacific Caribbean Cable System)
- AMX-1 (America Movil-1) & BRUSA
- Antillas-I & GTMO-PR
- SMPR-I & Taino-Caribe
- SAM-I & Americas-II

Below a map showing the Cable systems (detailed info in: https://www.infrapedia.com/app)

Main Submarine Fiber Cable System of the Continent Land in PR

The above FO Cable systems land in Cable Landing Stations strategically located in San Juan metro area. Main ones are: HUB787, AT&T Miramar POP (Point of Presence), and Punta Las Marías (Telsius). See below a map showing the stations:

Cable Landing Stations Strategically Located in Greater San Juan Metropolitan Area



According to the 2020 Census, Puerto Rico has a population of 3.3M and 1.2M households.[15] The computer penetration and home Internet subscription rates greatly lag those of the United States. The U.S. enjoys 89.75% households with broadband Internet subscription with a computer (device). In Puerto Rico, 72.20% of households have a broadband Internet subscription with a computer (device). Stated another way, 333,600 households (27.8%) lack a broadband subscription to the Internet for households with a computer (device).

The following set of charts and maps provide a current snapshot of the broadband adoption – which is quite low in comparison with the United States percent of broadband adoption. Puerto Rican Device Connectivity map correlates -- the more rural, low wealth, harder to reach municipalities have lower percentage of households with Internet capable devices. A similar pattern is seen on the more rural, low wealth, harder to reach municipalities lack Internet access. Taken together, Puerto Rico exhibits only 72.2% of households with broadband adoption.[16]

Examination of the disparities between United States and Puerto Rico highlights 17% fewer Puerto Rican households have computers than US households. The gap in % household Internet subscription between Puerto Rico and US lags even greater at 21%.

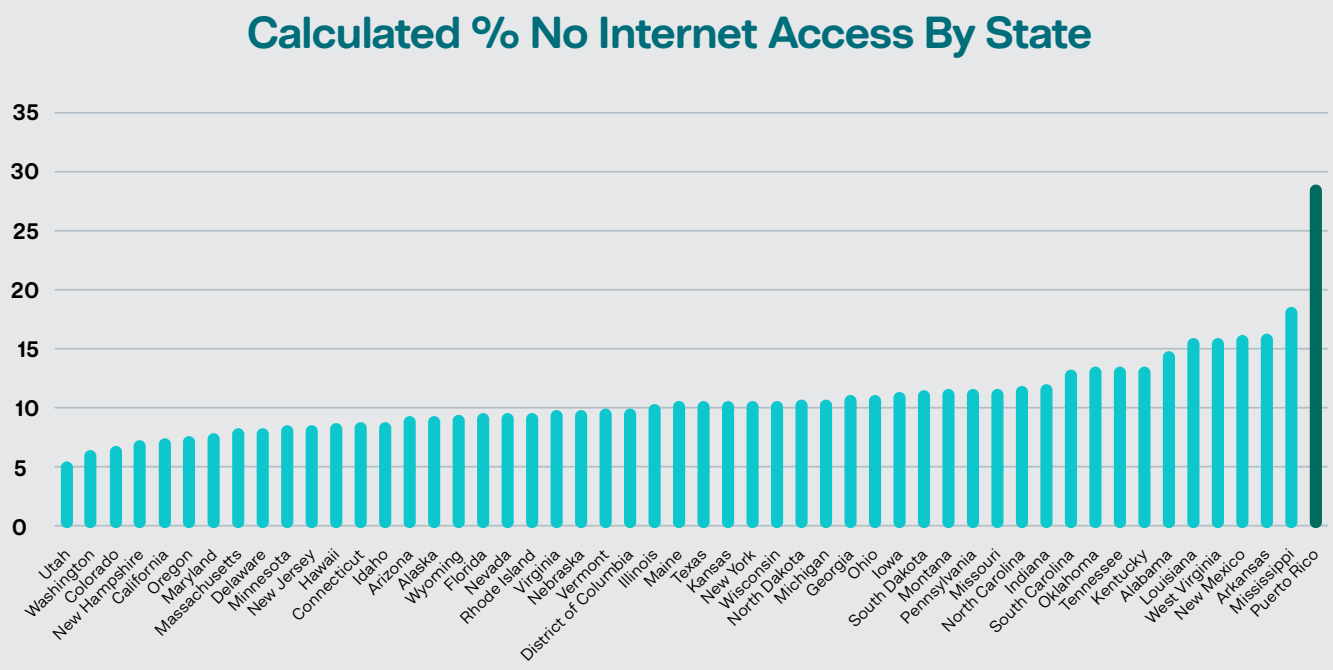
[15] U.S. Census Bureau. (n.d.). Puerto Rico quick facts table [Data table]. Retrieved July 27, 2023, from https://www.census.gov/quickfacts/fact/table/PR/PST045222
[16] https://www.census.gov/acs/www/about/why-we-ask-each-question/computer/

Figure 13: USA vs. Puerto Rico: Computer Ownership

	United States		*Puerto Rico*	
Label	**Estimate**	**%**	**Estimate**	**%**
Total	**124,010,992**		**1,196,790**	
Has a computer	115,397,459	93.05	908,230	75.89
With dial-up Internet subscription alone	265,164	0.21	14,007	1.17
With an Internet subscription	106,957,995	86.25	778,643	9.66
Without an Internet subscription	8,174,300	6.59	115,580	65.06
No computer	8,613,533	6.95	288,560	24.11

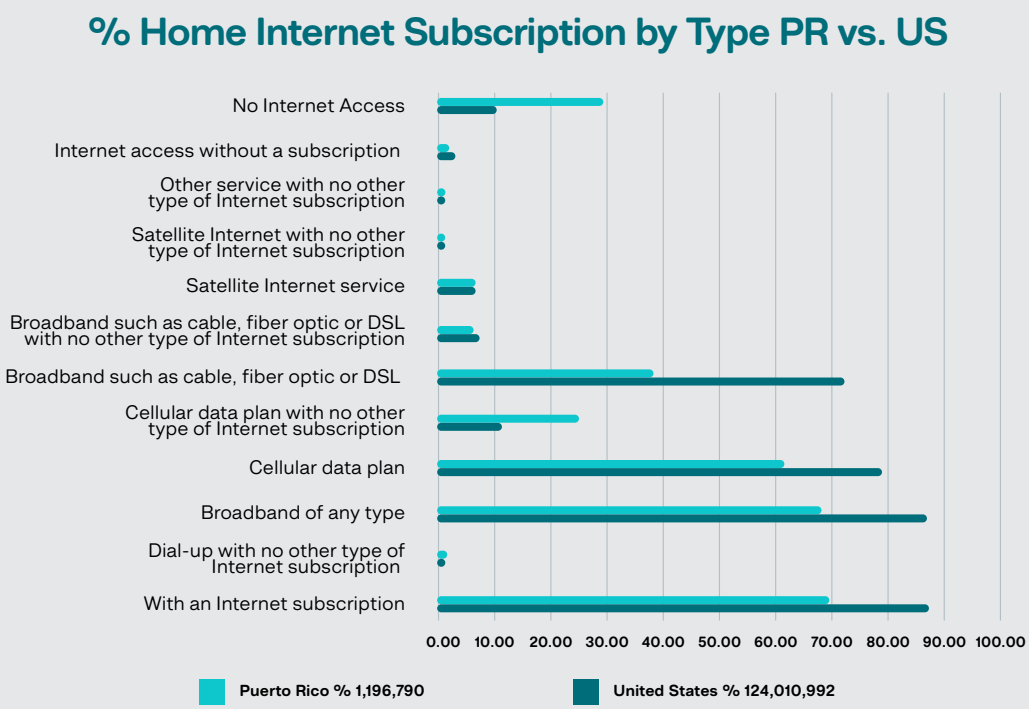
B28003. American Community Survey 2021. ACS 5-Year Estimates Detailed Tables

Figure 14: Internet Access by State



American Community Survey. ACS 5-Year Estimates Detailed Tables.

Figure 15: USA vs. Puerto Rico: Home Internet Subscription



B28002. American Community Survey 2021. ACS 5-Year Estimates Detailed Tables

The following tables reflect computer presence and Internet subscription in the Puerto Rican household. These data and charts provide some insight into the residents' choices in adopting the basics of the digital economy. Puerto Rico is highlighted in red.

Figure 16: USA vs. Puerto Rico: Households with Computer but Without Internet

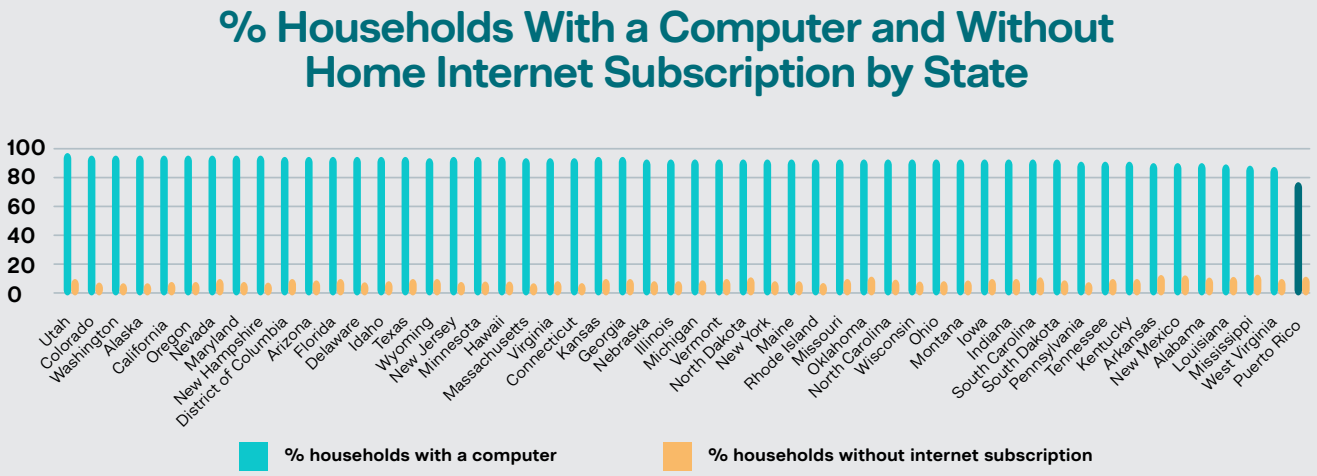
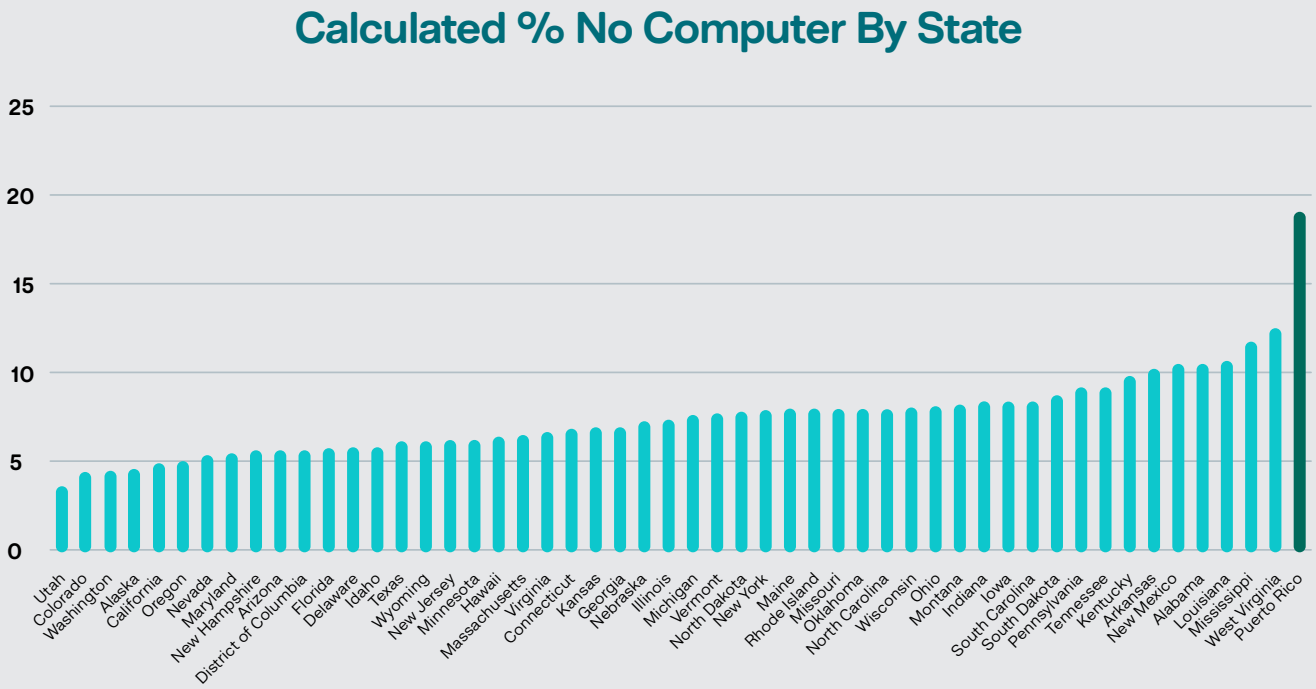


Figure 17: USA vs. Puerto Rico: Expanded Computer Ownership

	United States		*Puerto Rico*	
Label	**Estimate**	**%**	**Estimate**	**%**
Total	**124,010,992**		**1,196,790**	
Has one or more types of computing devices	115,397,459	93.05	908,230	75.89
Desktop or laptop	97,830,488	78.89	540,383	45.15
Desktop or laptop with no other type of computing device	4,705,149	3.79	38,693	3.23
Smartphone	107,227,652	86.47	843,736	70.50
Smartphone with no other type of computing device	10,793,298	8.70	285,750	23.88
Tablet or other portable wireless computer	78,367,808	63.19	383,235	32.02
Tablet or other portable wireless computer with no other type of computing device	1,085,378	0.88	12,760	1.07
Other computer	3,237,976	2.61	23,572	1.97
Other computer with no other type of computing device	30,800	0.02	104	0.01
No Computer	8,613,533	6.95	288,560	24.11

B28001. American Community Survey. ACS 5-Year Estimates Detailed Tables

Figure 18: USA vs. Puerto Rico: Computer Ownership by State



B28001. American Community Survey 2021. ACS 5-Year Estimates Detailed Tables

Figure 19: Internet Adoption by Municipality - Map

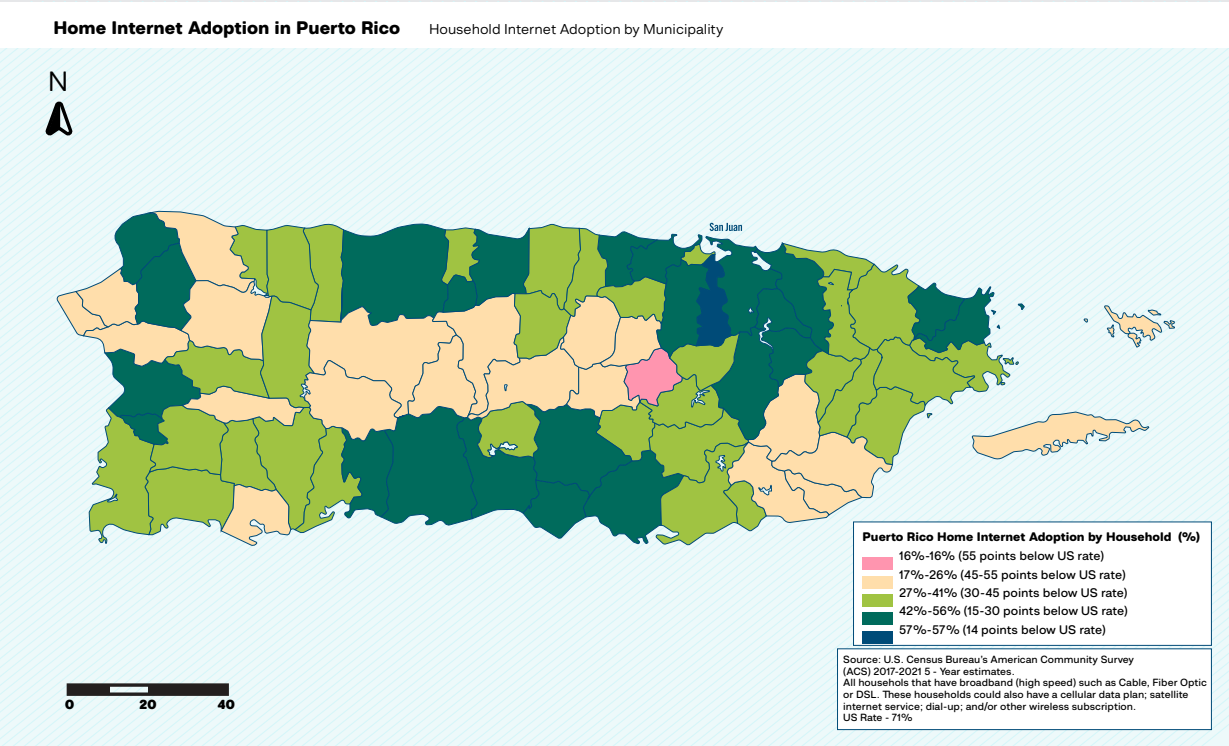


Figure 20: Computer Devices by Municipality - Map

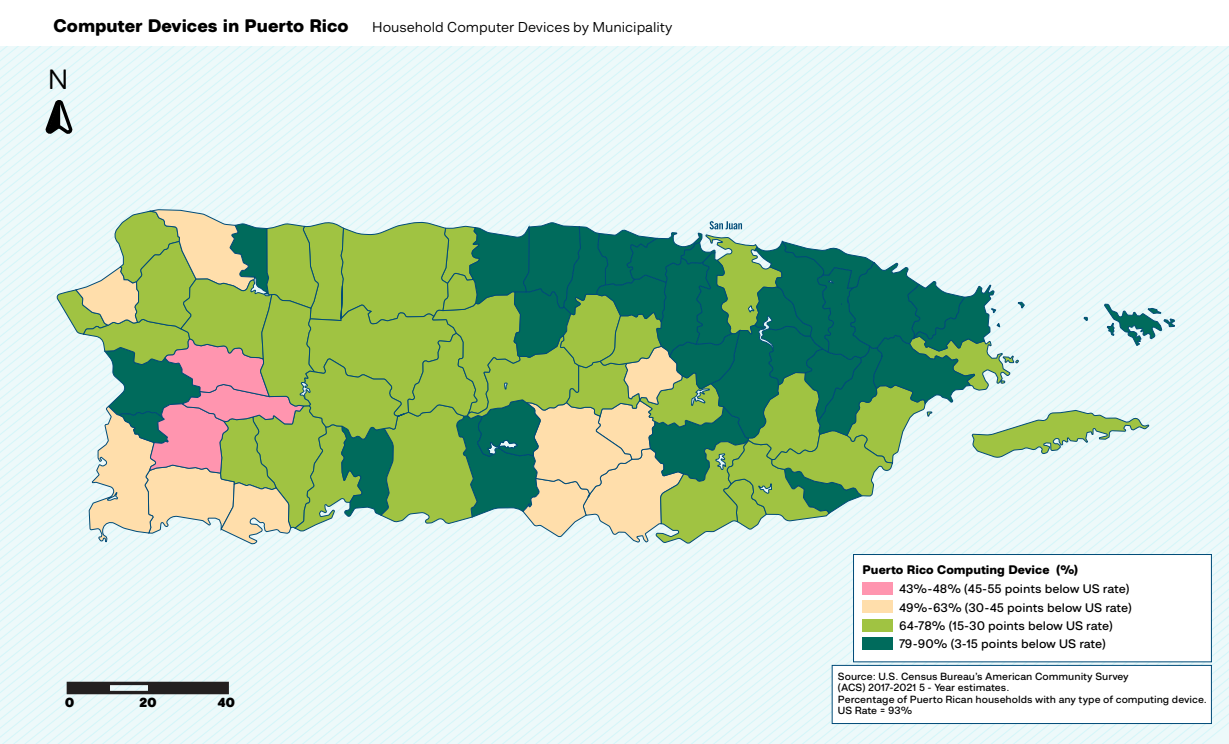


Figure 21: Computer Devices Expanded - Map

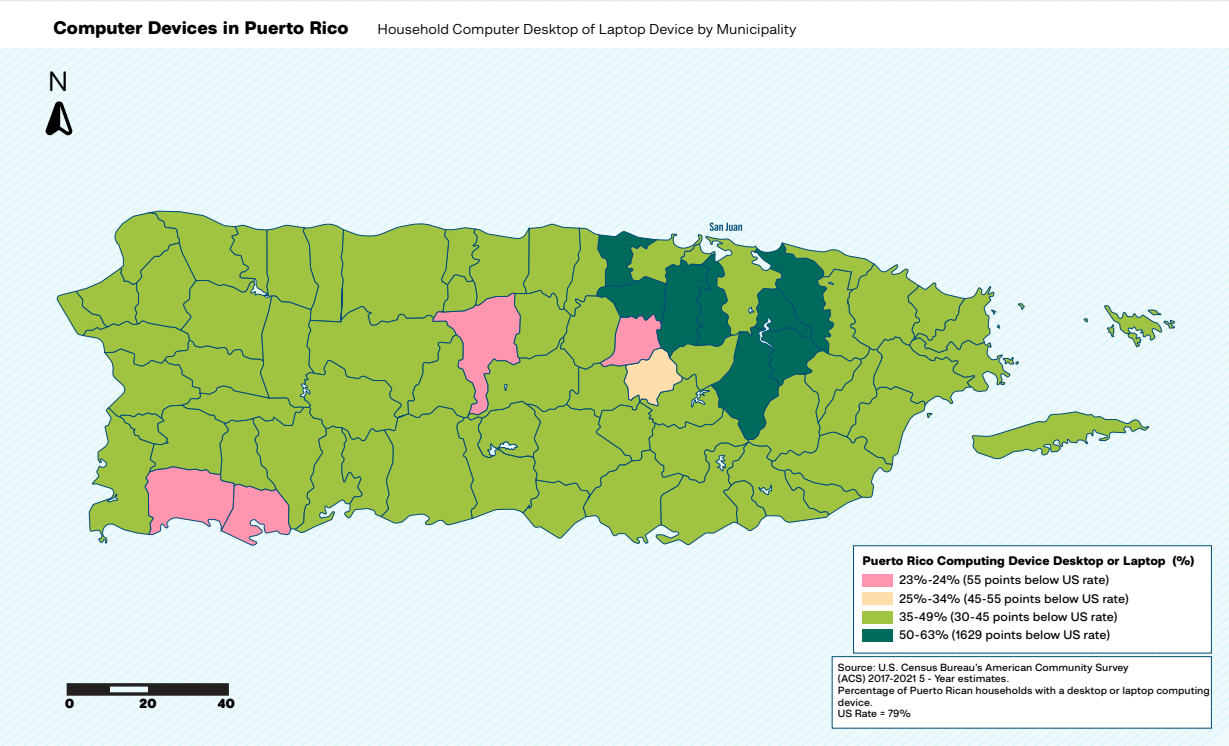
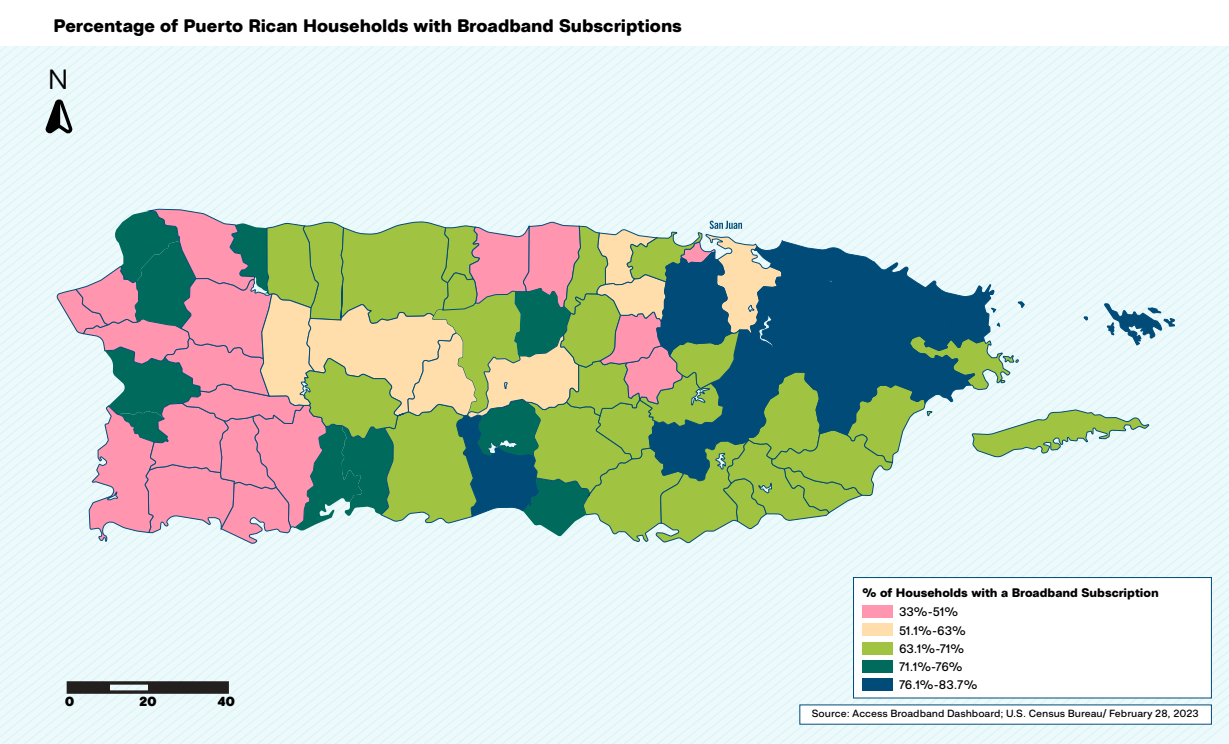


Figure 22: Households with Subscriptions by Municipality - Map



3.3.3 Broadband Affordability

3.3.3.1 Affordable Connectivity Program

72% of Puerto Rican households qualify for the Affordable Connectivity Program (ACP)– a federal broadband affordability program from the Federal Communications Commission (FCC), which offers qualifying Puerto Ricans up to $30 a month towards their broadband Internet bill and a one-time $100 voucher for the purchase of computers and tablets, provides a lower bound to estimate the affordability. There are many ways for Puerto Rican households to qualify for the ACP benefit. These include:

- Households already receiving Lifeline benefits.
- Households with a total yearly income of 200% of the poverty line or less – equivalent to a yearly income equal or less than $60,000 for a family of four.
- Households where at least one member participates in NAP, WIC, SSI, or FPHA; or
- Households with a member currently receiving a Veterans Pension or Federal Pell Grant.

The Federal Government does not provide estimates of the total number of households in Puerto Rico that qualify for the Affordable Connectivity Program. As such, the Puerto Rico Broadband Program analyzed all available data and provides an estimate of ACP-qualified households to assist community organizations enrolling Puerto Ricans in ACP benefits. Our estimate is that almost half of households qualify for ACP; as such, this factor provides a lower bound on the number of households struggling with affordability of broadband Internet services on Puerto Rico. In all, 72% of Puerto Rican households qualify for the Affordable Connectivity Program on household income alone, compared to 36% of households nationwide.

The map below provides a municipal-level estimate of Puerto Rican households who qualify for the Affordable Connectivity Program by meeting the household income criteria.

Figure 23: Households Qualifying for ACP by Municipality - Map

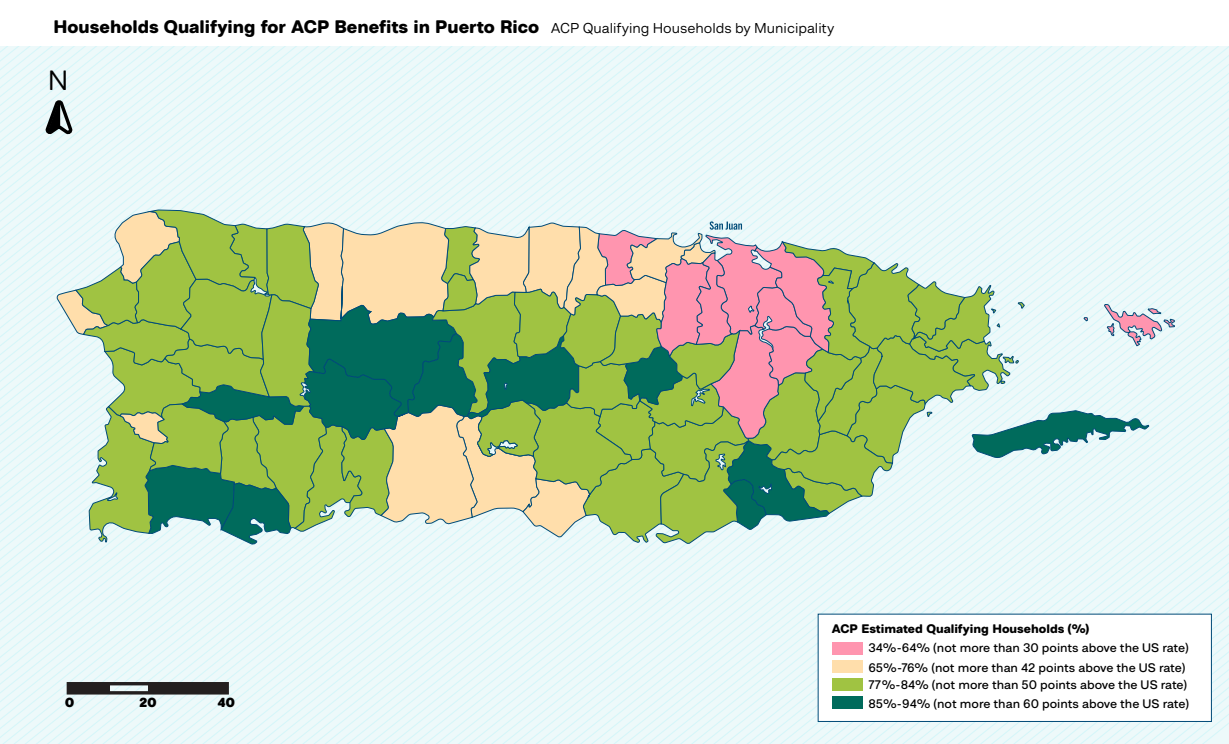
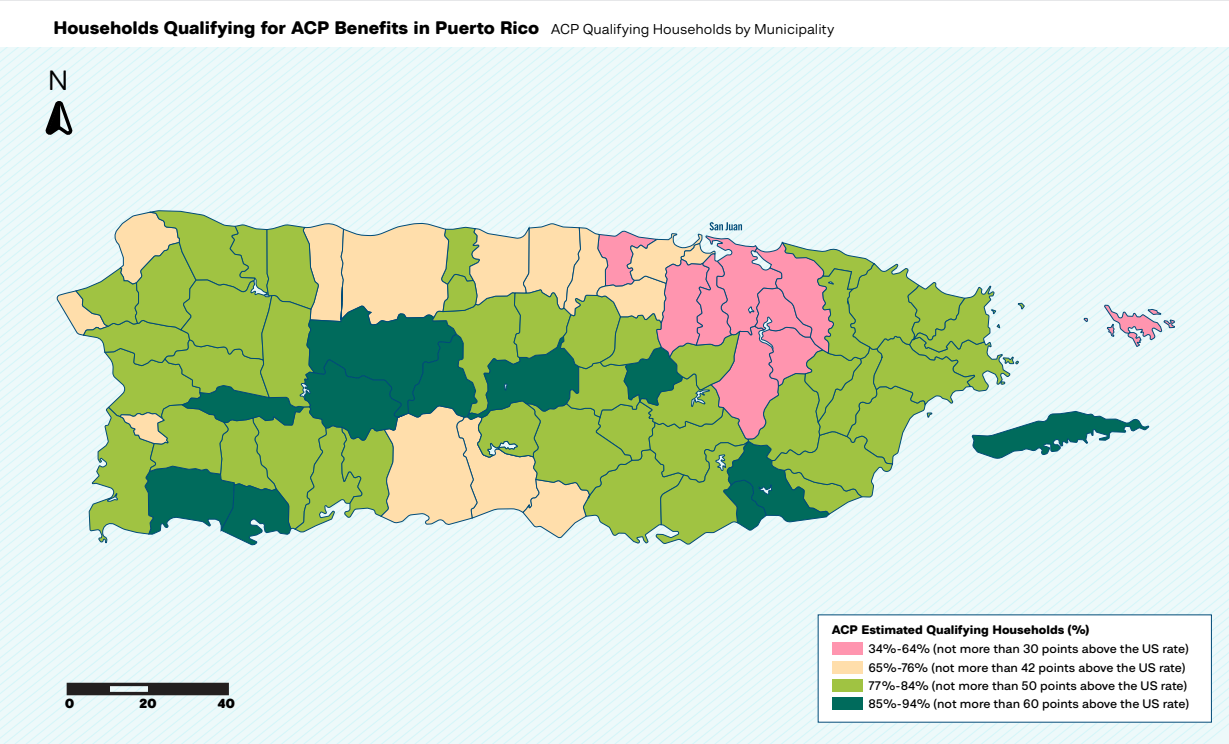


Figure 24: Enrolled Households in ACP by Municipality - Map



The PRBP has prioritized the success of the Affordable Connectivity Program and has already taken steps to increase enrollment for eligible residents in Puerto Rico. For example, the PRBP developed ACP enrollment training for community leaders, including AARP chapter leads and personnel in municipal governments, during outreach events to inform infrastructure planning. In addition, the PRBP has led training to inform these trusted community leaders about the program, eligibility requirements, and how they can help residents enroll.

The PRBP will be continuing ACP enrollment efforts through federal and local funds. In March 2023, the FCC awarded Puerto Rico $740,000 in ACP Outreach Grant funds for two years of enrollment support.[17] In addition, the Puerto Rico Broadband Program will be allocating $405,000 from the PRBP fund to bolster ACP enrollment. In addition, PRBP will be working with the Office for Socioeconomic and Community Development (ODSEC), the Department of the Family (ADSEF), the Department of Housing, and the Office of the Governor to conduct at least thirty awareness events across Puerto Rico and provide targeted marketing to ensure all residents with eligibility are able to access their broadband subsidy.

[17] FCC, "Affordable Connectivity Outreach Grant Program," WC Docket Nos. 21-450, DA 22-194, March 10, 2023, https://docs.fcc.gov/public/attachments/DA-23-194A1.pdf.

3.3.4 Broadband Access

3.3.4.1 Electric Utility Assets and Broadband

Since the devastation of hurricanes Irma and María in 2017, combined with the earthquakes in 2019 and 2020, the electrical grid suffered catastrophic damage leaving Puerto Rico without power for months, and some for more than a year. The telecom facilities carried along the power delivery systems (electrical towers and poles) were also decimated.

After these events, on June 1st, 2021, the administration of PREPA energy transport grid passed onto a new company called LUMA. Since the turnover of responsibility to LUMA, the company has embarked on a total renovation of Puerto Rico's infrastructure, which is expected to take multiple years to complete.

Currently LUMA is in the process of replacing PREPA's transmission towers and poles to more resilient structures and burying miles of electrical transmission lines where possible. Along with the infrastructure for electricity transport, arrangements have been made to include capacity for fiber and other telecom mediums along the same routes. While these future-looking arrangements have been contemplated, it is still unknown how LUMA will make available these assets for outside telecom and commercial providers to utilize.

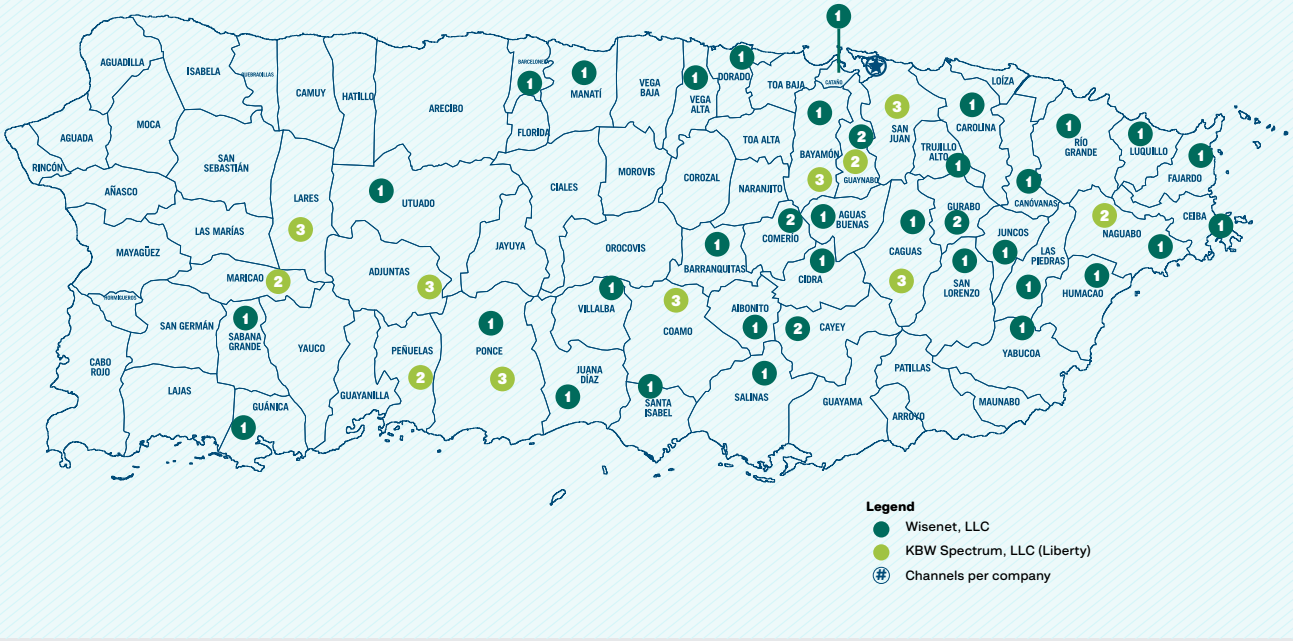
3.3.4.2 Spectrum

Spectrum is certainly a key asset for making broadband available to the whole population. Below are some of the main spectrum holdings for Puerto Rico's market:

Citizens Broadband Radio Service (CBRS)

Citizens Broadband Radio Service (CBRS) spans 3550 – 3700 MHz. Many of the potential CBRS applications have substantial commercial value including: ① mobile operator capacity augmentation; ② cable and MVNO system augmentation; ③ neutral host network for public space; ④ wireless Internet service providers (WISPs) particularly in rural areas; and ⑤ enterprise LTE. Below are the winners of the most recent auction for CBRS:

Winning Bidder For Auction 105 Wisenet and KBW Spectrum (Liberty)



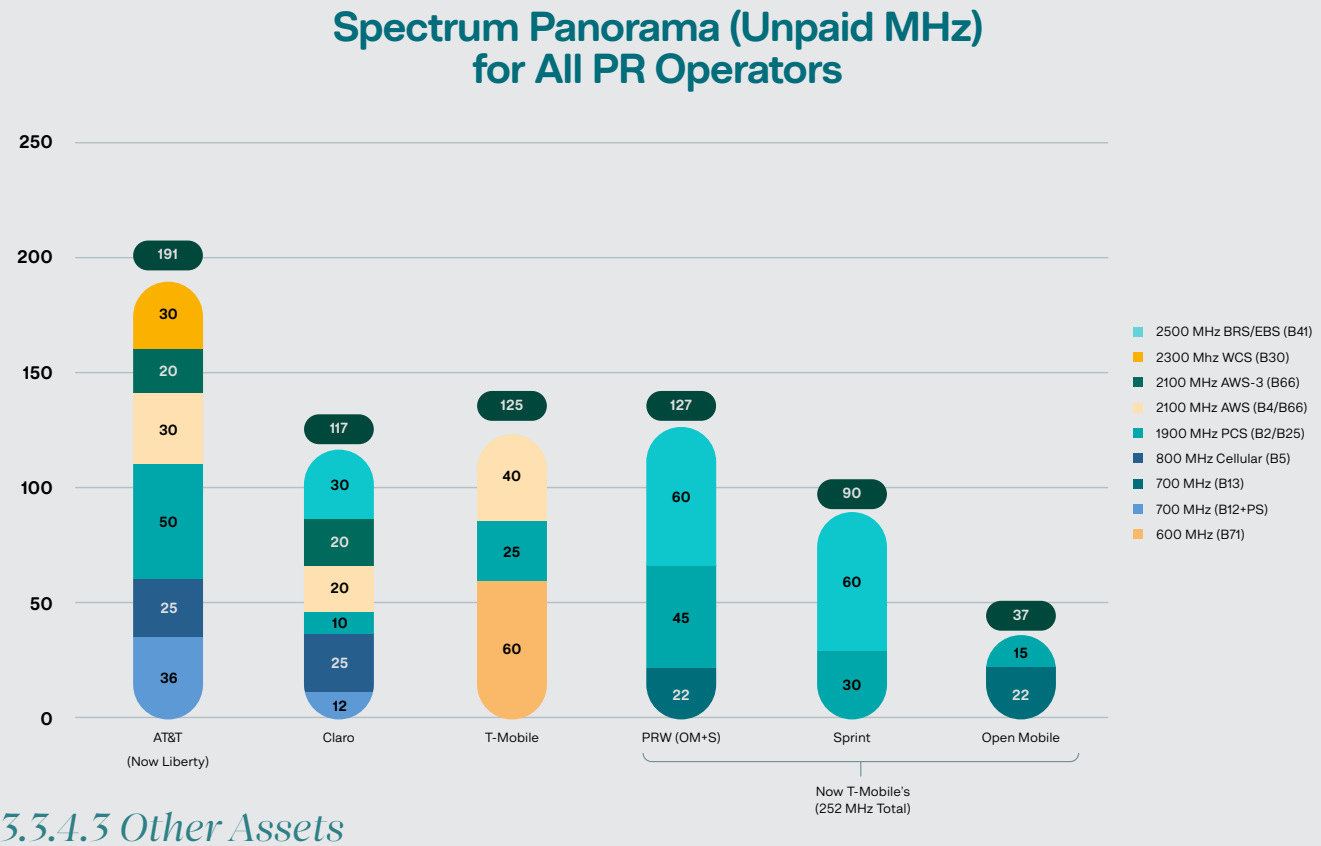
Winning Bidder For Auction 105 Wisenet and Aeronet

Mobile Operators

In the Mobile Operators market, there are several bands being used in Puerto Rico:

- 1900MHZ (PCS)
- 2100MHZ (AWS)
- 700MHz (B13)
- 800MHz (cellular)
- 2300MHz (B30)
- 500 (B41)
- 600MHz

Below is a distribution among actual carriers operating in the island:



3.3.4.3 Other Assets

Other assets that can provide Puerto Rico with conduit access for buried fiber are the Puerto Rico Department of Transportation and Public Works, and the Puerto Rico Highway Authority. Planning is currently in development, through Public Private Partnerships, for adding additional conduits between several toll plazas around Puerto Rico roads, as well as newly planned improvements and developments along several major roadways. The Office of the Governor is currently hosting events for dialogue with these providers to explore the best way to capitalize the current construction efforts for future fiber deployments.

In Puerto Rico, land and right-of-way assets are managed by the 78 municipalities. Each municipality has its own processes and priorities for the development of telecom resources. The State has its own agencies looking for State Level environmental protection and uniformity of permitting and telecom governance.

Each Municipal Mayor oversees and participates in the development of major island-level efforts that take place within their districts. Dialogue and negotiations take place independently by municipality and outcomes may vary due to factors such as civil participation, funding per municipality, and regulatory differences. Resiliency, reliability, and benefits to local constituents are major talking points and leverage for all sides to cooperate on major undertakings.

3.3.5 Digital Equity

The island of Puerto Rico benefits from the federal programs beyond BEAD and Digital Equity that advance digital equity. The table below identifies the Federal Communications Commission (FCC) programs that increase access to broadband and serve as key assets to advancing PRBP's vision.

Figure 25: Digital Equity Current Programs

Resource Type	Name of Asset & Provider	Description of Asset	Covered Population
Program – funding	Emergency Connectivity Funds	The FCC's Emergency Connectivity Fund (ECF) provided Puerto Rican schools and libraries with $103M for laptops, hotspots, and broadband connectivity purchases for off-campus use by students, school staff, and library patrons across Puerto Rico.	Rural and low-income households
Program – funding	Universal Service Fund	The FCC's Universal Service Fund (USF) allows rural health care providers to pay rates for telecommunications services similar to those of their urban counterparts. Schools and Libraries Support Mechanism, popularly known as the "E-Rate," provides Internet access, and internal connections (the equipment to deliver these services) to eligible schools and libraries.11	All
Program – funding	Affordable Connectivity Program (ACP) and ACP Outreach Funds	The ACP is an FCC program that provides a discount of up to $30 per month toward Internet service for eligible households and up to $75 per month for households on qualifying Tribal lands; and a one-time discount of up to $100 to purchase a laptop, desktop computer, or tablet if they contribute more than $10 and less than $50 toward the purchase price. Puerto Rico received an ACP Outreach Grant to increase enrollment in ACP.	Low-income households, which often overlaps with Aging populations, Veterans, previously incarcerated people, and rural inhabitants.

Puerto Rico's signature digital equity asset is its 158 community centers across Puerto Rico. The impact of the hurricanes made clear the importance of having resilient community centers to withstand chronic stressors, as well as to create gathering places for the local community. In June 2021, Puerto Rico published its plans for the Whole Community Resilience Planning (WCRP) Program. The program is ongoing and will result in comprehensive community recovery plans that include resilient community centers. The PRBP will work collaboratively with existing community centers and programming to provide specific services for digital equity, including technical support, digital skills training, and workforce development, in locations that suit residents.

3.4 Needs and Gaps Assessment

Conducting a comprehensive needs assessment prior to undertaking broadband deployment efforts in Puerto Rico is crucial for ensuring the efficient and equitable allocation of resources. This needs and gaps assessment enables the identification of unserved and underserved areas, evaluation of existing infrastructure, and establishment of strategic priorities to bridge the digital divide across Puerto Rico. By employing a data-driven approach, the government of Puerto Rico can target its investments and engage in meaningful collaboration with private sector partners, ultimately fostering a more inclusive and sustainable broadband ecosystem that benefits all Puerto Ricans.

3.4.1 Broadband Deployment

In response to a mandate from Congress, the Federal Communications Commission (FCC) rolled out a National Broadband Map beginning in 2022 that shows broadband service availability to individual locations instead of census blocks as presented in prior FCC maps.[18] The data in this map is obtained from required twice-annual reports from Internet Service Providers (the "Broadband Data Collection" or BDC), with opportunities for parties, including states, to challenge the accuracy of the reported data. As a component of this, the FCC contracted CostQuest Associates, a broadband consulting firm, to provide a base layer of all business and residential locations across the nation, called "the Fabric." As part of the design of the BEAD program, Congress required Fabric data to be the sole method of determining Broadband Serviceable Locations (BSLs); the number of these locations categorized as underserved and unserved would then primarily determine the share of funds states and territories received through the BEAD program.

3.4.1.1 FCC Broadband Data Collection Service Categories and Definitions

Pursuant to BEAD program requirements, broadband deployment analyses in this section rely almost entirely on the FCC BDC broadband availability and underlying location fabric data from December 2022. Additional commentary about limitations associated with this database of all BSLs to which broadband must be deployed will be provided later in this section.[19]

Under the BEAD program, BSLs must be classified into one of three categories: Served, Underserved, or Unserved. To provide additional context to interested parties and policymakers, an unserved BSL location is any existing location that does not have access to a terrestrial or licensed fixed wireless Internet service provider offering speeds of at least 25 Mbps download and 3 Mbps upload (25/3 Mbps). Underserved locations are defined as BSLs with maximum speeds of between 25/3 Mbps, and 100/20 Mbps. A served BSL location must have a terrestrial or licensed fixed wireless Internet service provider that provides, or could easily provide, a minimum connection speed of 100/20 Mbps, with a latency of less than or equal to 100 milliseconds.

Locations served by unreliable technologies, such as unlicensed fixed wireless or satellite technology, will also be deemed unserved. As required by the terms of the BEAD program, neither technology meets

[18] Federal Communications Commission. (2022, February 22). FCC announces inaugural broadband data collection filing dates. [Public Notice]. Retrieved July 28, 2023, from https://www.fcc.gov/document/fcc-announces-inaugural-broadband-data-collection-filing-dates

[19] BSLs are defined by NTIA as a business or residential location in the United States at which fixed broadband Internet access service is, or can be, installed."

the Reliable Broadband Service standard and thus may not count towards underserved or fully served broadband service regardless of reported available speed.[20]

3.4.1.2 Broadband Deployment in Puerto Rico

As of December 31, 2022, 94.32% of Puerto Rico's broadband serviceable locations were reported as fully served under the BEAD program. Of the remaining 5.89% of locations, 61,871 are unserved and 3,375 are considered underserved. The unserved either have service which falls below the 25/3 Mbps cutoff or have no reliable broadband service offered by providers. Figure 26 breaks down the location type, as determined by the Federal Communications Commission Fabric database.

Figure 26: Current BSL Counts

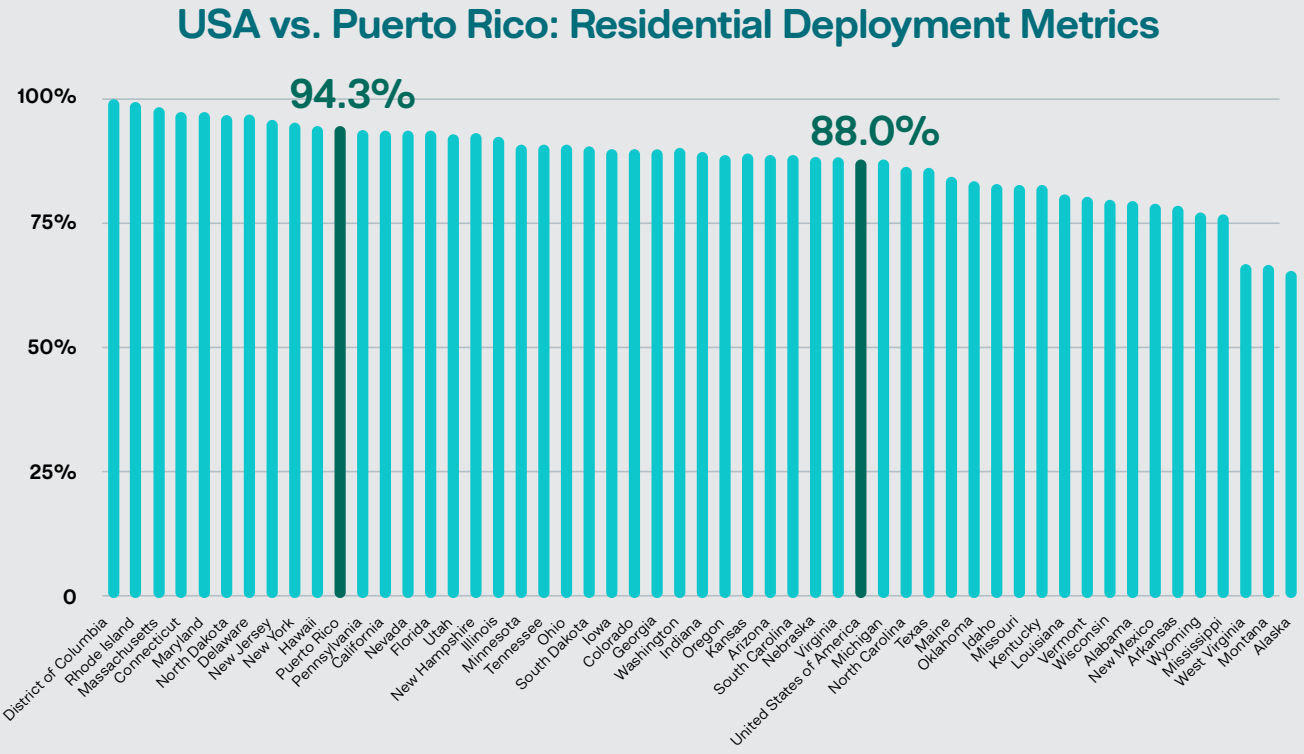
BEAD Service Category	*# of BSLs*	*% of total addresses*
Unserved	61,871	5.39%
Underserved	3,375	0.29%
Fully Served	1,083,038	94.32%
Total BSLs	**1,148,284**	**100%**

With 94.32% of locations reported as fully served in Puerto Rico, FCC reporting would appear to show that broadband is available across the island. However, there are reasons to believe that service as reported to the FCC does not fully reflect the reality of service provided in Puerto Rico. According to the Pew Charitable Trusts, there are several concerns regarding the FCC Broadband Map Challenge process.[21] From lack of affordability data reflected in the dataset, to the short timeframe proposed to conduct challenges to be considered in the BEAD allocation conversation, many issues exist nationwide.

Furthermore, Puerto Ricans also consistently face issues of service reliability and affordability. Figure 27 expands on this national comparison in more detail with a bar graph of the percentage of residential locations in each state/territory that were reported to the FCC as fully served.

[20] NTIA, "Broadband Equity, Access, and Deployment Program Notice of Funding Opportunity," NTIA-BEAD-2022, 11.035, May 2022, https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf, 28.
[21] Varn, J., & Gong, L. (2022, November 18). What is the FCC's new broadband map and why does it matter? [Web article]. Retrieved July 12, 2023, from https://www.pewtrusts.org/en/research-and-analysis/articles/2022/11/18/what-is-the-fccs-new-broadband-map-and-why-does-it-matter

Figure 27: USA vs. Puerto Rico: Residential Deployment Metrics



Even though there are locations that show up as "unserved" and "underserved" currently in the FCC map, the NTIA's definition of "unserved" and "underserved" also accounts for future service that is subject to an enforceable federal, state, or local commitment to expand broadband service. Puerto Rico is subject to an enforceable commitment to the FCC under the Uniendo a Puerto Rico program to deploy or upgrade service to 100/20 Mbps or more to each unserved and underserved location. Going forward, PRBP is working with each entity participating in the Uniendo program to ensure compliance and implementation.

While Uniendo funding is a key asset in Puerto Rican broadband deployment, it is a necessary but insufficient resource for closing the digital divide

3.4.1.3 BDC location challenges

Because of the importance of the FCC map influencing funding allocations, the Fabric of Broadband Serviceable Locations must be as accurate as possible. For example, any residences and businesses that exist but are not included in the dataset result in fewer BEAD dollars in Puerto Rico. Analysis by PRBP and other nationwide broadband agencies determined that the Fabric is neither exhaustive nor always accurate.

The FCC created a challenge process whereby states and territories may submit or amend individual locations, as well as associated broadband availability data. Puerto Rico challenged inaccurate information to the maximum extent provided by law: Puerto Rico issued 217,135 challenges to include new locations in the underlying Fabric. The significant number of location challenges underscores the incompleteness of the service layer fabric in Puerto Rico. Additionally, 83,681 broadband availability challenges were submitted to amend the FCC's broadband reported service availability data.

The Puerto Rico Broadband Program and the Governor's Office worked together to publish informative reminders for citizens to perform speed tests and challenges on their own. With every release of data from the FCC, PRBP continues to challenge both the Fabric and BDC dataset where it believes Puerto Rico's broadband situation is not being accurately represented. Through the PRBP's efforts the location challenge initiative resulted in the addition of 66,227 new locations, significantly enhancing the accuracy of the broadband serviceable fabric. For the PRBP's service availability challenge effort, service providers conceded at 26,122 locations, prompting amendments to conceded provider's broadband availability submission. Altogether, both these efforts helped play a huge role in improving the underrepresentation of many residents in Puerto Rico and the hope is to continue these challenge efforts to gain better accuracy and granularity with broadband availability data going forward.

3.4.1.4 Location characteristics: Geography

To better understand Puerto Rico's anticipated deployment needs, PRBP also conducted a geographical analysis of the locations of unserved and underserved Broadband Serviceable Locations (BSLs) across Puerto Rico and determined if they were residential, mixed-use, or non-residential.[22]

PRBP first produced an analysis of fully served Broadband Serviceable Locations (BSLs) units on a municipality basis, as seen in Figure 28 below. Each BSL contains at least one unit, which can be any combination of residential, non-residential, or mixed-use space. An apartment building will only count towards one BSL but can contain many units. An analysis of broadband service availability at the unit level helps demonstrate population-level need while correcting for population density. As such, future analyses will primarily focus on unit-level availability.

Not surprisingly, densely populated areas have significantly higher reported rates of full-service broadband availability. A list of the most-connected municipalities below maps nearly completely to a list of the most population-dense municipalities in Puerto Rico.

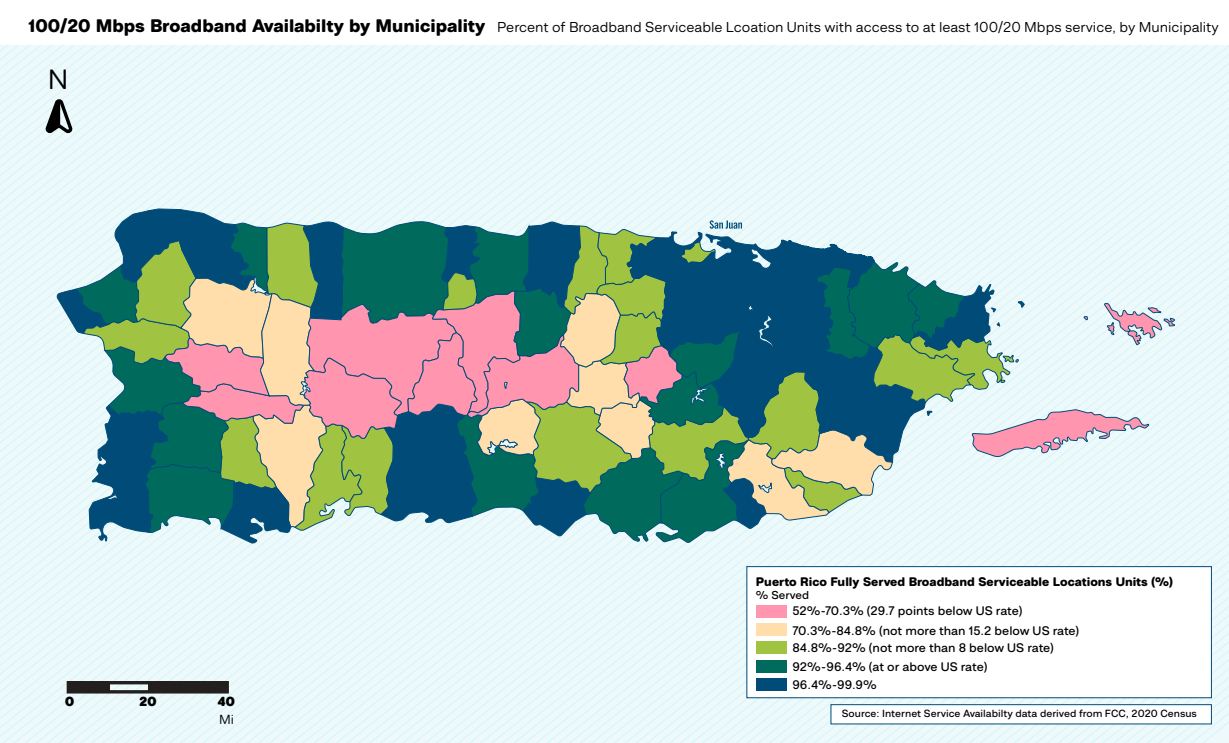
1. San Juan (with 99.96% of BSL units considered Served)
2. Bayamón (99.86%)
3. Ponce (97.89%)
4. Carolina (99.60%)
5. Caguas (99.74%)

While availability in these urban areas meets or exceeds the national average, many municipalities in

[22] A Broadband Serviceable Location (BSL) is "a business or residential location in the United States at which mass market fixed broadband Internet access service is, or can be, installed."
https://help.bdc.fcc.gov/hc/en-us/articles/16842264428059-About-the-Fabric-What-a-Broadband-Serviceable-Location-BSL-Is-and-Is-Not#:~:text=A%20broadband%20serviceable%20location%20(BSL)%20is%20%E2%80%9Ca%20business%20or,or%20can%20be%2C%20installed.%E2%80%9D

Puerto Rico fall well-below national fully served broadband availability rates. Some of the municipalities with the lowest deployment rates include Las Marías Municipality (with only 51.66% of BSL units considered fully served), Ciales Municipality (52.15%), and Maricao Municipality (59.98%).

Figure 28: Broadband Availability by Municipality - Map



Of all unserved broadband serviceable locations, 49.29% (43,022) of all units are in Census-designated rural areas.[23] This result illustrates how rurality is one of the biggest barriers to infrastructure construction.

3.4.1.5 Community Anchor Institutions

The BEAD program offers Puerto Rico the opportunity to supplement the NTIA's definition of Community Anchor Institution. NTIA states that a "Community Anchor Institution" means a school, library, health clinic, health center, hospital or other medical provider, public safety entity, institution of higher education, public housing organization, or community support organization that facilitates greater use of broadband service by vulnerable populations, including, but not limited to, low-income individuals, unemployed individuals, children, the incarcerated, and aged individuals. The NTIA's definition of CAI is used to depict their locations throughout Puerto Rico. The first set of four maps represent quadrants of Puerto Rico and highlight Community Anchor Institutions (CAI) as defined by NTIA:

- Colleges/Universities
- K-12 Schools
- Hospitals/Health Clinics
- Corrections (Jails/Prisons)

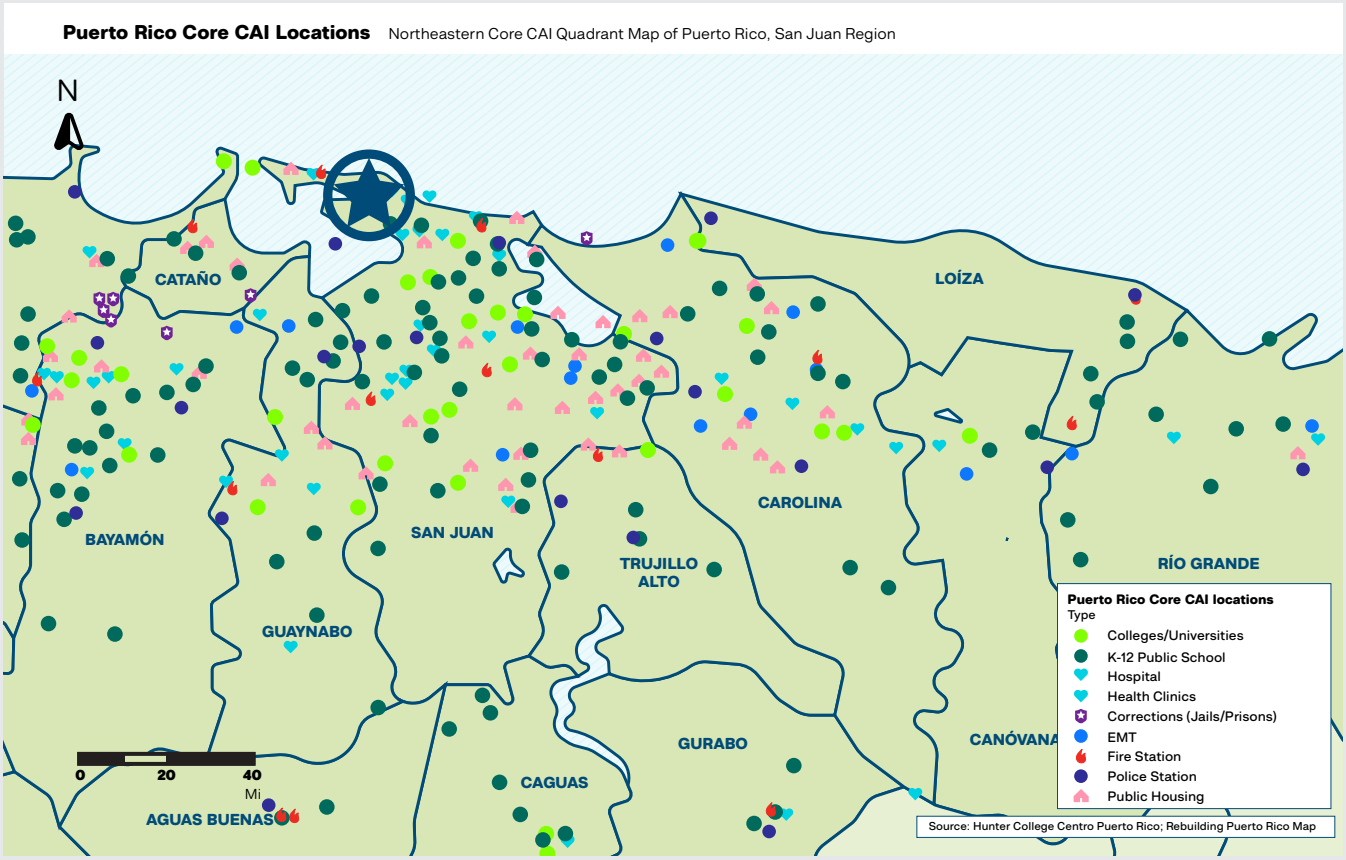
[23] Here, "Census-designated rural areas" is defined as 2010 vintage Census blocks classified as rural by the Census Bureau. This is distinct from the Digital Equity Act definition of rural areas in Puerto Rico.

- Emergency Medical Services, Fire Stations, Police Stations
- Public Housing

According to the NTIA, Libraries are an important defined Community Anchor Institution (CAI). However, identifying libraries in Puerto Rico presents a unique challenge. Following Hurricanes Irma and María (2017) and the earthquakes (2020), libraries closed in some parts of Puerto Rico due to water damage, lack of funding and other resource issues. Currently, there is no centralized directory of Puerto Rican libraries.[24] The Society of Librarians of Puerto Rico, among others, are working to resolve the challenge, as one of their goals for 2023 is to create an updated Directory of Libraries. Libraries will be included in planning and future updates.

It is notable that CAIs are distributed across Puerto Rico, including in underserved and unserved municipalities.

Figure 29: Northeastern CAI Locations - Map



[24] Mariela Santos-Muñiz, "Puerto Rican librarians call for greater investment in library sciences and infrastructure to serve public needs," Prism, July 13, 2022, https://prismreports.org/2022/07/13/puerto-rican-librarians-investments-library-infrastructure.

Figure 30: Northwestern CAI Locations - Map

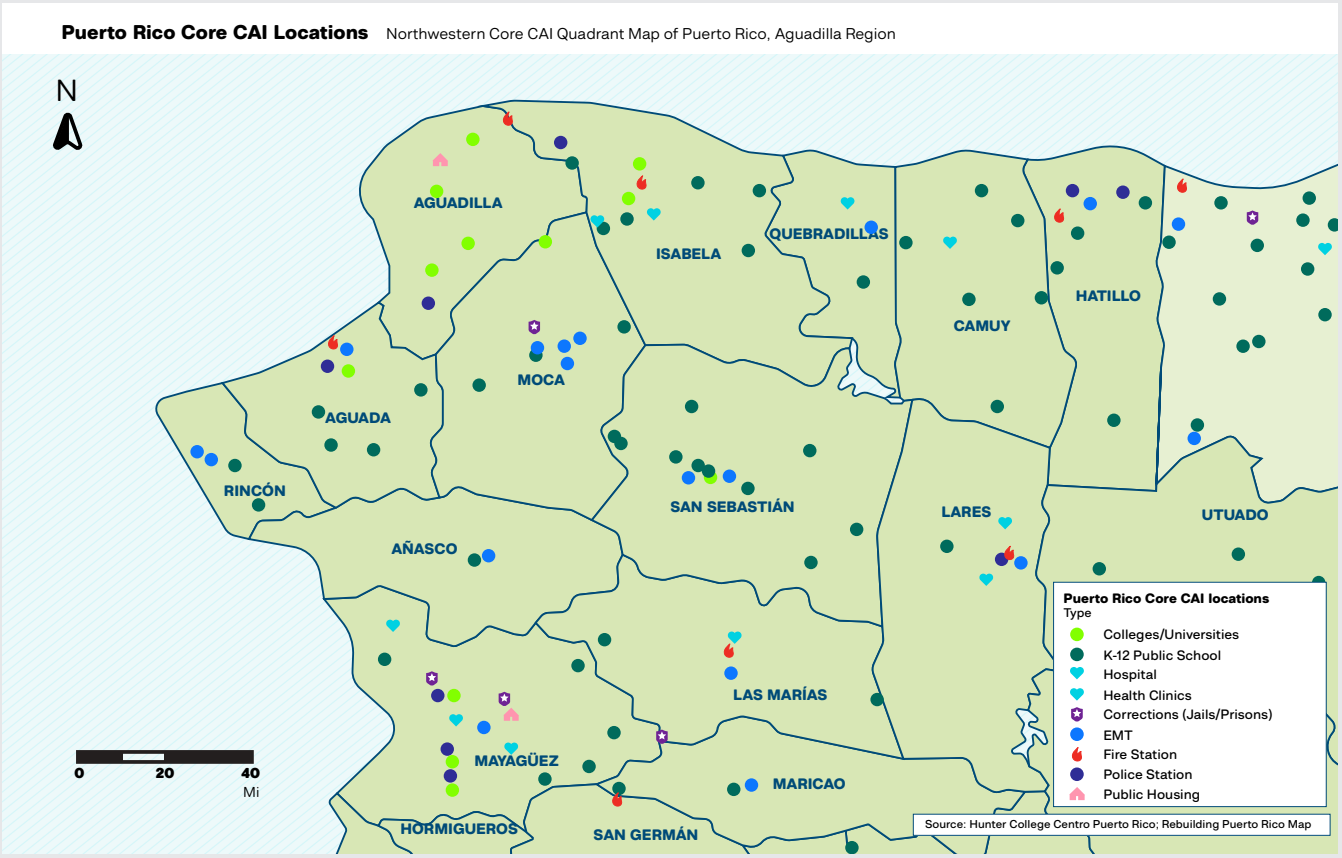


Figure 31: North Central CAI Locations - Map

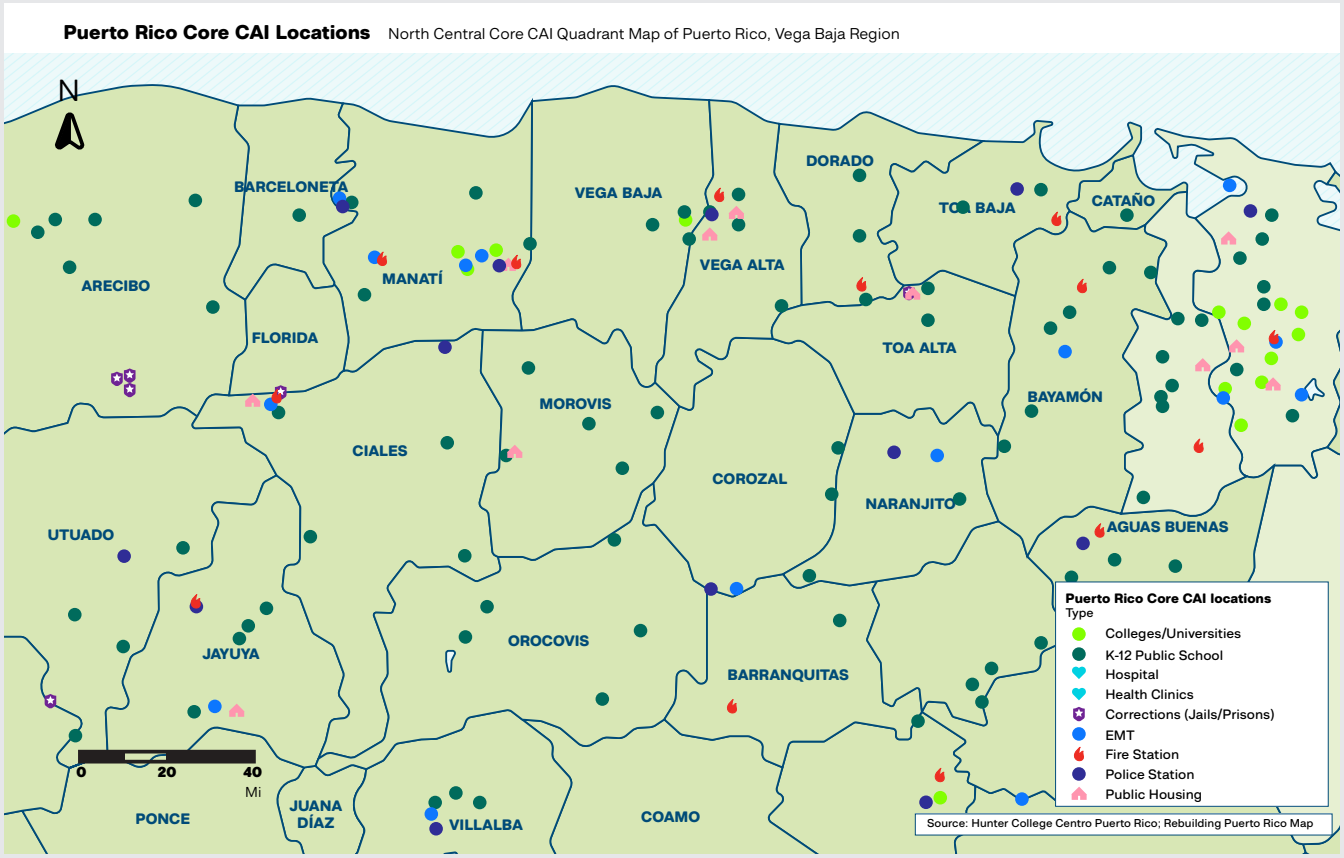


Figure 32: South Central CAI Locations - Map

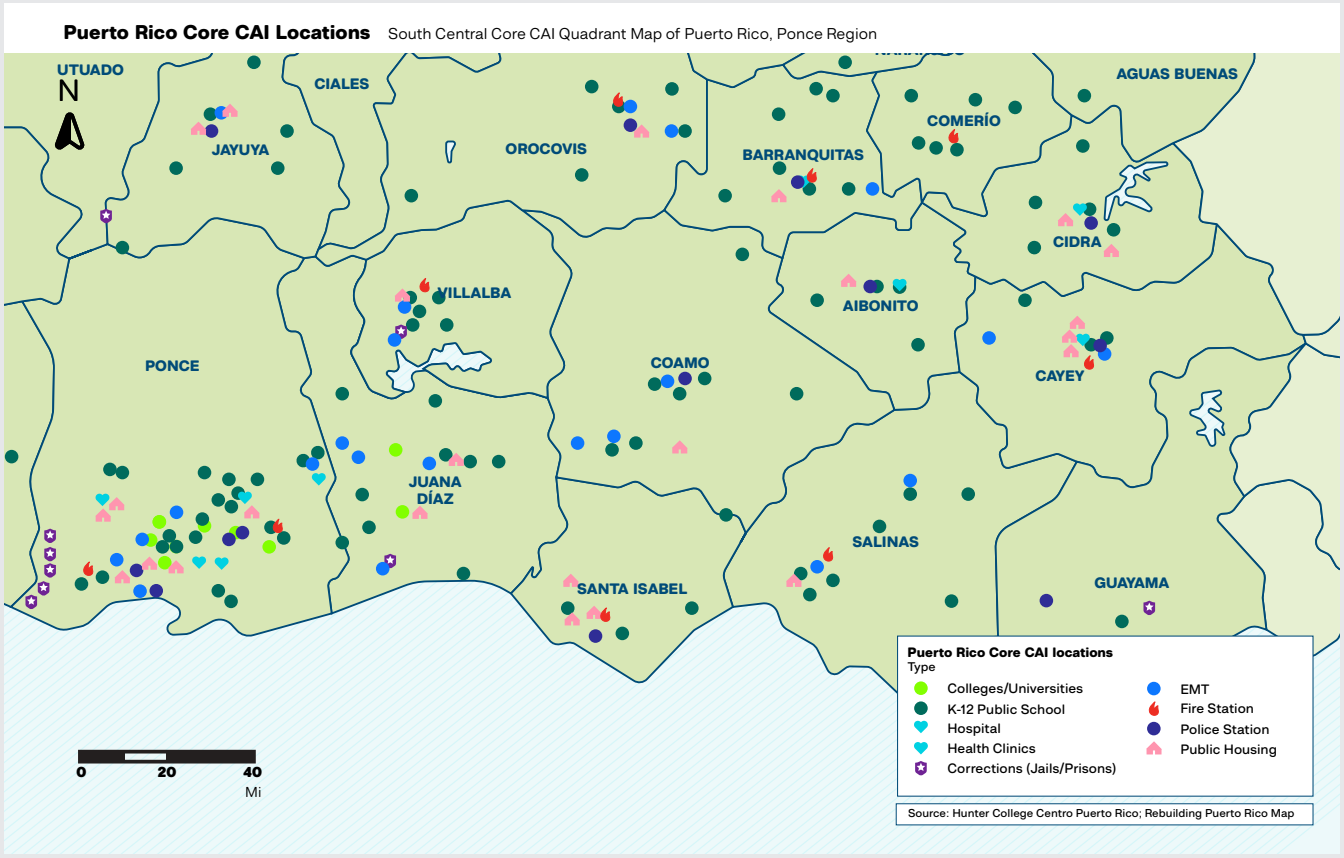


Figure 33: Southwestern CAI Locations - Map

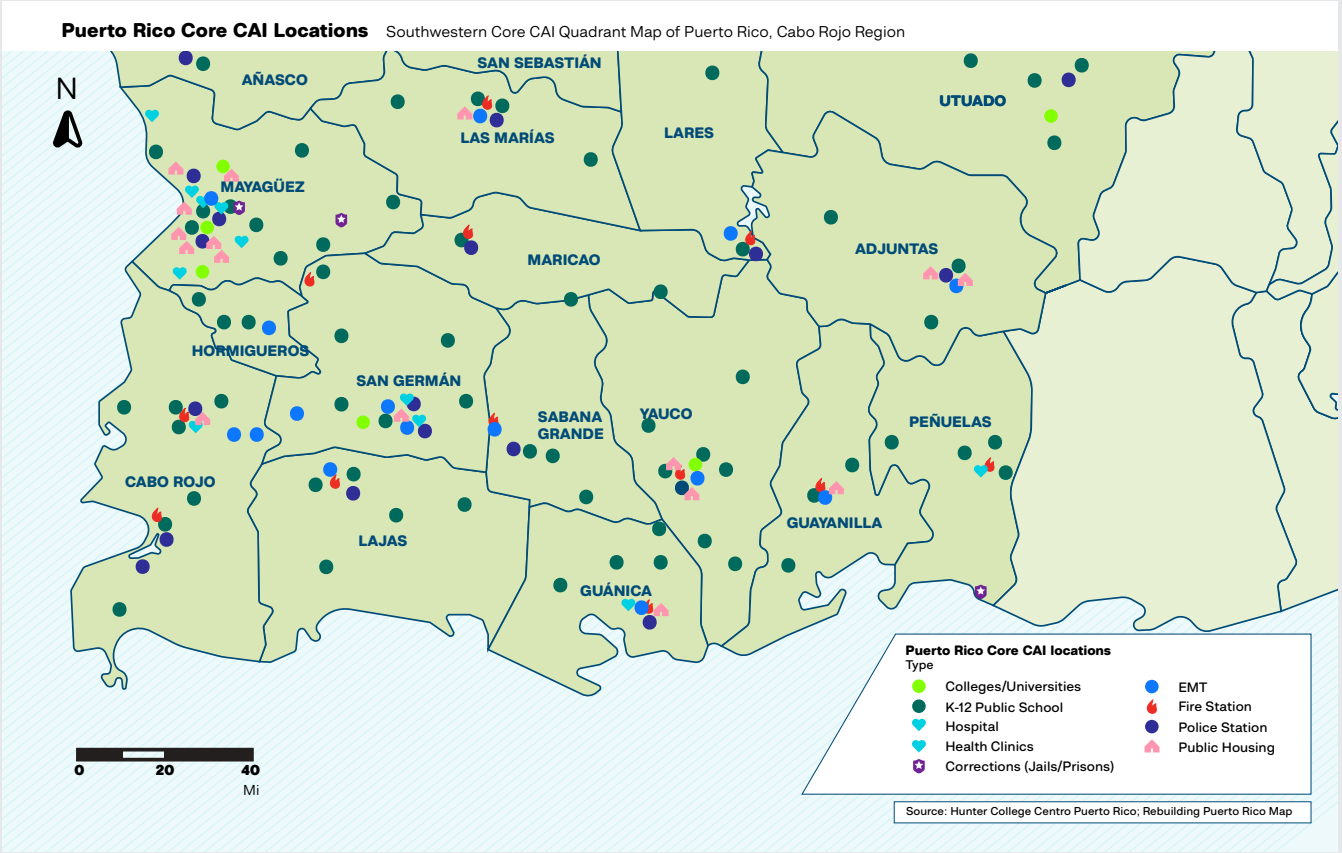


Figure 34: Southeastern CAI Locations - Map

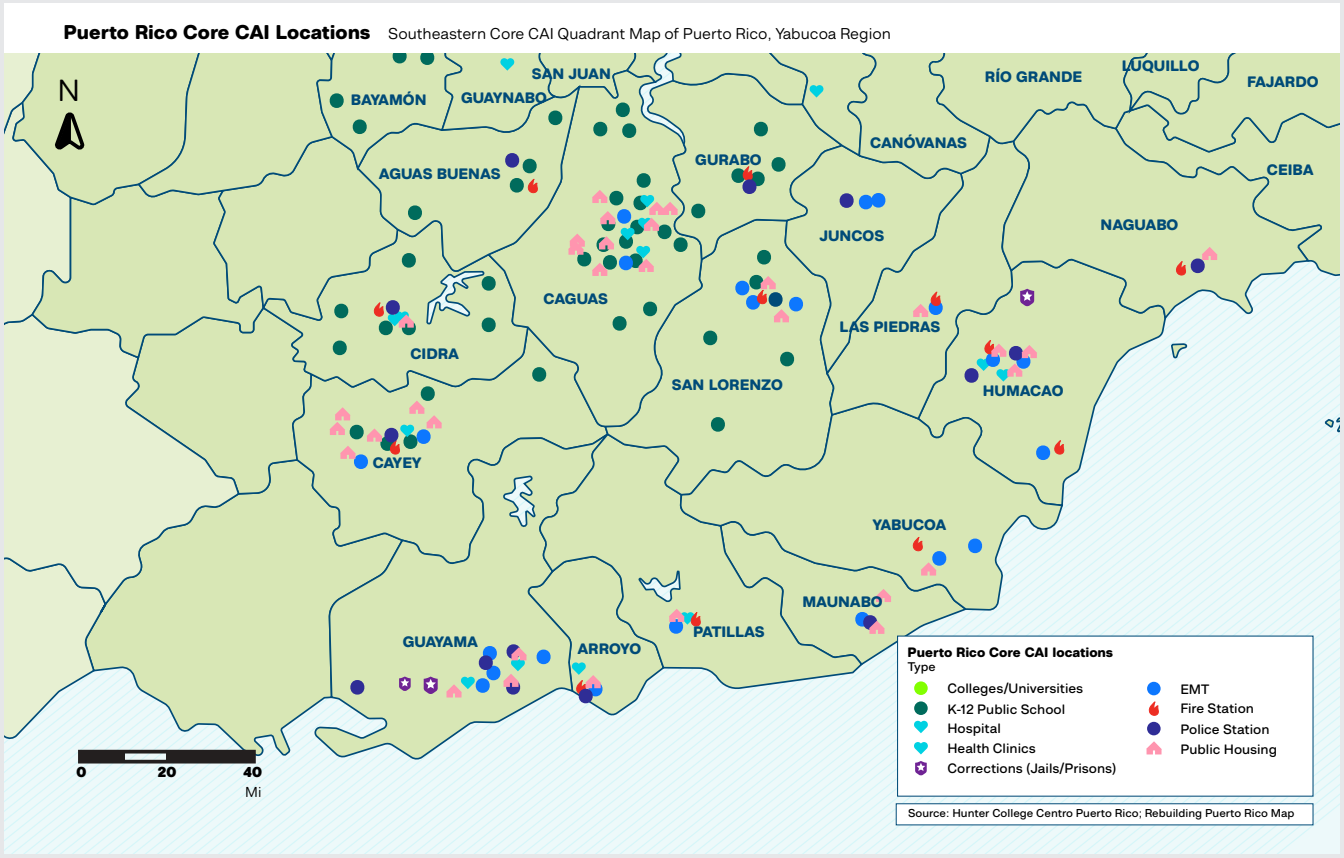
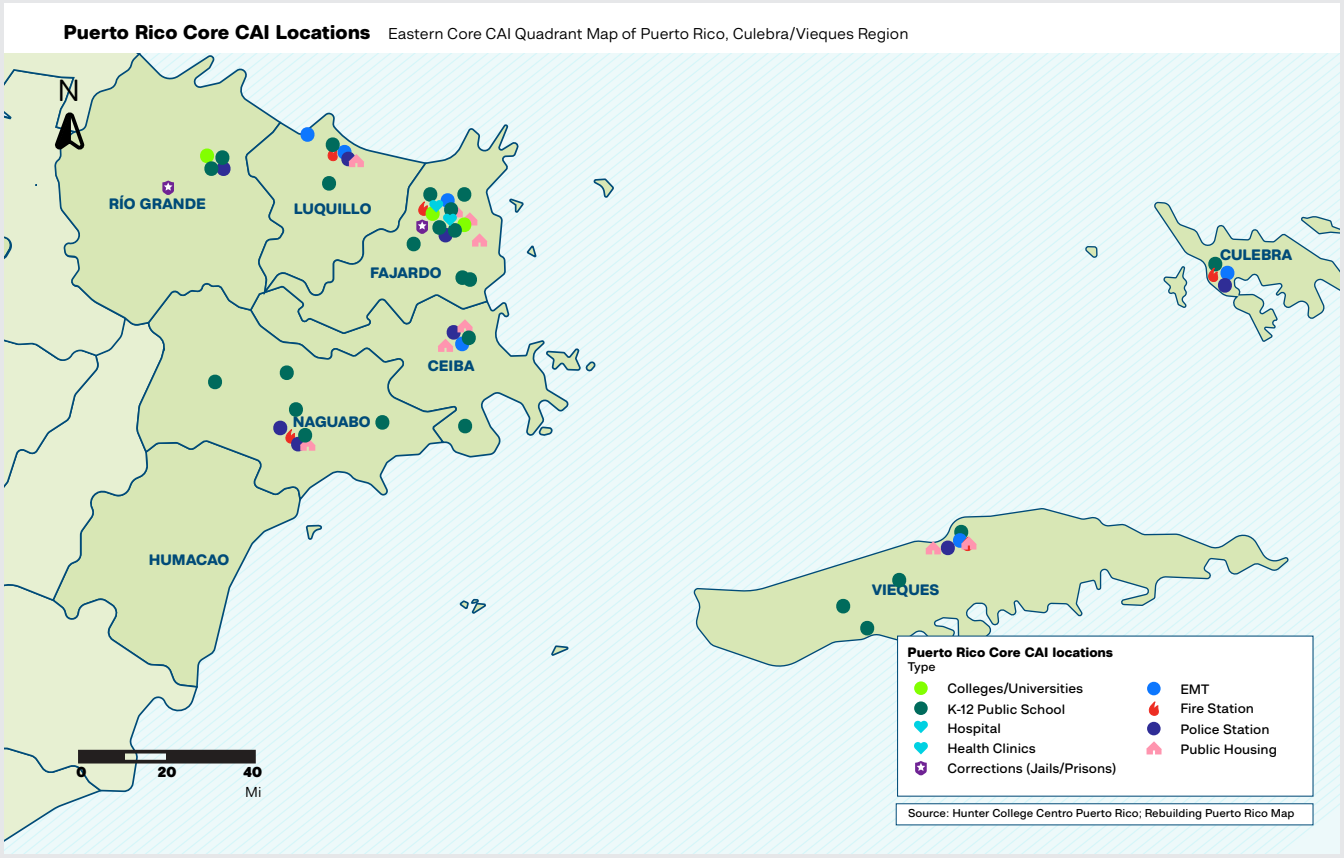


Figure 35: Eastern CAI Locations - Map



Puerto Rico may propose to NTIA additional types of institutions should qualify as CAIs in Puerto Rico. To do so, these must be institutions that facilitate greater use of broadband service by vulnerable populations, including low-income individuals, unemployed individuals, children, the incarcerated, and aging individuals.[25] The next set of four maps represent quadrants of Puerto Rico and highlight suggested CAIs for consideration, including:

- Community Centers
- Computer Centers
- Government Buildings (Federal and Local)
- Places of Worship
- Public Plazas
- Senior Centers
- Shelters

It is notable that Suggested CAIs are distributed across Puerto Rico, including in the underserved and unserved municipalities.

[25] NTIA, "BEAD Notice of Funding Opportunity," 22.

Figure 36: Northeastern Suggested CAI Locations - Map

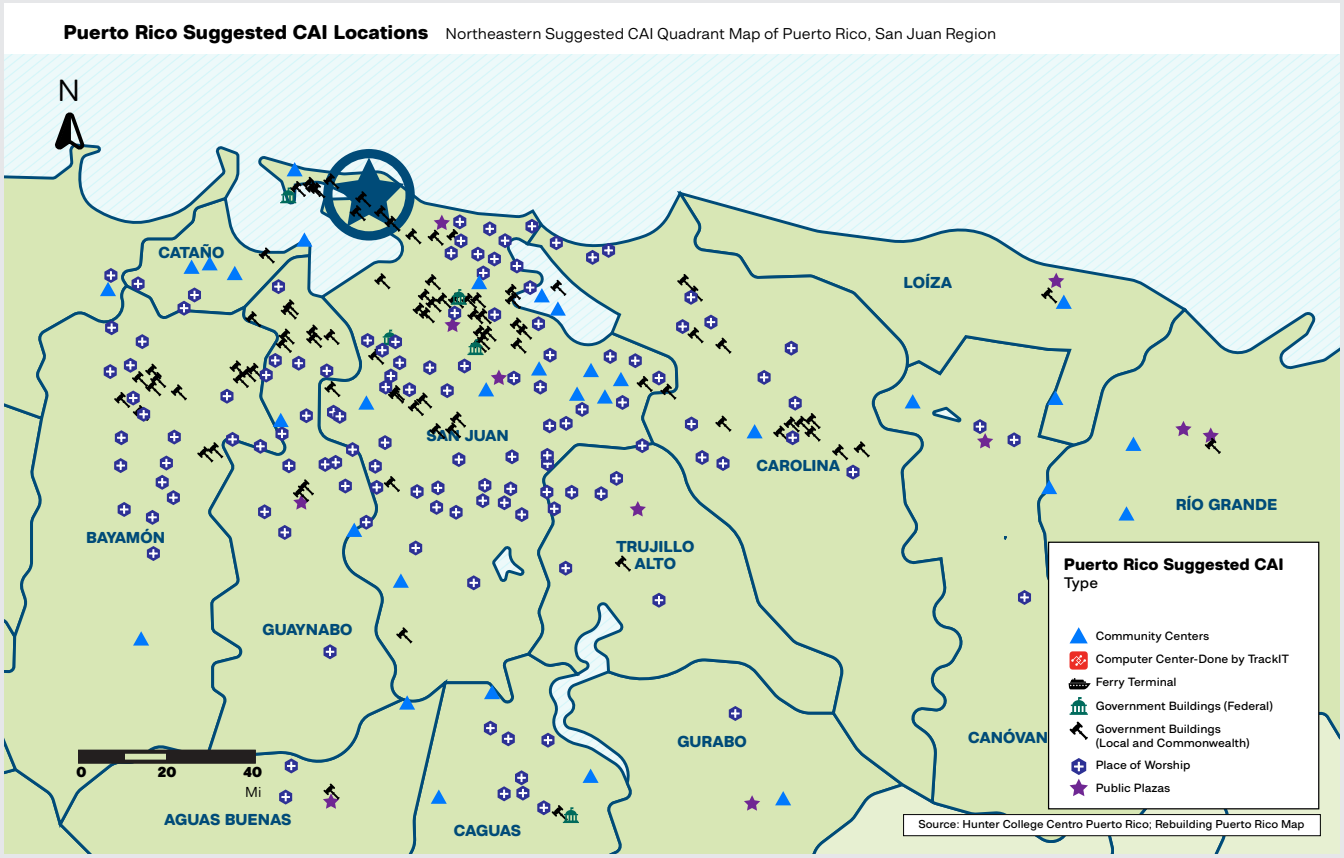


Figure 37: Northwestern Suggested CAI Locations - Map

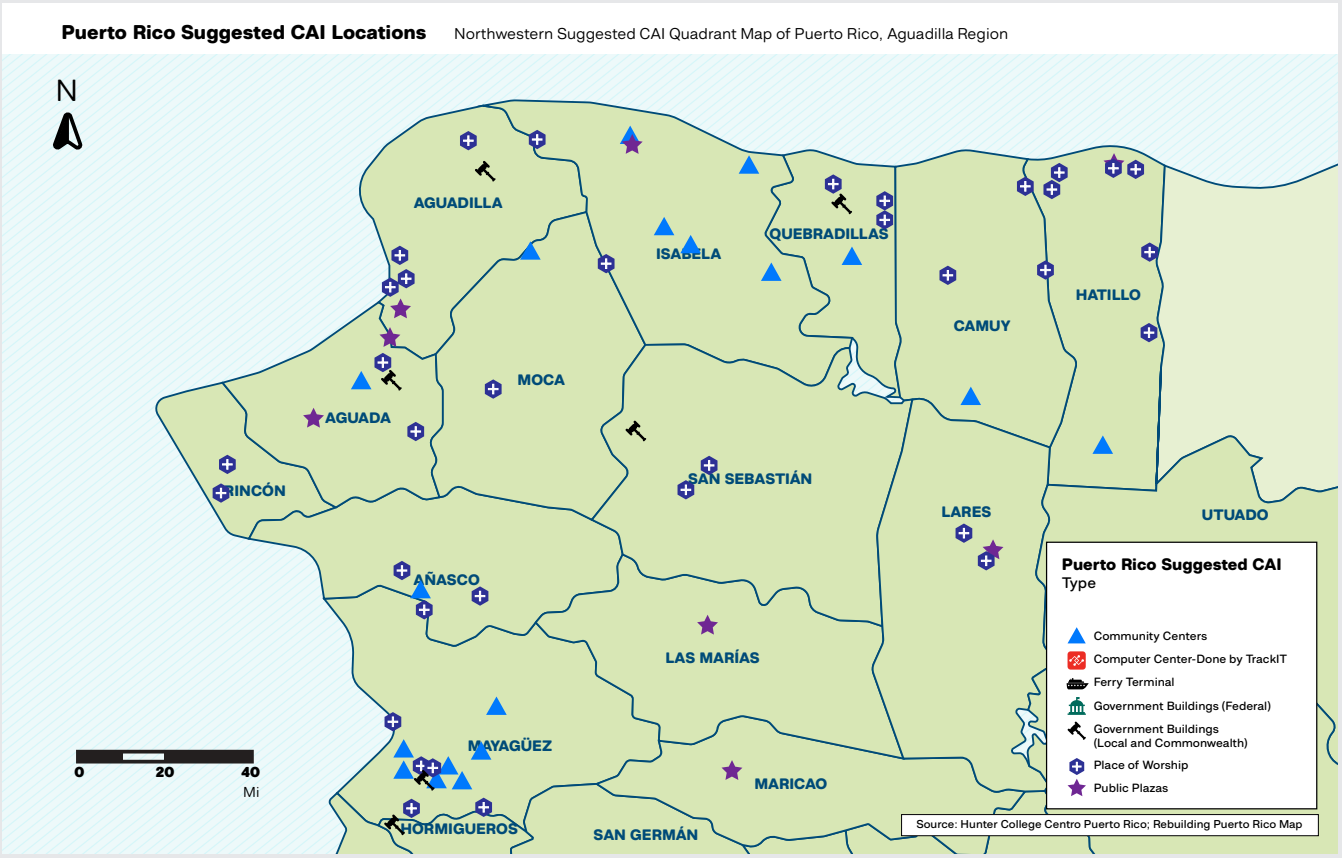


Figure 38: North Central Suggested CAI Locations - Map

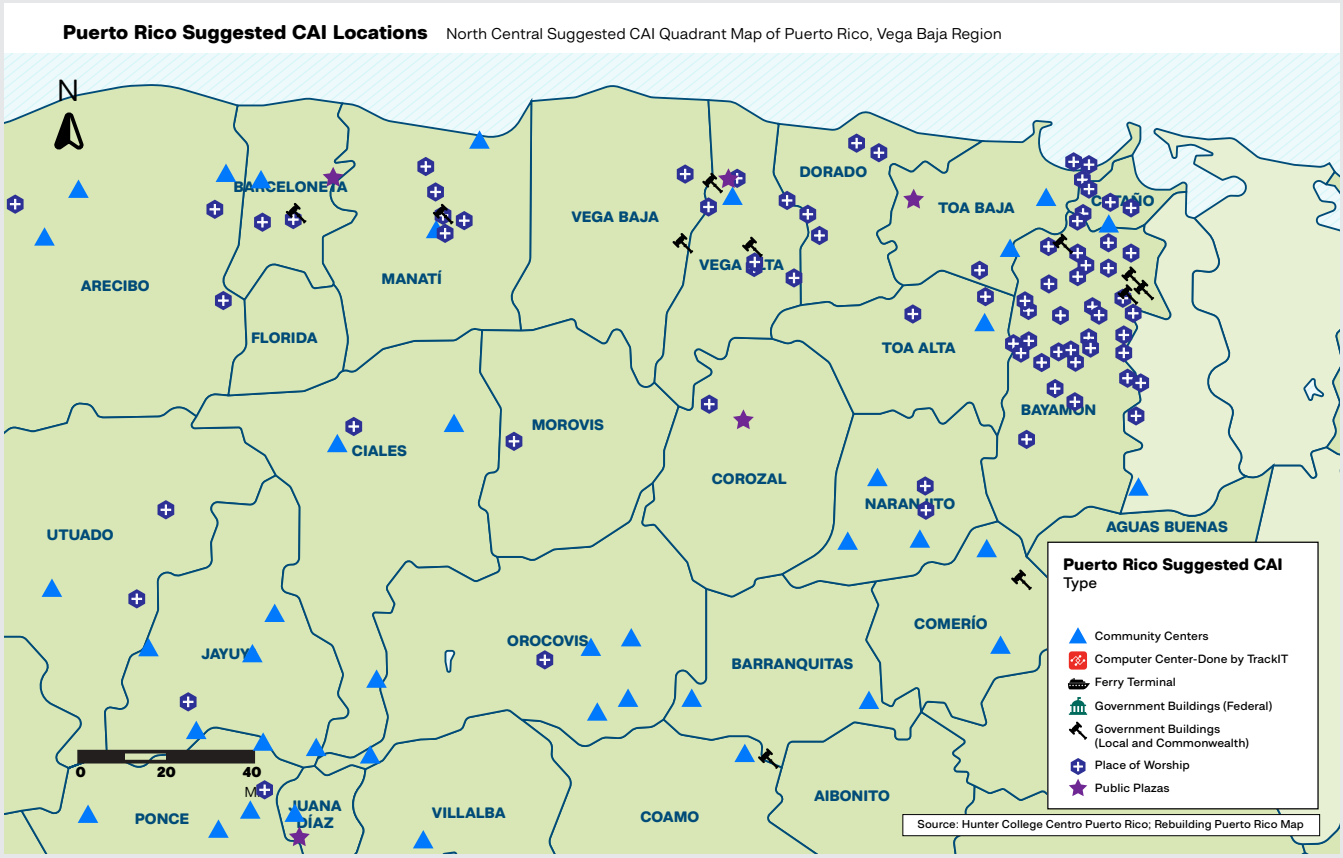


Figure 39: South Central Suggested CAI Locations - Map

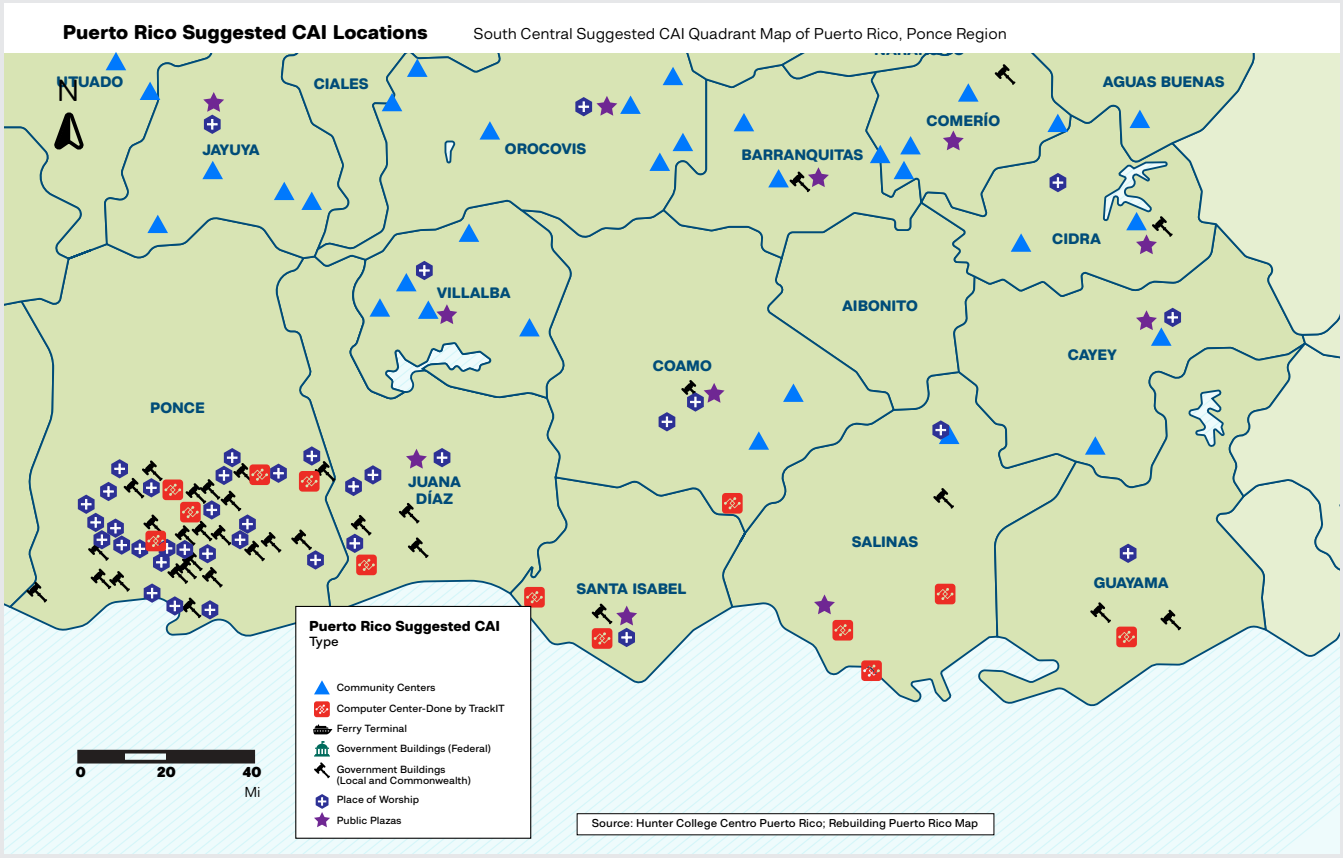


Figure 40: Southwestern Suggested CAI Locations - Map

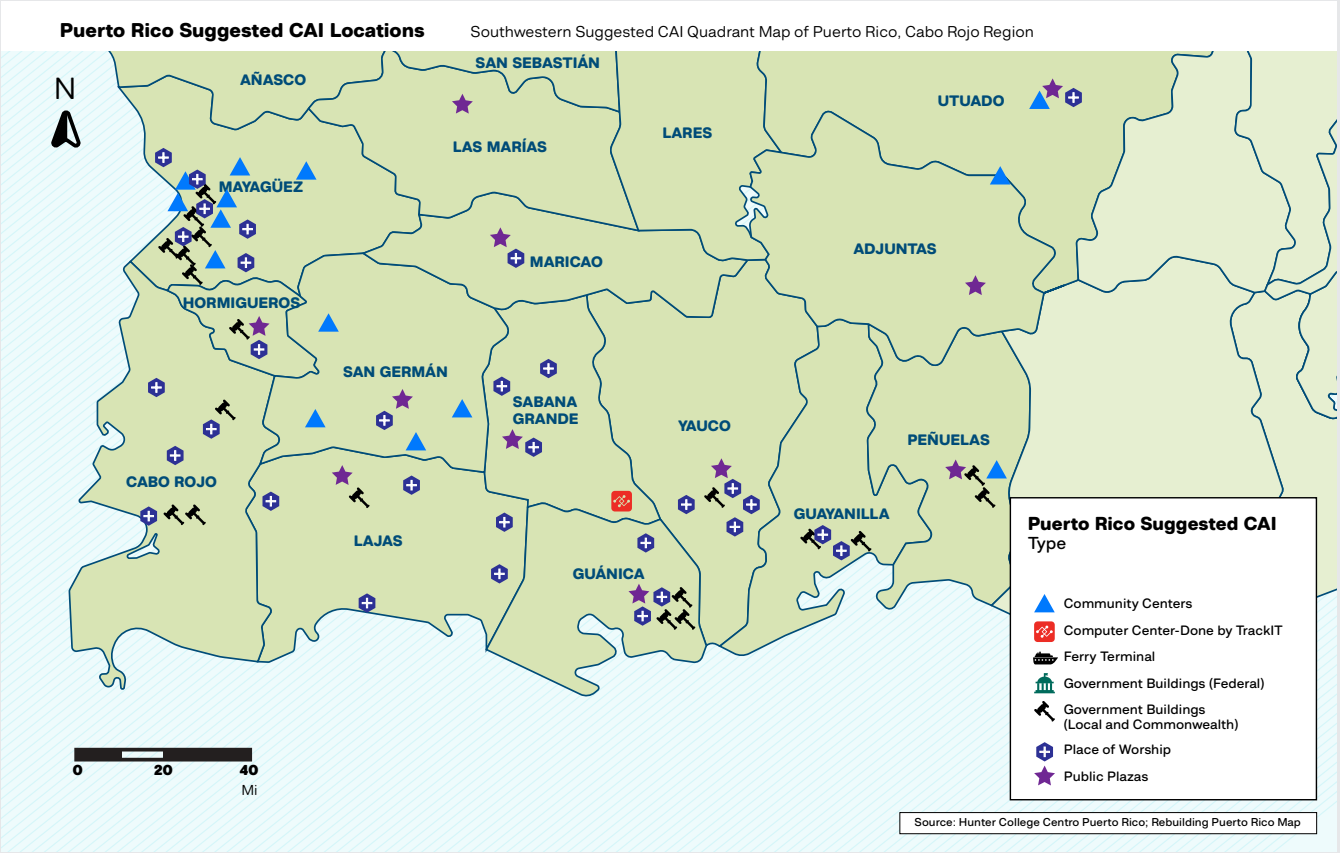


Figure 41: Southeastern Suggested CAI Locations - Map

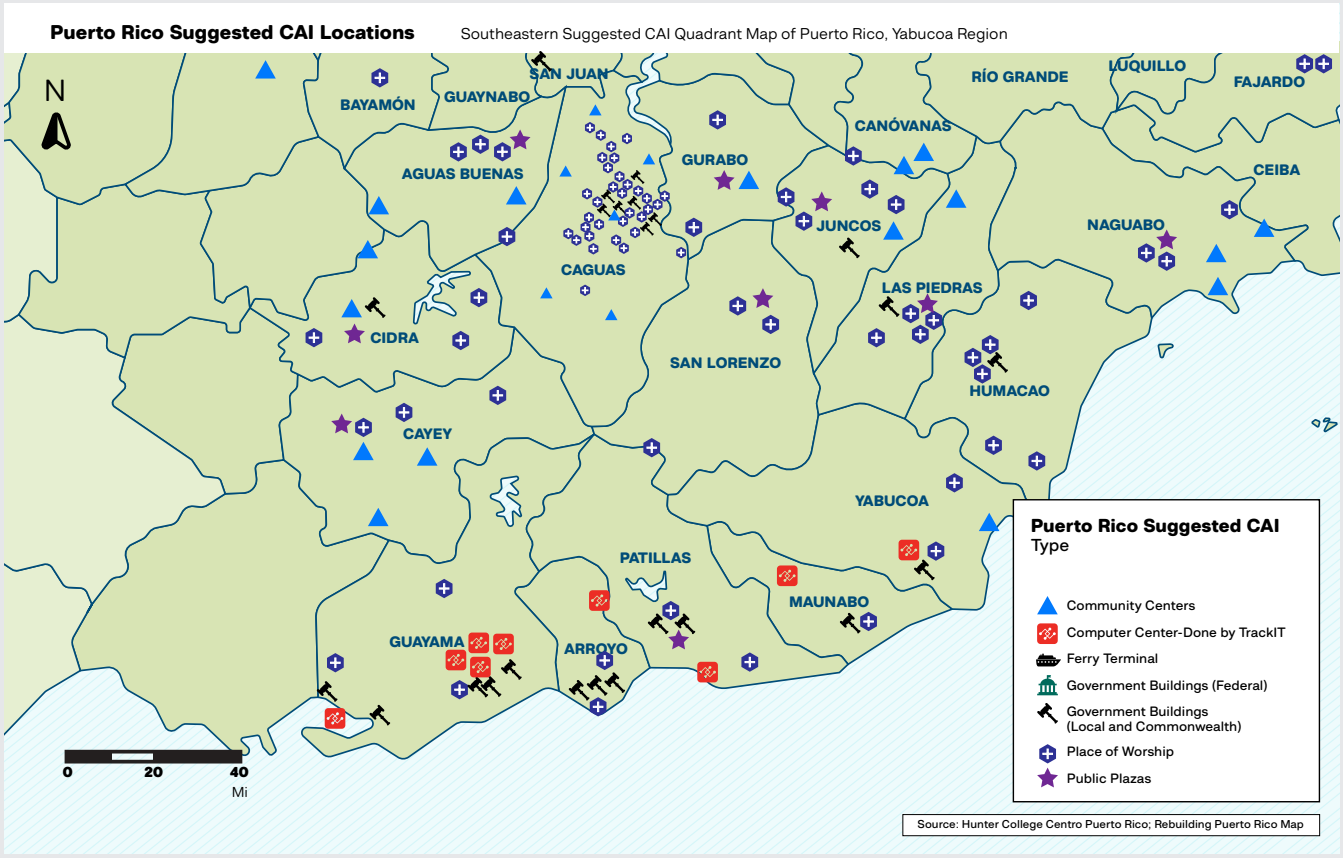
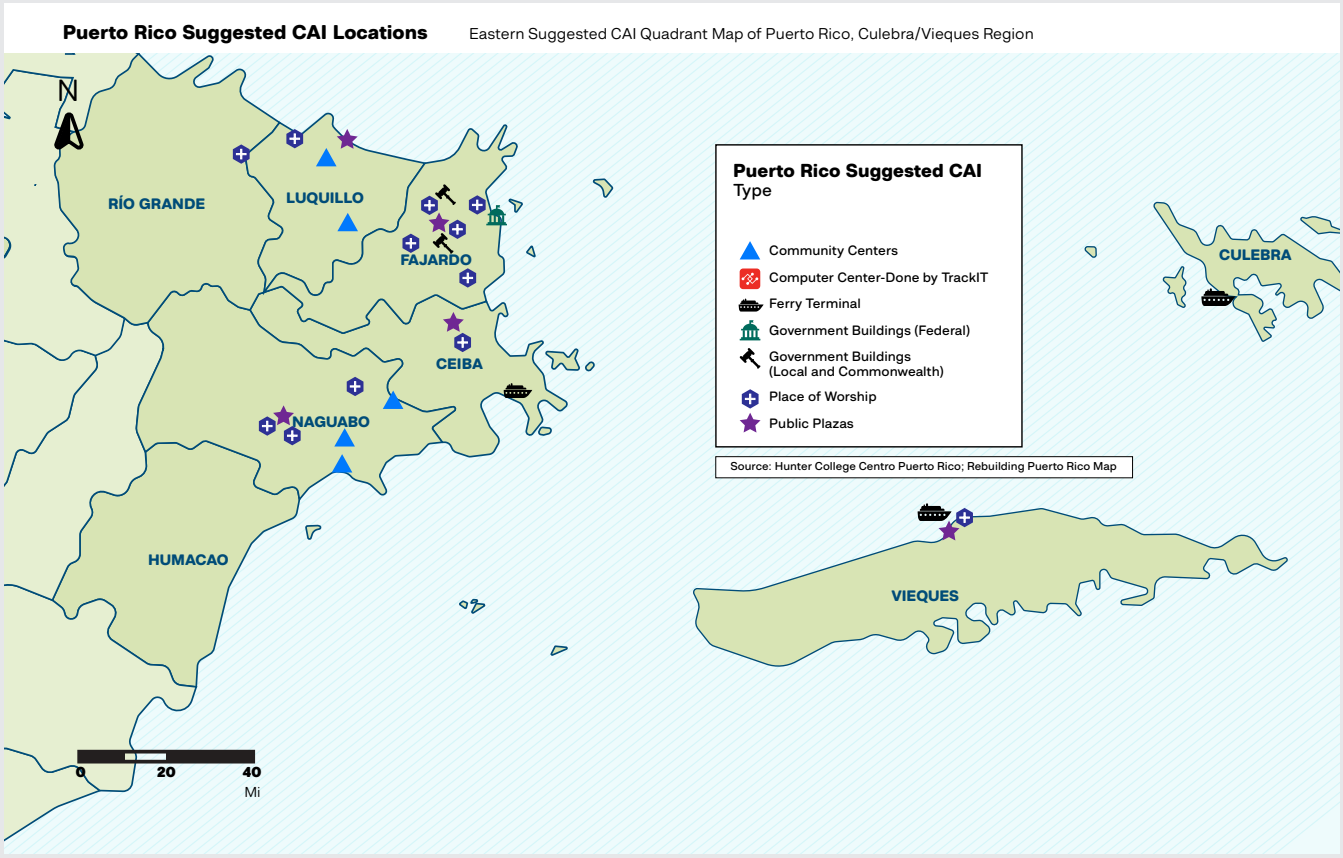


Figure 42: Eastern Suggested CAI Locations - Map



Puerto Rico has added local cultural and relevant entities to the definition of Community Anchor Institutions (CAIs) provided by the NTIA to create a robust list of CAIs. Puerto Rico's list of Community Anchor Institutions and the number of sites for each category are noted in Figure 43 below. A next step is to identify those CAIs that currently have 1G/1G service and those that lack 1G/1G service. This information is both a need and a gap. Surveys, interviews, and listening sessions are being held and planned to collect and update the CAI's 1G/1G broadband service landscape.

Figure 43: Existing CAI Counts

Community Anchor Institutions	#
Churches	626
Colleges and Universities	111
Computer Center	179
Corrections (jails / prisons)	23
Fire Stations	102
Government Buildings (Federal and Local)	530
Government health clinics (No private health clinics) Centers for Diagnostic Treatment	124
Hospitals	69
K-12 Schools (other)	89
K-12 Schools (public)	853
Police Stations	107
Public housing organization / Multi-Tenant Units	382
Public plazas	89
Senior Centers	86
Shelters	484
TOTAL	3854

Community Anchor Institutions identified above followed the NTIA definition for CAI's: Colleges/Universities, Schools, Healthcare facilities, Public Safety, Public Housing organizations/Multi-Tenant units, Government buildings, Senior Centers, and Shelters. Permitted by the NTIA, Puerto Rico added the following community-serving institutions to the list of qualifying CAIs: Churches, Computer Centers, and public plazas. Many of the Puerto Rico-specific CAI's will serve their local community as Multi-Service Centers and Community Service Centers; these institutions are critical for Digital Equity. Community Anchor Institutions are part of the fabric of Puerto Rico and will provide essential aid in delivering ubiquitous, affordable, accessible broadband..

3.4.2 Broadband Adoption

The National Digital Inclusion Alliance (NDIA) defines broadband adoption as daily access to the Internet:

- at quality and capacity necessary to accomplish common tasks,
- on a personal device and secure convenient network,
- with the digital skills necessary to fully participate online.

Access could be occurring at home or elsewhere but NDIA's definition includes "daily" so that if the access occurs not-at-home, then it must be highly convenient.[26] The three tenants of broadband adoption are:

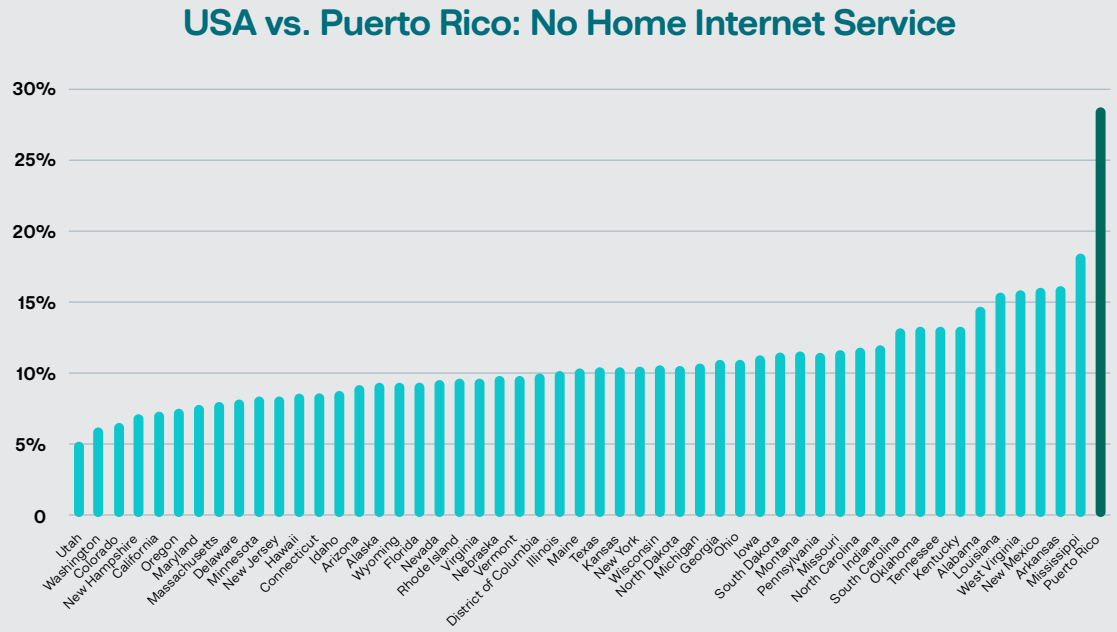
1. Broadband internet availability and adoption
2. Device usage and adoption; and
3. Digital skills.

There are many factors and considerations that affect broadband adoption, including but not limited to digital skills training programs, subsidized and/or low-cost devices, subsidized and/or low-cost device maintenance, availability of public computing labs and programs, and digital equity/inclusion coalitions.

Home Internet Adoption

While broadband deployment as of June 30, 2022, is 94.11%, broadband adoption rates lag significantly behind at 72%. Puerto Rico stands at the very last position regarding percentage of broadband adoption, revealing the complexity of Puerto Rico's digital divide (see Figure 44). Nearly 30% of Puerto Ricans report no home access to the Internet, significantly higher than the U.S. average rate of no Internet access (approximately 10%), and ten percentage points higher than the next-highest state.

Figure 44: USA vs. Puerto Rico: No Home Internet Service



Source: B28002. American Community Survey 2017-21. ACS 5-Year Estimates Detailed Tables

[26] Angela Siefer, "Practical Definition of Broadband Adoption," National Digital Inclusion Alliance, November 9, 2015, https://www.digitalinclusion.org/blog/2015/11/09/practical-definition-of-broadband-adoption/.

Broadband adoption rates across Puerto Rico are not homogeneously distributed, but rather they roughly follow the distribution of income across Puerto Rico. Much of San Juan and the surrounding metro area have significantly higher rates of broadband adoption than the rest of Puerto Rico. In contrast, municipalities in the central region of Puerto Rico have as low as a 16% home Internet adoption rate, which is one of the lowest rates of counties and county-equivalents in the entire United States. However, while the disparity between these two regions is especially stark, it's worth noting that the entire island falls significantly below the rest of the country's home broadband adoption rate.

Device Usage and Adoption

Across the board, device adoption in Puerto Rico falls significantly behind the national average. According to the most recent American Community Survey:

- **25% of Puerto Ricans do not have a computing device,** compared to the U.S. average of just under 7%. This is the highest rate of no computing device in the United States by at least 5 percentage points.
- **Many more residents in Puerto Rico only have a smartphone.** Nearly one quarter of Puerto Ricans use a smartphone with no other type of computing device, compared to the U.S. average of only 8%.
- **Just under half of Puerto Ricans use a desktop or laptop,** compared to the U.S. average of three-quarters. This may be a result of income and poverty rates in Puerto Rico.

Digital Skills

Access to affordable Internet connectivity and devices are not sufficient to promote adoption—residents also must be able to use and maintain these devices. A successful maintenance and upkeep program has two distinct requirements: residents must both be able to problem-solve to resolve basic technical problems (e.g., a frozen screen), as well as have a trusted person or organization to turn to in the case of more difficult or specialized issues. Trained digital navigators provide solutions to both: they can provide trusted ongoing assistance with affordable Internet access, device acquisition, basic technical skills, and application support to enable a Do-It-Yourself attitude, while also serving as an easily accessible, more-advanced resource to solve or triage more complex technical issues when residents need.

3.4.3 Broadband Affordability

Puerto Rico's long history of persistent poverty is a significant consideration for broadband affordability. Almost 99% of the population is considered low wealth; the Puerto Rican median household income ($21,967) is less than one-third of the median United States household income ($69,021).[27] Throughout engagement efforts, the PRBP heard residents say that Internet was too expensive for them. Low household income in Puerto Rico means that affordability measures will have to be a key focus of the PRBP.

The Puerto Rico Broadband Program is working to address affordability issues in several ways, including:

- Participation in the FCC's Affordable Connectivity Program (ACP) Outreach Grant Program ($740K) [28]
- Investing local funds to expand ACP outreach efforts ($405K)
- Leveraging BEAD funds to reduce subscription costs
- Investing in device distribution efforts.

[27] U.S. Census Bureau, "Quick Facts Puerto Rico," July 1, 2022, https://www.census.gov/quickfacts/fact/table/PR/PST045222.
[28] FCC, "Consumer and Governmental Affairs Bureau Announces ACP Outreach Grant Program Target Funding," WC Docket Nos. 21-450, DA 22-194, March 10, 2023, https://docs.fcc.gov/public/attachments/DA-23-194A1.pdf.

The ACP Outreach Program increases awareness of and enrollment in the ACP program, which provides discounts for Internet service and one-time subsidy for purchasing an Internet-enabled device.

While the federal government does not provide estimates of the total number of households in Puerto Rico that qualify for the Affordable Connectivity Program, PRBP analyzed all available data and estimates that almost three quarters of the households in Puerto Rico qualify for ACP, compared to 36% of households nationwide. Currently, 600,000 Puerto Rican households are enrolled in ACP, which is 65% of eligible households.[29] While compared to the rest of the United States, ACP enrollment in Puerto Rico is high, it is necessary but not sufficient. Continuing to increase awareness of the program is a priority, in addition to developing other affordability measures.

3.4.4 Broadband Access

3.4.4.1 Public Wi-Fi and Public Access Points

Public Wi-Fi is an important service in Puerto Rico. It can support local businesses by providing a service to customers and tourists, serve as a supplemental means of low-cost Internet access for residents, and provide a place to go to connect when service at home is taken out by storms or other factors that impact reliability.

The PRBP reached out to all 78 Puerto Rico municipalities to ask them if they had the need for public Wi-Fi hot spots and if so where they should be located. In the initial wave of responses, 46 responded that there is a need and have identified 138 Wi-Fi hotspot locations. The remaining 32 municipalities can still participate in the process and respond to PRBP's request and will be considered on a second stage.

3.4.4.2 Mobile Broadband Connectivity

Individuals without existing reliable fixed wireless or terrestrial broadband connectivity may currently rely on mobile service as a backup. To that end, PRBP analyzed mobile service at a high level as a useful tool in assessing current supply and demand for broadband in an outdoor stationary environment island wide. By area, the FCC reports that 4G coverage (5/1Mbps) currently covers 65.10% of Puerto Rico, as of June 2022. 5G mobile coverage covers 57.79% and 55.77% of Puerto Rico at 7/1 Mbps and 35/3 Mbps.[30] As terrain plays a large role in limiting both fixed and mobile wireless broadband coverage across Puerto Rico, PRBP considers it unlikely that many rural households or businesses rely on high-speed mobile broadband coverage to supplement existing lacking or non-existent fixed broadband connectivity across Puerto Rico.

3.4.5 Digital Equity

Increasing broadband adoption across Puerto Rico requires more than making reliable, high-speed service available to every Puerto Rican: digital inclusion efforts must also address the availability of devices, Internet knowledge, and digital skills. Funding from the BEAD program will be used to augment Puerto Rico's broader goals for increased digital inclusion.

Puerto Rico has many challenges and is far behind the rest of the U.S. in achieving digital equity. PRBP's

[29] Institute for Local Self-Reliance, "Affordable Connectivity Program," July 10, 2023, https://acpdashboard.com.
[30] FCC, "National Broadband Map Data Download, June 30, 2022, https://broadbandmap.fcc.gov/data-download/nationwide-data?version=jun2022.

asset inventory reveals the critical need for additional digital equity and inclusion resources. The additional federal funds that Puerto Rico has received are beginning to move the needle, and PRBP expects to quickly add resources to its asset inventory as federal programs spin up and additional resources become available.

To inventory Puerto Rico's digital equity assets, resources, programs, the Puerto Rico Broadband Program collected information in the following ways:

- Community listening sessions
- Survey of Puerto Rican organizations including nonprofits, government agencies, higher education institutions, municipalities, and community organizations
- Connectivity Survey with optional speed test for residents
- One-on-one interviews with local agencies, nonprofits, CAIs, and other organizations
- Small group discussions with key stakeholders
- Telephone surveys (landlines and cell phones) of residents
- Participation in partner events and conferences
- Analysis of federal programs that support digital equity.

Throughout PRBP's engagements, many stories and insights were shared. These qualitative findings paint a clear picture of the digital equity landscape. For example,

"People have virtually no knowledge whatsoever of how to use a computer, how to use a tablet, how to navigate to job search. The most they could know how to do is with their cell phone call the numbers they already have, which are already established. But in many cases, they do not know how to call [emergency services] or call their medical plans to coordinate a medical appointment or to coordinate a health matter."

–Listening Session Participant

In a survey of partner organizations, respondents reported a high need for:

- Offering services to help customers with their Internet needs, including workshops and digital skills training
    - Offering devices to help individuals complete online forms
- Referring individuals to other organizations that could support individuals with computing needs.
- Participating in alliances, partnerships, or coalitions with other organizations to promote high-speed Internet access or use
- Engaging with the Smart Island Summit or working with partners that work with the Smart Island Summit.

While the current gap in digital equity is large and pervasive, the connections between people and communities, and the organizations that serve them, are strong. These ties are key to bridging the digital divide and meeting the unique needs of Puerto Rico. The influx of federal funding will allow the

Government of Puerto Rico to provide needed support and services to organizations and island residents so that everyone can participate in the 21st-century economy. Puerto Rico's Digital Equity Plan provides more details on PRBP's approach to digital equity.

SECTION 4

Obstacles and Barriers

4.1 Climate and Topography

Puerto Rico has a tropical climate with a mix of warm temperatures and rainy seasons year-round. This makes it susceptible to severe weather events, such as hurricanes, which can cause significant damage to infrastructure. Puerto Rico has a rugged, mountainous interior and a coastal plain along the perimeter. This poses challenges for infrastructure development and deployment, as it can be difficult to build and maintain infrastructure in mountainous areas. The combination of a tropical climate and rugged topography makes it difficult to design, construct, and maintain telecommunications infrastructure in Puerto Rico. This can lead to disruptions in telecommunications services, which can have a significant impact on the economy and the quality of life of residents.

4.1.1 Hurricane and Storm Hazards

As mentioned before, Puerto Rico has a tropical climate with a variance of weathers year-round. All portions of Puerto Rico experience varying levels of rain throughout the year, with the eastern portion (windward side) of Puerto Rico averaging 50.0 in/yr. and the western portion (leeward side) of Puerto Rico seeing only 13.6 in/yr.[31]

Due to Puerto Rico's location in the Atlantic, it is impacted by the North Atlantic Hurricane season, which lasts from June through November. Since 1867, Puerto Rico has experienced 30 hurricanes, including 9 major hurricanes above a Category 3.[32] The frequency and intensity of hurricanes and flooding have increased since the 1980s and pose a significant threat to the infrastructure and economy of areas within these active hurricane zones. In September 2017, Hurricane María made landfall in Puerto Rico and caused widespread devastation, including loss of life and significant damage to infrastructure. The hurricane was the most powerful storm to hit Puerto Rico in nearly a century, with sustained winds of 155 mph and torrential rainfall that caused flooding and landslides. Hurricane María caused the longest blackout in US history and destroyed communication and infrastructure networks, leading to major rebuilding efforts that are still underway on Puerto Rico. [33]

[31] Puerto Rico Climate and Topography https://www.usgs.gov/centers/cfwsc/science/climate-puerto-rico
[32] Historical Data of Hurricanes - https://travellemming.com/hurricane-season-in-puerto-rico/
[33] Update on FEMA's Disaster Recovery Efforts in Puerto Rico and the U.S. Virgin Islands https://www.gao.gov/assets/gao-22-106211.pdf

The impact of hurricanes and flooding on infrastructure and the availability of skilled labor is a critical consideration for any construction project in hurricane-prone areas like Puerto Rico. By taking these factors into account and implementing appropriate risk management strategies, the government and private sector can reduce the impact of hurricanes on construction projects. Below is a list of obstacles that will be considered when planning project work where and when hurricanes and floods occur:

- **Delays due to evacuation orders:** During hurricanes and flooding, local authorities may issue evacuation orders that require construction workers to leave the area, resulting in significant delays to construction schedules.
- **Damage to construction materials and equipment:** Both hazards can cause significant damage to job sites and equipment, further delaying projects.
- Interruptions to power and communication networks: Widespread power outages and disruptions to communication networks make it difficult for construction teams to communicate and coordinate with each other.
- **Damage to existing infrastructure:** Significant damage to roads, bridges, and other critical infrastructure may need to be repaired before telecommunication construction can continue. Labor may be diverted away from the project, resulting in schedule delays.
- **Raising infrastructure:** Moving facilities into higher elevation areas or on building floors above historic flood levels can decrease the risk of additional damage from a storm event.[34]
- **Delays on materials:** Due to Puerto Rico location, all materials, equipment, and resources, must be shipped or air transport. The logistic of getting any materials to Puerto Rico is a challenge.

4.1.2 Earthquake and Tsunami Hazards

Puerto Rico is in a seismically active area where the North American and Caribbean tectonic plates meet, resulting in frequent earthquakes and at risk of tsunamis. Puerto Rico has a network of fault lines that extend across the mainland and offshore. The southern side is near the Muertos Trough, which has been active in recent years, including a 6.4 magnitude earthquake in January 2020 that damaged over 3,000 buildings and displaced thousands of people. In addition to the risk of earthquakes, Puerto Rico's coastal population is vulnerable to potential tsunamis from nearby seismic activity. Many critical infrastructure facilities, such as power plants, water treatment plants, and hospitals, are in these areas, making them particularly susceptible to the devastating effects of tsunamis and flooding.

The topography of Puerto Rico with geological faults, can exacerbate the effects of seismic activity, potentially impacting the stability of telecommunication infrastructure. Earthquake-resistant designs and rigorous structural engineering practices that adhere to strict requirements are crucial to mitigate these risks and improve resilience in Puerto Rico. Buildings, bridges, and other critical infrastructure must be designed and constructed with appropriate seismic-resistant features, such as reinforced concrete frames, steel bracing systems, and base isolation techniques. These measures help enhance structural resilience and reduce the risk of damage or collapse during earthquakes. Areas with higher seismic activity or proximity to fault lines may require additional engineering measures or avoidance strategies to minimize the risk to infrastructure and public safety.

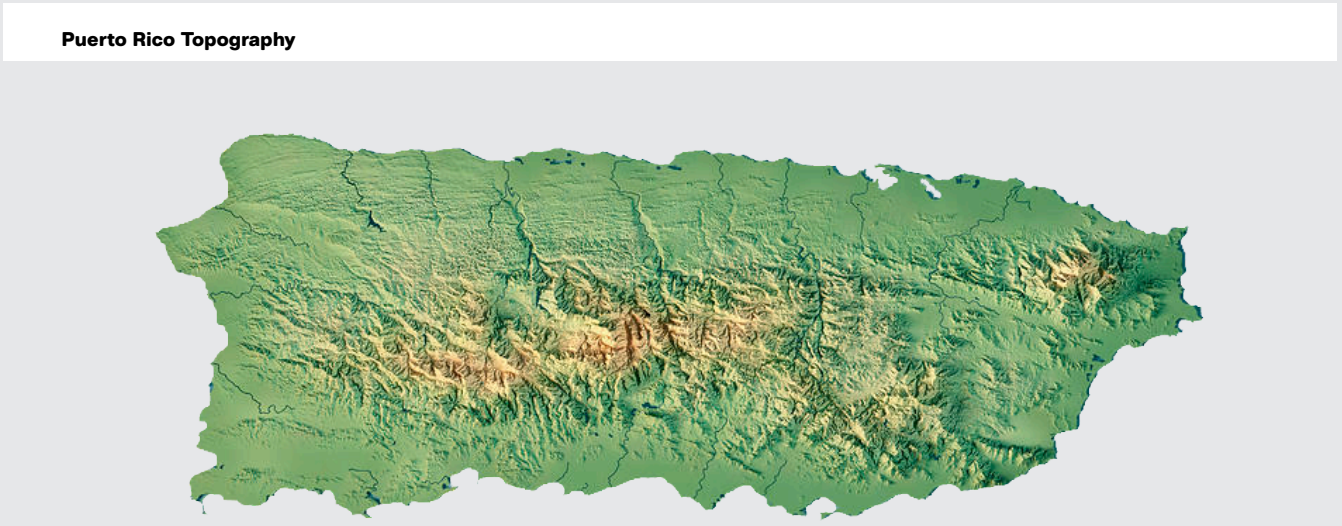
[34] Raising Building Infrastructure - https://riskfactor.com/solutions/flood

Seismic activity can trigger a phenomenon known as soil liquefaction, where saturated soils lose their strength and behave like a liquid. These events can significantly impact the stability of foundations, underground utilities, and infrastructure supported by loose or liquefiable soils. Seismic activity can disrupt critical lifeline infrastructure, including roads, bridges, water and sewer pipelines, and power distribution systems. Strong earthquakes can cause ground movements, landslides, or fault ruptures, leading to damage or complete failure of these infrastructure components. Seismic activity necessitates robust emergency preparedness and response strategies. Developing early warning systems, establishing evacuation plans, and implementing effective communication networks are critical for ensuring public safety and minimizing the impact of earthquakes on infrastructure and communities. Telecommunication infrastructure plays a vital role in facilitating communication and coordination during emergency situations and must be designed and built for deployment in a seismically active zone.

4.1.3 Challenges Due to Topography

Puerto Rico's topography is diverse and varied, featuring a mountainous interior with steep slopes, rocky terrain, and dense vegetation. This mountainous topography makes it difficult to access and construct infrastructure poses several challenges for telecommunication deployment. The Cordillera Central is one of the most prominent geological features on Puerto Rico. It is home to several notable peaks, including Cerro Punta, the highest point in Puerto Rico at an elevation of 1,338 meters above sea level. It forms the central spine of Puerto Rico and runs east to west throughout Puerto Rico creating a geographic division between the north and south portions of Puerto Rico. This region is sparsely populated due to its difficult terrain and lack of infrastructure. The mountain range also features numerous valleys, canyons and streams that pose challenges in designing and deploying broadband solutions as well as civil infrastructure. In contrast, Puerto Rico's largest metro area, the San Juan metro area, contains 75% of Puerto Rico's population and dominates the landscape in the north. By understanding and addressing these challenges, we can develop strategies and solutions to overcome the topographical barriers and create a resilient telecommunication infrastructure that meets the communication needs of Puerto Rico's residents and supports its socio-economic growth.

Figure 45: Puerto Rico Topography



The rugged mountainous terrain makes it challenging to identify suitable sites for infrastructure placement, particularly in remote or inaccessible areas. The selection of optimal locations for towers, antennas, and other telecommunication equipment becomes a complex task due to the uneven landscape and limited access. The mountainous terrain delays the installation of physical infrastructure such as fiber optic cables. Steep slopes and rocky terrain require additional effort and resources for excavation, trenching, and cable laying, increasing the overall construction costs and time required for deployment.

The rugged terrain also disrupts signal propagation and coverage. The uneven landscape can create signal shadowing, where signals are blocked or weakened by natural obstacles such as hills or mountains. This can result in areas with poor or limited connectivity, affecting the overall reliability and quality of telecommunication services. Limited line-of-sight is another significant obstacle presented by the topography of Puerto Rico, particularly in areas with dense vegetation and rugged terrain. The establishment of line-of-sight wireless communication links, such as microwave or satellite connections, relies on a clear, unobstructed path between transmitting and receiving stations. However, the presence of hills, mountains, and dense vegetation can obstruct the signal path, leading to signal degradation, reduced data transmission rates, and even complete signal loss. Limited line-of-sight also affects the deployment of certain telecommunication technologies that require direct signal transmission, such as point-to-point wireless connections or certain satellite communication systems. Signal repeaters or signal redirection through relays or towers, may be necessary to overcome the limitations and ensure effective connectivity. However, these workarounds may add complexity, cost, and potential points of failure to the network infrastructure. Limited line-of-sight can affect the accuracy and reliability of positioning systems used in telecommunications. Obstructed views of satellites can lead to weaker signals and reduced accuracy in determining precise locations, which can impact various applications relying on location-based services. These limitations and challenges can hinder the establishment of reliable long-distance communication links. Limited line-of-sight also affects the deployment of certain telecommunication technologies that require direct signal transmission, such as point-to-point wireless connections or certain satellite communication systems. Signal repeaters or signal redirection through relays or towers, may be necessary to overcome the limitations and ensure effective connectivity. However, these workarounds may add complexity, cost, and potential points of failure to the network infrastructure. Limited line-of-sight can affect the accuracy and reliability of positioning systems used in telecommunications. Obstructed views of satellites can lead to weaker signals and reduced accuracy in determining precise locations, which can impact various applications relying on location-based services.

Maintenance and repair of infrastructure in rugged mountainous terrain can be more challenging and costly, and lead to potential delays in resolving issues and restoring services. Accessing and reaching damaged or malfunctioning equipment in remote or elevated locations requires specialized skills, equipment, and logistical considerations. Remote and inaccessible areas often lack basic infrastructure, such as roads, power supply, and communication networks, making it challenging to establish the necessary foundation for deploying civil engineering projects. Transportation of equipment, materials, and personnel to remote areas can be difficult and costly due to lack of proper transportation infrastructure. It requires careful planning and coordination to ensure timely delivery and smooth execution of construction activities.
While the coastal plain along the perimeter of Puerto Rico offers relatively easier access for infrastructure

deployment, it can still present challenges. Coastal erosion, flooding, and the proximity to the ocean pose risks to the stability and longevity of telecommunication infrastructure, requiring careful planning and engineering solutions. The coastal plain of Puerto Rico refers to the low-lying areas along the perimeter of Puerto Rico that border the coastline. The coastal plain is susceptible to coastal hazards such as storm surges, hurricanes, and tidal flooding. These natural events can cause significant damage to telecommunication infrastructure leading to disruptions in services and costly repairs. The soil composition of the coastal plain contains loose sediments, sand, or clay, which can pose challenges for construction projects. Special consideration needs to be given to the stability and load-bearing capacity of the soil when installing foundations for telecommunication infrastructure.

Proximity to the ocean, exposure to salt spray, and vulnerability to extreme weather events may require enhanced safety measures, such as reinforcement against high winds, corrosion-resistant materials, or flood-resistant designs. These safety considerations can contribute to increased construction costs. The coastal plain is prone to saltwater intrusion into underground infrastructure, such as utility cables and pipelines. This can lead to corrosion and degradation of equipment, affecting the reliability and lifespan of the infrastructure. The coastal plain contains sensitive coastal ecosystems and often falls under environmental protection regulations. Construction and development activities may require additional permits and compliance with specific guidelines to mitigate the impact on the environment and preserve coastal resources. The coastal plain is typically densely populated and developed, with limited available land for new infrastructure. Securing suitable sites for telecommunication facilities may require negotiation with landowners and careful consideration of zoning regulations and land-use planning.

The topography of Puerto Rico often limits the available space for infrastructure deployment. The combination of mountainous terrain and densely populated areas can make it challenging to find suitable sites for towers, antennas, and other equipment, requiring strategic planning and innovative design solutions. Limited space horizontally often necessitates vertical deployment options. Constructing tall structures, such as high-rise buildings or elevated platforms, becomes necessary to accommodate the required infrastructure. This can present additional engineering challenges, including structural integrity, wind loading, and aesthetics. Limited space affects the availability of right-of-way corridors for laying underground cables or installing utility infrastructure. This can result in more complex routing and potentially require negotiations with multiple landowners or public entities to secure the necessary access. Limited space can impede the logistics of construction and installation processes. It may require careful coordination of equipment, materials, and workforce to navigate restricted areas, ensure safety, and minimize disruptions to existing infrastructure and communities.

Soil stability refers to the ability of the soil to maintain its structural integrity and resist movement or deformation. In the context of Puerto Rico's topography, poor soil stability necessitates proper soil analysis and engineering for the design and installation of communications foundations -- towers and equipment shelters. Remediation may require specialized foundation designs, including deep foundations or ground improvement techniques, to ensure the stability and safety of the infrastructure. Sustainability for long-term maintenance of the infrastructure may require ongoing monitoring, maintenance, and stabilization measures to prevent soil movement, settlement, or damage to underground utilities. Regular inspections

and maintenance programs should be implemented to address any potential soil stability issues and ensure the longevity of the infrastructure.

The varied mountainous and coastal plains topography with various degrees of soil stability creates challenges that need to be considered and planned for when designing broadband build-out and maintenance plans and schedules.

4.1.4 Resiliency Strategies

When planning the telecommunication infrastructure of the next generation in Puerto Rico, it's crucial to consider the challenges presented by the climate and topography. To ensure the infrastructure is resilient and that it can withstand potential natural disasters, certain factors must be considered. These include careful site selection, implementing network redundancy, deploying fiber optic and wireless infrastructure, strategically placing antennas, maintaining security, complying with regulations, developing comprehensive disaster recovery plans, and engaging with the local community.

Resiliency and redundancy in broadband networks are crucial for maintaining connectivity during natural disasters, such as the devastating Hurricane Irma and Hurricane María that impacted Puerto Rico. According to the Federal Communications Commission (FCC), Hurricane Irma left over one million residents without access to broadband services, while Hurricane María caused even greater devastation, leaving 97% of Puerto Rico's cell sites out of service and knocking out power to virtually the entire island. These events highlighted the importance of maintaining reliable and resilient broadband infrastructure in Puerto Rico, as access to critical information and emergency services becomes more important in times of crisis. Investing in redundant and resilient broadband networks can help ensure that Puerto Rico's residents remain connected and informed during future natural disasters.

The topography of Puerto Rico presents numerous obstacles for the deployment of civil engineering infrastructure, specifically in the field of telecommunications. The rugged mountainous terrain, limited line-of-sight, remote and inaccessible areas, coastal plain, limited space for infrastructure, soil stability concerns, seismic activity, environmental preservation, cultural and historical sites, and construction costs all pose significant challenges. However, with careful planning, innovative solutions, and strategic approaches, these obstacles can be overcome. By leveraging advanced technologies, such as wireless communication systems, satellite networks, and aerial infrastructure, it is possible to bridge the gaps caused by the topography and create a more resilient system. Additionally, adopting resilient design practices, like micro-trenching, additional buried conduits, redundant/alternative routes, implementing effective risk management strategies, and collaborating with local stakeholders can contribute to successful telecommunication deployments in Puerto Rico. It is crucial to prioritize the development of adaptable and scalable infrastructure that can withstand the unique challenges of the topography, ensuring reliable and efficient communication services for Puerto Rico's residents and businesses.

In planning out the development of our infrastructure, the PRBP will be mindful of the following factors during the hurricane and seasonal storms.

- Developing an evacuation plan for our engineering and construction teams.
- Have an emergency team in place to take charge and make decisions pre- and post-storm.
- Take steps to secure the job site.
- Document and inventory available material resources.
- Have a detailed risk assessment sheet.
- Evaluate damage and restore the site to pre-storm conditions after storms.[35]

While working in rural areas, central highlands, and urban areas in the north the PRBP will be strategic in working with other stakeholders and community members. Planning will be crucial to prevent significant delays and cost setbacks. When working in this area, we will need to consider the following:

- Conducting more in-depth site surveys to minimize environmental impacts and identify problem areas ahead of constructing the network.
- Working with community leaders and engaging them in the process.
- Using non-traditional construction methods such as micro trenching or using high-density conduit systems to minimize the impact in an area. These methods create a minimum disturbance to an area and allow crews to quickly move forward.
- Partnering with government agencies and private entities when building infrastructure through difficult urban or rural areas.
- Cost-sharing while building in a high-cost area can reduce the financial burden on one entity and make the project more feasible to a wider array of entities.
- Partnering with other entities can help minimize disruptions in a local area.

After the 2020 earthquakes, the Operational Earthquake Plan of Puerto Rico was developed by Puerto Rico Emergency Management Bureau in collaboration with FEMA, industry experts, and academic institutions like the University of Puerto Rico and Georgetown University.[36] The plan is a comprehensive framework of initiatives, strategies, and resources that provides a roadmap for government agencies to make effective decisions during times of crisis. Through the plan, the government aims to identify vulnerabilities in existing infrastructure, enforce building codes of new construction, harden utility infrastructure, and build in redundancy to critical infrastructure. The goal of the plan is to mitigate the impact of these hazards that Puerto Rico has experienced in recent years. The broadband infrastructure deployment plan will adopt relevant strategies and applicable processes to improve resilience outcomes in local and nationwide networks.

[35] FEMA – Hurricane Ready Toolkit - https://www.ready.gov/sites/default/files/2020-04/ready_business_hurricane-toolkit.pdf
[36] Operational Earthquake Plan of Puerto Rico, 2021. https://manejodeemergencias.pr.gov/wp-content/uploads/2021/09/Annex-H-Earthquake-Annex-to-PREMB-Puerto-Rico-All-Hazard-Plan-1-of-2.pdf

4.1.4.1 Site Selection

The site selection of telecommunication infrastructure in Puerto Rico is significantly impacted by the climate and topography of Puerto Rico. As mentioned previously, Puerto Rico is prone to severe weather events, including hurricanes and tropical storms, which can cause significant damage to infrastructure. The rugged, mountainous interior and coastal plain also pose challenges for infrastructure development and deployment. To work around these challenges, the site selection strategy involves careful consideration of the location, terrain, and existing infrastructure. For example, the installation of telecommunication towers and equipment must be placed in areas with minimal risk of damage from severe weather events, such as high elevations or inland locations. In addition, the use of resilient materials and construction techniques can help mitigate the impact of weather events. It is also important to consider the existing infrastructure, such as roads and power lines, and their vulnerability to damage from weather events. Site selection of telecommunication infrastructure in Puerto Rico will consider:

A. Elevation

Consider the elevation of the site in relation to the surrounding terrain to determine potential risks for flooding or landslides during severe weather events.

B. Access

Assess the accessibility of the site for construction, maintenance, and repair of telecommunication infrastructure, considering the topography, road conditions and capabilities.

C. Vegetation

Evaluate the vegetation surrounding the site and determine if it poses a risk for damage to infrastructure during high winds, storms, or heavy rain events. It is important to establish buffer zones around the infrastructure to minimize the risk of falling tree damage.

D. Power Source

Access to reliable power sources is a critical consideration for the telecommunication infrastructure in Puerto Rico, particularly given the challenges presented by Puerto Rico's climate and topography. Power outages are a common occurrence during severe weather events, such as hurricanes, which can cause significant disruption to communication services. The site selection process must ponder the availability and reliability of power sources, such as the proximity to electrical substations and the capacity of backup energy. Critical-Path routes should be identified along the telecommunication network for the implementation of hardening standards or engineering redesign that assure reliability. Alternative energy sources such as solar, wind power, hydrogen should also be considered, as they can provide a sustainable and reliable source of energy for telecommunication infrastructure. By prioritizing reliable power sources in the site selection process, telecommunication providers can ensure that their infrastructure is better equipped to withstand the challenges of Puerto Rico's climate and topography.

E. Soil Stability

Conduct a soil stability analysis to determine if the site is suitable for the construction of telecommunication infrastructure, considering the topography and potential for erosion or other soil-related issues.

Consideration of these factors during the site selection, the telecommunication infrastructure of Puerto Rico can be designed and constructed to withstand the challenges of Puerto Rico's climate and topography, resulting in improved availability and reliability of communication services

4.1.4.2 Network Redundancy

Given Puerto Rico's vulnerability to severe weather events and other potential disruptions, network redundancy is crucial to ensure reliable telecommunication infrastructure. Redundancy planning can minimize the impact of outages and ensure that connectivity remains available during emergencies. Implementing backup solutions such as alternate routes, failover mechanisms, and multiple network providers can further improve the reliability and resiliency of the network. to the following five factors will be considered when designing and building telecommunication infrastructure for network redundancy:

A. Location Diversity

It is important to select sites for redundant network infrastructure that are physically separated from the primary network. This reduces the risk of simultaneous disruption from severe weather events or other hazards.

B. Power Redundancy

Power sources for network equipment should be diversified and designed to withstand severe weather events such as hurricanes.

C. Fiber Diversity

Network redundancy should also be achieved using diverse fiber routes or rings. This can involve laying fiber in diverse paths, which can mitigate the risk of damage from hurricanes or other weather events.

D. Automatic Failover

Network redundancy should be designed with automatic failover mechanisms that can detect disruptions and reroute traffic automatically. This can minimize downtime and improve the resilience of the network. Examples of this include:

i. Server Failover
ii. Network Failover
iii. Cloud Failover
iv. Power Failover
v. Storage Failover

This process by which a system automatically switches over to a backup or redundant system when the primary system fails or experiences an outage, ensures that critical operations can continue with minimal interruption, reducing the impact of downtime of the network cause by the challenges presented by the climate and topography of Puerto Rico.

E. Regular Testing and Maintenance

It is important to conduct regular testing and maintenance of the redundant network infrastructure to ensure that it is functioning properly and can withstand severe weather events. This can include regular power supply checks, fiber optic testing, and other maintenance tasks.

F. Regulatory Constraints

To meet regulatory standards, operators must secure permits from infrastructure and landowners before conducting deployment. This often delays the deployment of critical telecommunication infrastructure. The constraints are further complicated when the site is in a cultural, historic, or environmentally protected area.

4.1.4.3 Deploying of Fiber Optic Cables and Wireless Infrastructure

Deploying fiber optic cables along the rugged topography of Puerto Rico presents significant challenges in terms of design, construction, and maintenance, especially in remote or inaccessible areas. The mountainous terrain makes it difficult to excavate and lay cables or pipelines, and the soil composition can also make it challenging to achieve adequate depth for underground installations. Secondly, Puerto Rico is prone to heavy rainfall and flooding, which can damage underground infrastructure and cause interruptions in service. Finally, the coastal areas of Puerto Rico are vulnerable to storm surges and sea level rise, which can also threaten underground infrastructure and require additional protective measures.

Therefore, it is important to develop innovative solutions and employ careful planning to overcome these obstacles and ensure reliable connectivity. Selecting the right type of fiber optic cable and equipment, as well as conducting regular maintenance and upgrades, can help to maximize the longevity and performance of the infrastructure. Careful consideration should be given to the route selection for fiber optic cables. This includes evaluating the topography and vegetation to avoid areas prone to landslides, floods, or other natural hazards that could impact the cable's integrity. Protective measures should be taken to safeguard fiber optic cables from potential damage caused by severe weather events. Finally, regular maintenance of fiber optic cables is essential in Puerto Rico's climate, where storms and high winds can damage the infrastructure. Proper maintenance can prevent failures and outages, ensuring the network's reliability.

Wireless infrastructure deployment has several advantages in addition to being a cost-effective solution for providing connectivity in areas where fiber optic cables are challenging to deploy. It is less vulnerable to damage caused by high winds, storms, and heavy rain events that are common on Puerto Rico. This is because there are no physical cables that can be damaged or destroyed as with fiber optic infrastructure. Wireless networks can be deployed faster than wired networks, and they can be more flexible and adaptable to changing circumstances. Wireless infrastructure can provide coverage to remote areas where it would be too costly or impractical to deploy wired networks.

To ensure the reliability of wireless infrastructure, careful planning, redundancy measures, and cybersecurity protocols must be in place to mitigate the risks of potential disruptions.

When planning antenna placement in Puerto Rico, it's essential to consider the topography of the island to ensure optimal coverage and minimize interference. By conducting site surveys and using advanced modeling techniques, it is possible to determine the best locations for antennas, even in areas with limited line-of-sight. Careful planning and site selection can help to overcome these challenges and ensure effective, reliable, and resilient telecommunications infrastructure.

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Ensuring the security of telecommunication infrastructure is crucial to avoid network downtime or data breaches. With the increasing sophistication of cyber-attacks, strong security measures and protocols must be put in place to protect against these threats. Physical security measures such as surveillance cameras, fencing, and access control systems can also be employed to protect critical infrastructure. Cyber security measures to ensure the integrity of the data and information must include robust firewalls, intelligent surveillance of data streams, and breaches in protocols and transport standards. The seven layers of the OSI Model is a key standard to ensure physical and network security.

In addition to the challenges posed by the climate and topography of Puerto Rico, the regulatory environment is also an important consideration for telecommunication infrastructure deployment. Local laws and regulations can vary widely and may impact the design, construction, and operation of the network. Working closely with local authorities and stakeholders is crucial to ensure compliance and avoid any potential legal or regulatory issues. In some cases, regulatory barriers may need to be addressed through policy changes or advocacy efforts to create a more favorable environment for telecom infrastructure deployment. By navigating the regulatory landscape with care and diligence, telecommunications companies can help to ensure the success and sustainability of their networks in Puerto Rico.

Disaster recovery planning is crucial for ensuring rapid network restoration and improved resilience in the event of an outage or disruption. Puerto Rico's susceptibility to severe weather events and other potential disruptions underscores the importance of having comprehensive disaster recovery measures in place. These measures may include redundancy planning, backup power sources, and quick response protocols to minimize the impact of any outages. Additionally, regular testing and updates to the disaster recovery plan can help ensure its effectiveness and minimize downtime.

Community engagement and support is essential for ensuring successful telecommunications deployment. Building trust and rapport with local stakeholders can help to identify community needs and priorities, as well as address concerns and potential barriers to deployment. It is important to incorporate community feedback into the planning process to ensure that the network infrastructure meets the needs of the community it serves. By working closely with local communities, telecommunication providers can build stronger, more resilient networks that are better equipped to withstand the challenges posed by Puerto Rico's climate and topography.

Specifically, the Puerto Rico Broadband Program has been active in their outreach efforts by visiting municipalities, interacting with the population by offering information sessions on the different efforts and programs available to them. Understanding the importance of receiving community feedback, the Puerto Rico Broadband Program created the Executive Advisory Committee and a Digital Equity Subcommittee to gather information on community needs and develop strategies to tackle them.

Overall, telecommunication infrastructure planning and deployment in Puerto Rico requires careful consideration and accommodation of Puerto Rico's tropical climate, susceptibility to hurricanes and other severe weather events that can cause significant damage, and the rugged topography. Site selection must

consider the vulnerabilities to severe weather events and access to reliable power sources. Planning for network redundancy, fiber optic and wireless infrastructure deployment, and antenna placement must also account for the mountainous terrain and coastal plain soils. Physical and cybersecurity measures are necessary to ensure network security, while compliance with local regulations is essential. Disaster recovery planning is crucial to enable quick network restoration in the event of an outage or disruption. Engaging with local communities is also vital for successful deployment that meets their needs and priorities. In summary, addressing the challenges posed by Puerto Rico's climate and topography requires innovative planning and deployment techniques, redundancy measures, and community engagement to ensure the resilience and reliability of the telecommunication infrastructure of the next generation.

4.2 Legislative and Regulatory Barriers

4.2.1 Environmental Permitting Requirements

Puerto Rico's topography includes diverse ecosystems, protected natural areas, and sensitive habitats. Deploying telecommunication infrastructure while preserving the environment requires adherence to environmental regulations, conducting thorough environmental assessments, and implementing mitigation measures to minimize ecological impact. Puerto Rico is home to diverse and unique ecosystems, including forests, wetlands, tropical rainforest, and coastal areas. The deployment of civil engineering infrastructure should consider the preservation of these habitats and minimize any negative impact on wildlife and plant species. Measures such as the establishment of buffer zones, wildlife crossings, and the use of environmentally friendly construction practices can help mitigate the disruption to natural habitats.

Puerto Rico's topography and rainfall patterns contribute to the formation of watersheds, which are critical for the regulation of water flow, water quality, and the sustenance of aquatic ecosystems. Infrastructure development should consider the protection and sustainable management of watersheds to avoid soil erosion, sedimentation of water bodies, and contamination of water sources. Implementing best practices for stormwater management, erosion control, and the use of permeable surfaces can help mitigate the negative impacts on watersheds. Puerto Rico is home to a diverse range of plant and animal species, including several endangered and endemic species. Infrastructure development should consider the preservation and conservation of biodiversity hotspots and sensitive ecosystems. This may involve the implementation of measures to avoid or minimize habitat fragmentation, the protection of migration corridors, and the restoration of degraded areas.

Puerto Rico enjoys many cultural and historic sites. The State Historic Preservation Office, Office of the Governor, (OECH) maintains an inventory of historic properties. OECH enforces the requirements of the National Historic Preservation Act (1996) to protect these sites according to the Rules and Guidelines of the Secretary of the Interior Archaeology and Historical Preservation. Accordingly, telecommunications planning will coordinate with OECH to inform their infrastructure designs and builds – avoiding physical damage, visual intrusion, and disruption of Puerto Rico's preservation sites. For example, mitigation measures can include bypasses, buffer zones, and construction techniques to minimize disturbances. Adaptive reuse of existing structures or integration of design elements that harmonize with the cultural and historic context can help preserve the site's integrity and contribute to the overall aesthetic value of

the project. Engaging with local communities, cultural organizations, and heritage authorities is essential for ensuring the preservation of national treasures. Their knowledge, insights, and concerns should be considered during the planning and design stages of infrastructure projects. This collaborative approach helps foster a sense of ownership and ensures that the sites are treated with respect and sensitivity.

At the state level, any broadband deployment or improvement project in Puerto Rico would eventually need to go through the Office of Permit Management (OGPe), known as "Oficina de Gerencia de Permisos" in Spanish. The office, created in 2009 under Law 161-2009, is responsible for evaluating the feasibility of new construction or improvements, including the environmental aspects of construction applications.

In general, construction applications must include an environmental assessment, which should consist of the following:

1. A narrative describing the proposed project.
2. The project's location.
3. The total area of the project.
4. The zone classification.
5. An environmental analysis.
6. Construction drawings.
7. If there is an environmental impact, a description of that impact.

There are three situations recognized by the jurisdiction of Puerto Rico in which an environmental evaluation is not required: when the proposed project is routine or is expected to have no environmental impact, when there are previous resolutions from the Board of Environmental Quality authorizing the project or activity, and when there are established exemptions by law.

In 2019, after experiencing two major hurricanes that impacted telecommunications in Puerto Rico, Law Number 127-2019 was enacted to facilitate the installation of poles and conduits on public rights-of-way. This law exempted companies from performing an environmental assessment when installing poles (for smart cells) that are under 50 feet tall.

At the municipal level, each municipality may have its own environmental requirements. The duplication of processes at both the state and municipal levels can often cause delays in the construction process for any broadband deployment project.

4.2.2 Deployment of Infrastructure on Private Property

When broadband infrastructure needs to be deployed on private property, the applicant is required to submit a construction application to the Office of Permit Management under Law 161-2009. The permitting code requires the endorsement of multiple agencies, including environmental-related entities. To obtain the endorsement of these agencies, the applicant must provide a memorandum describing the project, including an environmental assessment, which will be subject to review by the Department of Natural Resources. Aside from the regulatory requirements that an applicant must comply with to deploy broadband infrastructure, there are other elements that can affect the project timeline.

Unlike most states, Puerto Rico follows a civil law system that utilizes the Property Registry (administered by the Department of Justice) to document and protect property titles within its jurisdiction. Any change of title or long-term lease must be submitted to the public registry to receive title protection.

Companies dedicated to broadband infrastructure development often encounter situations where the private property on which they intend to deploy infrastructure lacks proper title. This means that the title owner listed in the registry is not the same person seeking to enter into a ground lease agreement or purchase agreement. This presents a problem for long-term projects, as there is a chance that a third party (the individual listed as the owner of the property) may initiate legal action to reclaim the title.

Broadband companies should also be aware of the Municipal Center for Revenue Collection (CRIM), known as "Centro de Recaudación de Ingresos Municipales" in Spanish. In Puerto Rico, all immovable properties are required to be registered with the CRIM, which assesses the value of the property to establish the corresponding payment. As part of their due diligence, broadband companies looking to acquire or lease private property must determine if the property is registered and if it has any outstanding property taxes. If the property is not registered, the CRIM can charge retroactive tax payments for up to Five-Years. In cases where the property has debt, it can become a lien on the property, and if left unpaid, the CRIM can execute the lien and become the new owner. These risks exist when purchasing or leasing a property with a significant amount of CRIM debt. In Puerto Rico, both scenarios mentioned above often present obstacles. It is estimated that there are 250,000 properties that have not been registered and, consequently, owe retroactive taxes. Additionally, regarding the total outstanding debt of registered properties, it was estimated in 2017 to be between 600 million and 1 billion dollars.

4.2.3 Access to Poles and Conduits

In 2019, recognizing the importance of facilitating broadband deployment, the government of Puerto Rico enacted a law aimed at expediting the permitting process for pole and conduit installations in state public rights-of-way. This law was incorporated into the construction regulations of the Office of Permit Management under the Joint Code of 2020. The permits for such installations will be obtained through the Office of Permit Management. Unlike the regular permitting process, this law establishes fewer requirements than normal construction applications.

Applicants for the installation of poles and conduits in state public rights-of-way are exempt from obtaining environmental permits for structures under 50 feet tall and zoning permits. The agencies designated by the law to certify the installations are the Telecommunications Bureau (NET), the Public Electricity Company (AEE), and the Department of Transportation (DTOP). Once the applicant obtains all the certifications and submits the application, the Office of Permit Management has 30 days to respond. If there is no response within that time, the application is considered approved. Additionally, to promote uniformity in the fees associated with infrastructure deployment in state public rights-of-way, the law establishes a cap on the amount that can be charged.

In 2021, the Appellate Court of Puerto Rico declared the Joint Code of 2020 null and void, creating a gap in the construction regulations applicable under the current legal framework.[37] In 2023, the Supreme Court of Puerto Rico reaffirmed the nullification of the Joint Code. Currently, the government of Puerto Rico is in the process of developing a new code that will comply with all the legal requirements established by the courts. However, in the interim period, there is confusion regarding which code is applicable. It is understood that the Joint Code of 2010, which has not been nullified by the courts, is currently in effect.

Irrespective of the applicable code, the private sector consistently encounters a significant obstacle during the process outlined by the law, which is the bureaucratic procedures within the various endorsing/approving agencies. This administrative aspect is the most time-consuming component of the process, as once all the required endorsements are submitted, the agency has a 30-day window to grant approval. Furthermore, if the project involves a municipal right-of-way, the permitting process of the municipality will apply. This can become an obstacle to broadband deployment when the project spans multiple municipalities. Therefore, considering the law's protection of municipal autonomy, there needs to be more uniformity between the state and municipal governments and among municipalities. To minimize this time-consuming component of the process, members of the government agencies have been appointed to the Puerto Rico Broadband Advisory Council to help with procedures.

4.3 Labor Shortages

With the significant influx of funding from the BEAD Program, the industry estimates a need for over 205,000 new jobs within the next Five-Years to meet the demands of broadband network construction and maintenance.[38] According to the Fiber Broadband Association, 150,000 jobs will be created as a result of the BEAD program, creating a labor shortage in the foreseeable future.

Puerto Rico has faced labor shortages in certain industries and sectors, which has had an impact on Puerto Rico's economy and workforce. Here are some factors contributing to labor shortages in Puerto Rico:

- **Outmigration:** Puerto Rico has experienced significant outmigration of its population in recent years. Economic challenges, including high unemployment rates and limited job opportunities, have led many residents to seek better prospects elsewhere, particularly in mainland United States. This outmigration has resulted in a reduced labor pool and shortages in specific industries.
- **Skill Mismatches:** There may be a disconnect between the skills demanded by employers and the skills possessed by the available workforce. The education and training system may not align effectively with the needs of the job market, leading to shortages in certain specialized or technical fields.
- **Aging Population:** Puerto Rico has been grappling with an aging population (22.7%), with a decreasing number of younger workers entering the labor force.[39] This demographic trend can lead to labor shortages, particularly in industries that require a younger workforce, such as manufacturing and healthcare.

[37] Fideicomiso de Conservación de Puerto Rico y Para la Naturaleza, Inc. y otros v. Oficina de Gerencia de Permisos del Departamento de Desarrollo Económico y Comercio de Puerto Rico y otros, 2023 TSPR 81
[38] Fiber Broadband Association. (2023, May 11). The Fiber Broadband Association Expands State Broadband Resources with Workforce Development Guidebook. https://fiberbroadband.org/2023/05/11/the-fiber-broadband-association-expands-state-broadband-resources-with-workforce-development-guidebook/
[39] U.S. Census Bureau. (n.d.). Puerto Rico quick facts table [Data table]. Retrieved July 28, 2023, from https://www.census.gov/quickfacts/fact/table/PR/PST045222

Addressing labor shortages in Puerto Rico requires a multi-faceted approach, including efforts to attract and retain skilled workers, aligning education and training programs with industry needs, encouraging entrepreneurship and economic diversification, and addressing the underlying economic factors that contribute to outmigration.

4.4 Supply Chain Issues and Materials Availability

Supply chain disruptions can affect the availability of equipment and construction materials. The supply chain system in Puerto Rico faced some challenges due to various factors, including Puerto Rico's geographic location, infrastructure limitations, and external events. An overview of challenges within the supply chain system in Puerto Rico follows.

4.4.1 Logistics and Transportation

The infrastructure in Puerto Rico has faced challenges, especially in the aftermath of Hurricane María in 2017. The hurricane caused significant damage to roads, bridges, ports, and other critical transportation infrastructure, which affected the smooth flow of goods within the supply chain. After the impact of Hurricane María, there has been a greater focus on enhancing the resilience and preparedness of the supply chain system in Puerto Rico. This includes efforts to strengthen infrastructure, improve communication and coordination between stakeholders, and establish contingency plans to mitigate disruptions.

Puerto Rico relies heavily on imports for many essential goods and supplies. This dependency on external sources can create vulnerabilities in the supply chain, particularly when faced with disruptions such as natural disasters or global events like the COVID-19 pandemic. Puerto Rico has several ports that play a crucial role in the supply chain, but the busiest and most important port is the Port of San Juan, Puerto Rico. Efforts have been made to enhance the capacity and efficiency of the port facilities to support the supply chain.

Transportation networks play a vital role in the supply chain system. Puerto Rico has a network of highways and roads that connect different regions of Puerto Rico. However, improvements are still needed to ensure efficient and reliable transportation of goods throughout the territory.

4.4.2 Supply Chain Vulnerabilities

Puerto Rico has a relatively limited local production capacity for certain goods and relies heavily on imports for construction materials due to limited local production capacity. This dependency on external suppliers can make the availability of construction materials vulnerable to disruptions. The need for construction materials has increased in Puerto Rico for various reasons, including post-hurricane rebuilding efforts, infrastructure development, and private sector construction projects. This increased demand can put pressure on the availability and pricing of construction materials. The availability and pricing of construction materials in Puerto Rico can be subject to volatility. Efforts have been made to promote local production of construction materials in Puerto Rico to reduce dependency on imports. For instance, initiatives have been undertaken to boost local cement production and encourage sustainable building practices that utilize alternative and locally sourced materials.

Building codes, regulations, and standards in Puerto Rico may influence the types of construction materials used. Compliance with specific requirements can impact material availability and sourcing options.

4.4.3 Trade and Market Factors

Global market conditions, fluctuations in commodity prices, and trade policies can impact the availability and cost of construction materials in Puerto Rico. Changes in tariffs, import regulations, or international market dynamics can influence the supply chain and availability of materials. Economic factors, such as fluctuations in currency exchange rates and economic downturns, can impact the supply chain in Puerto Rico. These factors can affect the cost of imports, pricing dynamics, and overall demand for goods, which can, in turn, affect supply chain operations.

The global chip shortage has had a significant impact on the broadband industry, as it has on many other industries. This shortage has made it difficult to obtain the components needed to build new broadband networks. For example, fiber optic cables are made with semiconductors, and the shortage of semiconductors has made it difficult to obtain fiber optic cables. This has slowed the deployment of fiber optic networks, which are the most reliable and efficient way to deliver broadband Internet.

The cost of shipping goods has increased significantly in recent years, due to a number of factors, including the COVID-19 pandemic, and the ongoing shortage of shipping containers. These factors have led to a surge in demand for shipping services, which has raised prices. Materials for broadband construction will not only face large lead-times caused by supply-shortages, but also may face long waits in Puerto Rico due to the logistical challenges created by the need to move them though Puerto Rico's ports.

4.4.4 Build America, Buy America Act

As noted in the BEAD notice of funding opportunity, The Build America, Buy America Act requires that all of the iron, steel, manufactured products (including but not limited to fiber-optic communications facilities), and construction materials used in the project or other eligible activities are produced in the United States unless a waiver is granted.[40]

Under the Build America, Buy America Act (BABA) and the Buy America Guidance issued by the Office of Management and Budget, the Secretary of Commerce may waive the domestic content procurement preference if it is not in the public interest, if the materials are not available in the US, or if the cost will increase by more than 25%.[41] Additionally, and among other requirements, Infrastructure Investment and Jobs Act (IIJA) prohibits subgrantees from using BEAD funds to purchase or support fiber-optic cable and equipment manufactured in China. This, too, is subject to potential exemptions.

It is foreseeable that the Secretary of Commerce will authorize waivers on many IIJA grants in relation to the Build America, Buy America Act. The Office of Management and Budget (OMB) received approximately

[40] NTIA, Broadband Equity, Access, and Deployment Program, Notice of Funding Opportunity, May 2022. https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf.
[41] Shalanda D. Young, Director, OMB, Initial Implementation Guidance on Application of Buy America Preference in Federal Financial Assistance Programs for Infrastructure, M-22-11 (Apr. 18, 2022), available at https://www.whitehouse.gov/wp-content/uploads/2022/04/M-22-11.pdf.

2,000 comments on its proposed revisions to the guidance that will govern how BABA requirements codified in the IIJA are applied to federal assistance programs.[42]

4.5 Industry Participation

Industrial participation in Puerto Rico refers to the involvement of industries and businesses in the economic development and growth of Puerto Rico. The government and various stakeholders have implemented strategies and programs to attract industrial investment, promote local entrepreneurship, and foster economic diversification. With regards specifically to Broadband Industry Participation, here are some key aspects for Puerto Rico:

Tax Incentives: Puerto Rico offers tax incentives and benefits to attract industrial investment. The Puerto Rico Industrial Development Company (PRIDCO) provides incentives such as tax exemptions, grants, and incentives for manufacturing, renewable energy, tourism, and other targeted industries. These incentives aim to encourage businesses to establish operations in Puerto Rico and contribute to its economic development. These incentives extend and include incentives for Broadband participation on Puerto Rico for providers of services and to retailers/resellers of Broadband services.

Manufacturing Sector: Manufacturing plays a significant role in Puerto Rico's economy. Puerto Rico has historically been home to a robust pharmaceutical and medical device manufacturing industry, with major companies operating manufacturing facilities on Puerto Rico. Other sectors such as aerospace, electronics, and food processing also contribute to the industrial landscape. For the Telecommunications sector the economic incentives for production and manufacturing are still lacking to attract business in this sector.

Small and Medium Enterprises (SMEs): The development of small and medium enterprises is crucial for industrial participation in Puerto Rico. The government and various organizations provide support programs, funding opportunities, and technical assistance to encourage local entrepreneurship and the growth of SMEs in sectors such as technology, agriculture, and creative industries. With the lack of reliable high speed/bandwidth Broadband for business outside of the metropolitan areas the SMB sector is lacking advancement as compared to similar jurisdictions stateside. With the advancement of contiguous and reliable Broadband services, this sector will benefit greatly for the local and commonwealth-wide economy.

Economic Diversification: Puerto Rico aims to diversify its economy by attracting investments in emerging industries and sectors. Efforts are being made to promote sectors such as renewable energy, biotechnology, information technology, and tourism as part of Puerto Rico's industrial participation strategy. The current Broadband providers are scaling their networks to be able to meet these economic goals, but with the relatively small size of Puerto Rico, and the higher costs for development, these

[42] Government Publishing Office. (2023, February 14). OMB-2023-0004-0001. https://www.regulations.gov/document/OMB-2023-0004-0001

efforts have been progressing slowly. With an increased availability of funds to lower the barrier to entry for smaller providers, diversification in this area should promote the economic diversification needed.

The Commonwealth of Puerto Rico, as an island territory of the United States, benefits from the economic strength and security provided by its association with the mainland US. However, due to its geographical location in the Caribbean and the substantial expenses associated with transportation and importation of materials and resources, the region has faced significant challenges which hamper affordable and available broadband adoption and utilization. Factors such as the heightened vulnerability to tropical disturbances, seismic activity, and the logistical obstacles posed by its distance from the mainland have impeded local broadband providers from establishing and maintaining the required infrastructure at a level comparable to their counterparts on the mainland. As part of its strategic objectives, the government of Puerto Rico aims to concentrate industrial activities involving Broadband and dependent industries and foster an environment conducive to business growth and development.

4.6 Lack of Digital Inclusion Programs & Digital Literacy

Puerto Rico has many challenges and is far behind the rest of the U.S. in achieving digital equity. The Puerto Rico Broadband Program's asset inventory reveals a critical need for additional digital equity and inclusion resources. The data presented below capture key elements of digital equity.

99% of Puerto Ricans are eligible to be covered by Digital Equity Act funding

25% of Puerto Ricans do not have a computing device- the lowest rate of device adoption in the United States

30% of Puerto Ricans report no internet access at home

Many Puerto Ricans don't have the digital skills training resources required to use the internet and internet-enabled devices.

The Puerto Rico Broadband Program's engagement efforts revealed that many Puerto Ricans struggle accessing the Internet for a variety of reasons, including a lack of digital skills. The following quotes offer that perspective:

The older adults 65+ have a deficit of knowing how to use technology.

They don't understand cell phones and they don't have money for computers.

People have virtually no knowledge whatsoever of how to use a computer, how to use a tablet, how to navigate to job search. The most they could know how to do is with their cell phone call the numbers they already have, which are already established. But in many cases, they do not know how to call [emergency services] or how to call their medical plans to coordinate a medical appointment or to coordinate a health matter.

- Listening Session Participants

The Puerto Rico Broadband Program has set the following five goals to advance digital equity:

1. Broadband will be accessible at affordable prices.
2. Internet-enabled devices will be accessible and affordable for all.
3. Online public resources will be inclusive and accessible to all Puerto Ricans, regardless of ability.
4. Puerto Rico will support digital literacy and digital skills for all residents.
5. All Puerto Ricans will be aware of the importance of online security and privacy.

The additional federal funds that Puerto Rico has received are beginning to move the needle, and PRBP expects to quickly add resources to its asset inventory as federal programs spin up and additional resources become available. Section 3.4.5 of this 5 Year-Action Plan provides additional details on the PRBP's digital equity initiatives.

4.7 Local Opposition

Given the varied terrain, lush tropical vegetation, rural areas, and mixed population centers across Puerto Rico, the need for more reliable coverage, connectivity, and bandwidth is always a challenge. More telecommunications towers are needed to keep up with evolving technology demands and devices. With the expansion of communities and urbanizations stemming out from town centers and metro areas, property values and aesthetics have become increasingly important for the citizens in and around neighborhoods across Puerto Rico.

With this expansion—consisting of a mix of households, dwellings, and small businesses—the NIMBY phenomenon is taking root in Puerto Rico. NIMBYs, short for Not In My Back Yard, opposes some telecom structures for a variety of reasons, one of which is the potential impact on property values. Some residents feel that the presence of towers can excessively lower the attractiveness, desirability, and economic value of their neighborhoods.

Other opposition to telecommunication towers stems from health concerns raised from a portion of the community. They express concerns about the long-term exposure to RF (Radio Frequency) radiation and associate this with diseases like Cancer, Lymphoma, and other serious ailments. Despite overwhelming consensus and studies among scientific organizations and regulatory bodies that telecommunication towers comply with established safety standards and pose no significant health risks, the vocal opposers to these telecommunication structures persist in their beliefs of Precaution over Progress.

Ironically, despite opposition to telecommunication towers for the varied reasons stated previously, there is an implied consensus when it comes to having poor connectivity and service in the most needed areas, where many of the NIMBYs live and work. A delicate balance must be achieved to ensure progress, safety, and cohesion with the environment of the local residents.

SECTION 5
Implementation Plan

Planning by the Puerto Rico Broadband Program and its partners has culminated in a comprehensive strategy for connectivity, quality, accessibility, and knowledge for all Puerto Ricans. This section describes past and future local coordination, priorities for Puerto Rico's unique situation, and the path forward for addressing current barriers to deployment, adoption, affordability, and access.

5.1 Stakeholder Engagement Process

Stakeholder events during development of this plan covered the entire island. Puerto Ricans in every municipality had the opportunity to inform infrastructure planning through in-person government service events, an online connectivity survey, and by phone or email. The PRBP and its partners led additional meetings, interviews, and surveys with government agencies, community leaders, and representatives of organizations that primarily serve underrepresented groups and covered populations.

5.1.1 Stakeholder Engagement for Plan Development

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Broadband Advisory Council

The Broadband Advisory Council, established by Hon. Governor Pedro R. Pierluisi at the creation of the Puerto Rico Broadband Program, advises and supports program efforts. Eight council members, representing infrastructure agencies and municipalities, contributed their local and specialized knowledge to infrastructure and digital equity strategies in this plan. Council representation is shown in Figure 45.

Partners

While dozens of entities across Puerto Rico engaged with the PRBP during plan development, key partners provided critical data, resources, and feedback to this plan.

The **Puerto Rico Office for Socioeconomic and Community Development (ODSEC), the Department of Economic Development and Commerce (DDEC),** and the **Administration for the Socioeconomic Development of the Family (ADSEF)** provided assessment and outreach support, including introductions to community groups and longstanding services for marginalized communities that will greatly benefit from increased access to high-speed Internet and devices.

All 30 chapters of the **American Association of Retired Persons (AARP)** collaborated with the PRBP to offer recommendations for making interventions accessible for residents aged over 50.

Nearly 80% of municipalities have participated in broadband meetings so far, and more are currently coordinating with the PRBP to further inform planning in their areas.

Figure 45 below showcases key stakeholders that informed the development and content of this five-year action plan.

Figure 45: Key Stakeholders

Broadband Advisory Council

- Aqueduct and Sewers Authority
- Association of Mayors
- Telecom Alliance
- Highway and Transportation Authority
- Federation of Mayors
- Department of Public Safety
- Department of Housing
- Fiscal Authority

Additional Partners

- Municipal Governments
- Office for Socioeconomic and Community Development (ODSEC)
- Department of Economic Development and Commerce
- Administration for the Socioeconomic Development of the Family (ADSEF)
- Patient Advocate Office (OPP)
- Elder Advocate Office (OPPEA)
- Veteran Advocate Office (OPV)
- Defender of the People with Disabilities (DPI)
- Internet Society Puerto Rico (ISOC)
- Department of Corrections and Rehabilitation
- American Association of Retired Persons (AARP)
- Tecno Abuelos
- Estudios Técnicos

Outreach activities conducted by the PRBP throughout its first year included stakeholder meetings, interviews, surveys, and traditional and social media updates in Spanish and English to incorporate as many ideas as possible from relevant stakeholders and affected populations. A broadband and digital equity summit was convened in Puerto Rico with municipalities, ISPs and relevant government stakeholders and nonprofit organizations. Figures 46 and 47 summarize activities conducted by the PRBP during planning. Each of these activities contributed valuable feedback for the asset inventory, discussion of barriers, and strategies developed for this five-year action plan and the related Digital Equity Plan.

Figure 47: Meetings for Planning

Activity	Purpose	Attendees	Key Takeaways
Smart Island Summit	In-person convening of stakeholders on infrastructure strategies and closing the digital divide	300 stakeholders from municipalities, telecommunications, academics, advocates, and government agencies	Workforce strategies, telehealth, inclusivity for aging individuals, the role of service providers, and cybersecurity
Regional Listening Sessions and Municipal Engagement	10 regional listening sessions and additional municipality follow-up meetings	Municipal leaders and 130 listening session participants	Connectivity issues, areas for public Wi-Fi, and feedback on digital opportunities throughout Puerto Rico
Stakeholder Meetings	15 meetings to inform workforce planning, digital equity, and infrastructure strategies	Service providers, telecommunications unions, university and industry leaders	Deployment challenges, curriculum needs, and digital literacy opportunities
Covered Population and Underrepresented Community Interviews	Interview series with organizations representing covered populations, unserved and underserved communities	Organizations supporting individuals with disabilities, incarcerated populations, aging individuals, veterans, and others	Digital equity barriers and service options in rural areas of Puerto Rico

Figure 48: Deployed Surveys

Purpose	Distribution	Key Takeaway
Survey of Key Organizations on Existing Digital Inclusion Initiatives	Online form and email distribution to government agencies, school districts, higher education, nonprofits, philanthropy, service providers, private entities	· Service providers noted workforce needs and interest in developing affordability programs · Universities and private entities recognize some of their activities as "digital equity," but others do not describe their work in those terms · Future engagement with nonprofit leaders will focus on supporting increased use of online resources in ways that support their work
Digital Equity Survey for Unserved and Underserved Residents	Phone dial survey of residents unreachable through online distribution	· Assessment of device and Internet use, privacy and cybersecurity practices · Update to 2018 Connect Puerto Rico Residential Technology Assessment
Connectivity Survey and Speed Test	Online service survey and optional speed test administered at public service events and shared through email newsletters	· Information on provider choices, available speeds, service costs, and technology use · Speed test data of residents across Puerto Rico

Additional Awareness and Participation Mechanisms

Unserved, underserved, and underrepresented communities made their voices heard throughout Puerto Rico. The PRBP attended monthly on-site events in the Fortaleza por Puerto Rico series, which allowed residents to have one-on-one discussions with PRBP staff about their connectivity issues and share their concerns about utilizing the Internet and Internet-enabled devices. During these public service events, the PRBP shared enrollment information for the Affordable Connectivity Program and provided updates on its work. Other government agencies provided important benefits for residents in need, including the Office for Socioeconomic and Community Development (ODSEC) and the Administration for the Socioeconomic Development of the Family (ADSEF). The PRBP will continue to pair its outreach efforts with those of longstanding trusted government agencies, maximizing efficiency and drawing in more residents.

Topics and materials that were shared at in-person meetings and events were subsequently posted on the Puerto Rico Broadband Program's (PRBP)website: smartisland.pr.gov. The program's site describes the funds available for broadband and related initiatives in Puerto Rico, provides access to ongoing surveys led by the PRBP, and information about the Affordable Connectivity Program subsidy. Residents can access the program's contact information to speak with a staff member by phone or reach them by email. Continuous updates include upcoming events, recent news, and open Requests for Proposals to partner with the PRBP.

A combination of traditional and social media has supported commonwealth-wide awareness efforts. The PRBP has shared updates in newsletters, social media, public radio and in newspapers. Partner community organizations have supported the PRBP's efforts to reach residents by distributing information to the communities they work with daily. Residents will continue to hear about the PRBP's upcoming initiatives and have opportunities to make their needs known during implementation.

5.1.2 Ongoing Engagement Strategy

The PRBP will prioritize further data collection and local coordination during implementation for impactful broadband expansion and digital equity outcomes for all Puerto Ricans. The following sections describe the PRBP's plans for ongoing engagement.

Puerto Rico Broadband Program Committees

The PRBP will continue to consult with government, community, infrastructure, and technology leaders that have contributed to the development of this five-year action plan. The **Executive Committee** and **Broadband Advisory Council** will review strategies and progress on infrastructure and digital equity to ensure all efforts are advancing the goals set forth in this plan.

Building upon consultations with unions and workforce organizations, the PRBP will convene the **Labor and Workforce Committee** to discuss broadband workforce strategies and provide updates on the current state of the industry during implementation. This committee will include representatives from unions and workforce organizations, universities, training programs, and service providers. The Labor and Workforce Committee will convene on a quarterly basis to support workforce strategies and contribute

to the program's capacity to connect broadband workforce interventions with additional employment opportunities on Puerto Rico.

The PRBP will continue to convene the **Digital Equity Advisory Subcommittee,** formed of organizations representing members of covered populations and those that provide technology interventions for residents. The Digital Equity Advisory Committee will convene on a biweekly basis following submission of the Digital Equity Plan to evaluate efforts and support Puerto Rico's participation in digital equity programming.

Implementation Partners

The PRBP will continue to engage stakeholders including government agencies, community organizations, unions and worker organizations, educational institutions, industry leaders, and residents historically underrepresented in planning processes. Stakeholder expertise and the lived experience of residents provides critical insights into designing and implementing comprehensive strategies for broadband deployment and digital inclusion that respond to the needs of Puerto Ricans.

The PRBP has worked to create an inclusive environment to foster collaboration and ownership among stakeholders. This approach has been instrumental for planning strategies that address the specific needs of diverse stakeholder groups and will continue to inform next steps for the program.

Ongoing engagement with key stakeholders is paramount for Puerto Rico to achieve its vision and goals. The dynamic nature of technology and infrastructure necessitates continuous collaboration with stakeholders to stay informed about emerging challenges, evolving needs, and innovative solutions. By maintaining an open and ongoing dialogue with stakeholders, the PRBP will ensure that initiatives remain responsive and adaptable throughout Puerto Rico.

Data Collection

Additional data collection will support responsive program designs. The PRBP will continue to collect survey and interview data, especially from those who have been historically underserved. For example, distribution of the connectivity survey and optional speed test will extend beyond submission of this plan to further inform infrastructure planning by municipalities.

Building upon the success of outreach and awareness efforts during the last year, the PRBP will collect additional feedback in multiple ways to hear from residents at all levels of connectivity. As available, the PRBP will consult with representatives of covered population groups and underserved communities on implementation topics. The PRBP will continue to be available by phone, email, and at public service events alongside other government agencies.

The PRBP will also monitor demographic, health, and workforce data to track the positive impacts of broadband expansion on other areas of life.

5.2 Priorities

Puerto Rico's vision for broadband deployment and digital inclusion is to ensure all Puerto Ricans, regardless of their background or location, have access to the resources and opportunities necessary to thrive in the digital world and fully participate in modern society. The following four pillars of the PRBP's work serve to advance its vision and goals:

1) **Connectivity** to resilient infrastructure,
2) **Quality** and speed for demanding use,
3) **Accessibility** at an affordable price, and
4) **Knowledge** of technology and digital tools.

The PRBP will invest multiple funding streams in a coordinated manner to advance its broadband goals. Of these, the largest will be the Puerto Rico Broadband Infrastructure Fund (PRBIF). BEAD program funding will be used to build upon and extend planned initiatives through PRBIF and through prior allocations of federal funding. Puerto Rico's approach is to complement, rather than duplicate, the obligations that carriers Claro and Liberty have through the FCC under the Uniendo program to extend broadband service universally across Puerto Rico. PRBP will coordinate with Claro and Liberty and monitor performance on their obligations.

Puerto Rico's future investments in broadband will prioritize activities that respond to its distinct needs, prioritizing the most pressing needs. High among these are the need to harden Puerto Rico against natural disaster. The PRBP will capitalize on this moment to build resilient infrastructure, ensuring all residents can rely on multiple avenues for reliable service to their homes, schools, businesses, government offices, and essential community areas. Puerto Rico will also prioritize funding programs that can comprehensively address significant digital equity gaps and implement robust cyber security strategies to protect against potential cyber threats and breaches which could be detrimental to the communities and end users.

To make investments go farther, Puerto Rico will work to reduce the procedural barriers to deploying new broadband infrastructure and prioritize PRBP efforts to strengthen the local workforce and create opportunity for smaller and local service providers to thrive.

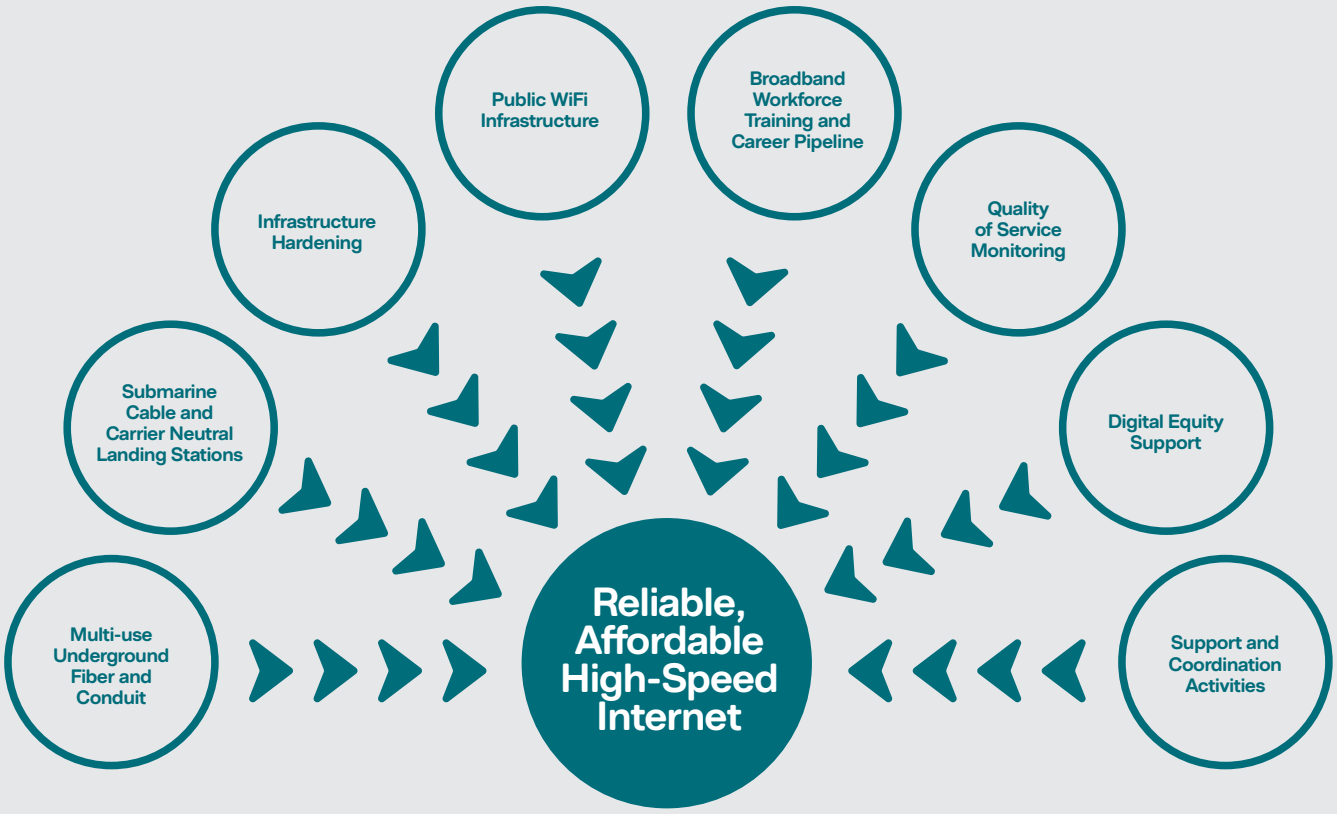
The Puerto Rico Broadband Program is committed to an integrated strategy and implementation that delivers on the priorities of its vision and goals. The four strategic pillars support infrastructure deployment and digital equity strategies. These priorities are complementary and interdependent. All strategies and activities in Puerto Rico's implementation plan are built upon achieving and maintaining these priorities for the economic benefit of the Puerto Rican community.

5.3 Key Strategies and Planned Activities

The strategies that PRBP will need to achieve its vision include creating grant and infrastructure investment programs, and activities that create a supportive environment for those investments. Puerto Rico has the

resources to dramatically improve broadband in Puerto Rico.
Figure 49 below illustrates the key strategies PRBP will implement with this funding. This section of the plan will describe each of these in turn. These will work together to achieve connectivity, quality, and speed for residents through reliable, affordable high-speed Internet.

Figure 49: Planned Activities and Implementation



These strategies address the current state of broadband deployment in Puerto Rico, provide resilient connection through new and upgraded infrastructure, and support resident access and digital equity. The PRBP's support and coordination activities include:

- Develop mechanisms for the participation of small and medium enterprises based in Puerto Rico
- Establish clear, consistent, and expeditious regulatory and permitting processes
- Convene broadband industry partners to coordinate deployment workforce needs
- Enforce Claro and Liberty's Uniendo commitments to FCC
- Support schools to extend Wi-Fi to classrooms
- Support coverage within public housing units

These strategies support the goals of this plan, and in many cases more than one goal. Figure 50 below outlines how these key strategies and support activities advance the broadband equity, access, and deployment goals for connectivity and quality introduced in Section 2.

Figure 50: Plan Goals and Supporting Activities

Plan Goals	*Key Strategies and Support Activities*
Competition among ISPs	· In-person convening of stakeholders on infrastructure strategies and closing the digital divide
Resilient broadband infrastructure	· Continue implementation of Infrastructure Hardening Grant Program · Launch multi-use underground and fiber conduit project · Launch Submarine Cable and Carrier Neutral Landing Programs · Launch Public Safety Telecommunication Hardening Program · Launch Government Data Sites Hardening Program
Eliminated barriers to new broadband infrastructure	· Work closely with the Assembly, government agencies, and key stakeholders to ensure utility pole and conduit access, environmental permitting, "dig once" regulations, and access to public rights-of-way
Sustained and skilled broadband workforce	· Convene broadband industry partners to coordinate deployment needs · Launch Broadband Workforce Training and Career Pipeline Programs
Low-latency broadband speeds of 100/20 Mbps or more	· Enforce service provider commitments to FCC · Enable alternative ISPs through multi-use underground fiber and conduit project · Continue implementation of expanded wireless broadband through the Public Wi-Fi Infrastructure Program · Launch Quality of Service Recurrent Monitoring Program
Symmetrical gigabit service to community anchor institutions	· Launch multi-use underground and fiber conduit project · Support extension of Wi-Fi to classrooms · Support coverage within public housing units

5.3.1 Multi-use Underground Fiber and Conduit Project

To ensure faster recovery from storms and other major natural events, the PRBP is prioritizing the creation of a resilient and hardened fiber system along key routes of Puerto Rico. Buried fiber and conduit will supply the reach, bandwidth, and diversity of routes needed to provide key community anchor institutions with access to reliable symmetrical gigabit service. Further, buried fiber will position Puerto Rico to accommodate future bandwidth needs of schools, highways, and traffic systems, as well as initiatives such as smart cities that demand faster service.

This commonwealth-wide interconnected network of resilient infrastructure will serve multiple last-mile, middle-mile, and institutional users. A core route will enable last mile providers to reach end users. Buried fiber will connect some of the most significant routes in and out of communities across Puerto Rico. Where terrain prevents buried fiber, resilient microwave and aerial routes will ensure even remote areas have connections through hardened infrastructure.

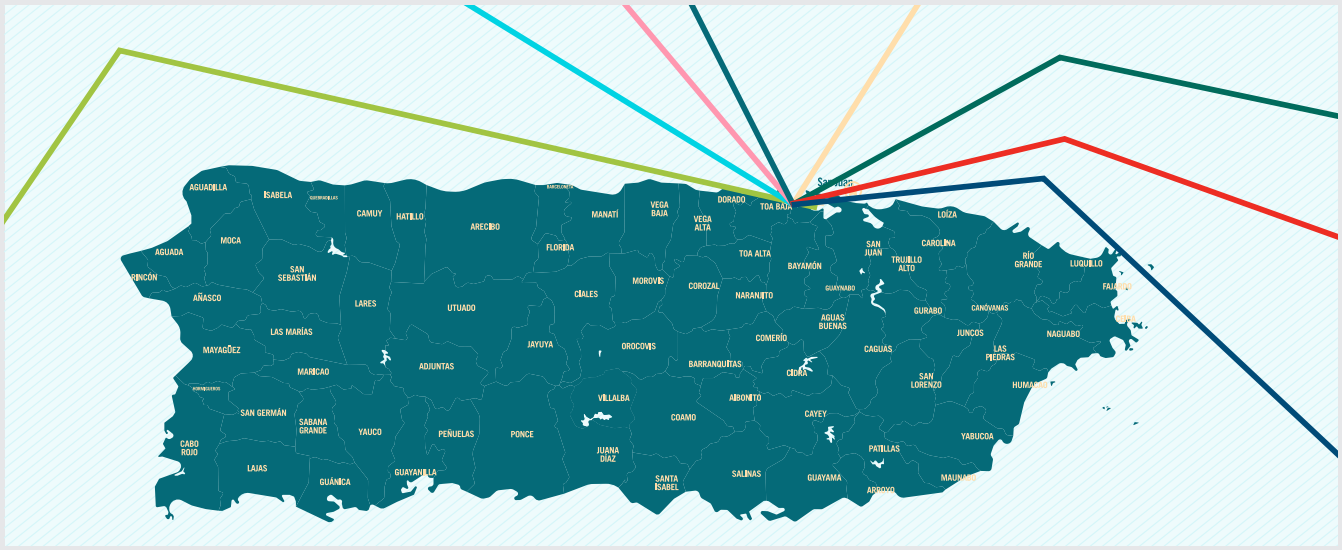
The system will allow multiple users and smaller carriers to participate with equal access. Using a "dig-once design," additional capacity will be built into the conduit system to enable future expansion. From planning through execution, the system will promote a cooperative approach amongst entities for access to new routes.

Rather than recovering systems after major storms, this buried fiber and conduit system will transform telecommunications on Puerto Rico and support the future of hardened, resilient infrastructure in Puerto Rico.

5.3.2 Submarine Cable and Landing Programs

Currently, the only access points for submarine cables to points off-island are in San Juan on the north side of Puerto Rico, a major vulnerability in the event of a localized natural disaster or a deliberate act.

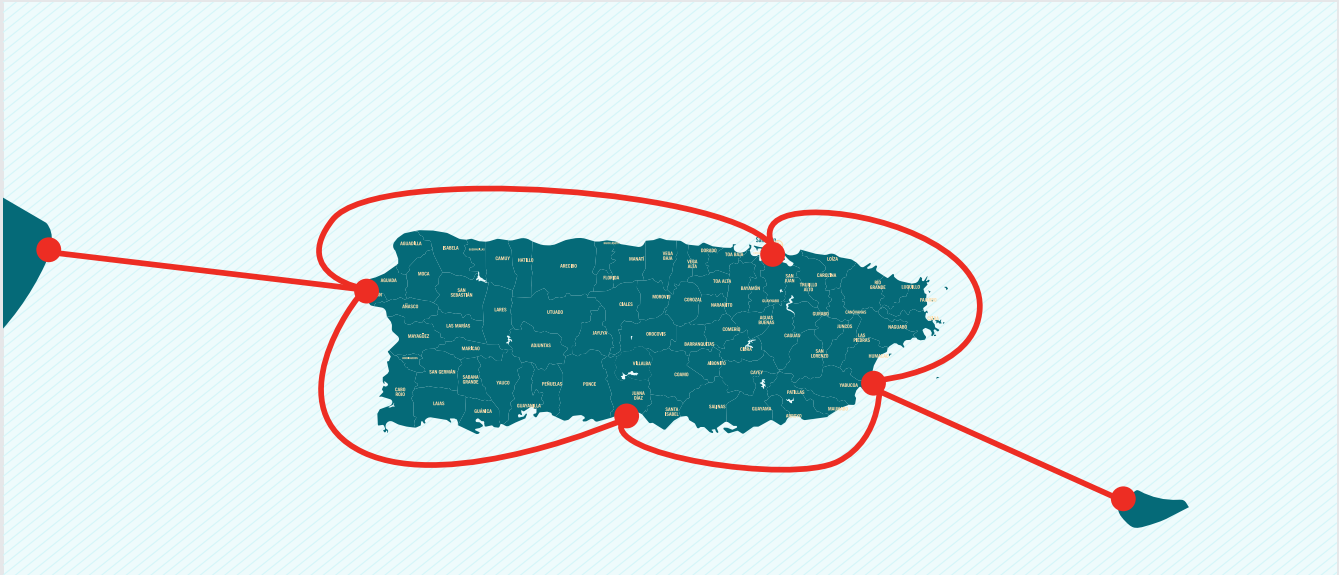
Figure 51: San Juan Submarine Cable Landing Stations



The PRBP will direct funding to the construction and operation of a submarine cable connecting to the Dominican Republic in the west and the U.S. Virgin Islands to the east. The PRBP will also enable the construction and operation of at least three additional cable landing sites with Internet exchange points, as well as sub-sea ducts capable of growth for multiple network operators. These additional landing stations with Carrier Neutral hosting facilities will be located around the island coast at diverse locations to ensure resiliency and survivability for connectivity in the event of a disaster.

These geographically diverse fiber optic cable landing stations and submarine cable will be developed in partnership with public and private entities to ensure carrier neutral operations. These enhancements will not only promote competition among operators but will further expand the diversity and resiliency of Puerto Rico's telecommunications infrastructure.

Figure 52: Resilient Submarine Cable and Landing Stations (Concept)



5.3.3 *Infrastructure Hardening Grant Program*

As more reliable systems and technology are deployed, it is crucial to harden existing infrastructure to withstand these challenges as quickly as possible. The PRBP is currently awarding grants in an initial round of funding for "shovel ready" projects that can be implemented rapidly to provide resilient power and hardening solutions in vulnerable areas of the network. Subsequent phases of this initiative will address projects not yet shovel ready. Key infrastructure including wireless towers, points of presence, and major equipment shelters will be made resilient against environmental challenges and power failures. This will include structural reinforcement, backup power, and redundant connections to other network infrastructure. The PRBP will continue to evaluate existing infrastructure to determine next steps for keeping communities connected, informed, and safe.

5.3.4 Public Safety Telecommunications and Government Data Sites Hardening Programs

Additional hardening and resiliency measures will be applied to safety, emergency, and government data anchor locations. The PRBP will support the assessment of current telecommunications infrastructure at fire stations, police stations, emergency management facilities, and other public safety and emergency locations. Modifications and repairs to vulnerable areas will include reinforcing and replacing equipment, upgrading technology, and installing new communications lines. The PRBP will also award grants for hardening government data communications sites. Facilities will be made more resilient through upgrading equipment including servers, routers, and firewalls. These hardening programs will support the resiliency of critical infrastructure in the event of emergencies and protect residents and their data.

5.3.5 Public Wi-Fi Infrastructure Program

Through the Public Wi-Fi Infrastructure Program launched this year, the PRBP is awarding grants for the deployment of free Wi-Fi and supporting infrastructure to key areas of municipalities. The PRBP has collaborated with municipal governments to determine the area's best suited for Wi-Fi hotspot zones. Awardees must provide free public Wi-Fi access to these zones for at least 10 years, with the opportunity to apply for additional funding to develop supporting infrastructure for fixed or mobile broadband service including structures, backhaul, and backup power systems. Fixed wireless infrastructure provided through this program must support speeds of at least 100/20 Mbps, and mobile wireless must support 5G. The availability of public Wi-Fi throughout Puerto Rico is a first step to ensuring all residents have access to affordable, reliable service.

5.3.6 Broadband Workforce Training and Career Pipeline Programs

Affordable, reliable service must be maintained by a skilled broadband workforce. The PRBP is committed to bolstering its workforce through increased access to new training programs—accessible in-person and online. To fully understand the workforce landscape, the PRBP conducted listening sessions, surveyed constituents, interviewed residents, businesses, and partners, led small group discussions, researched the demographics, and convened a Digital Equity Advisory Committee.

Further efforts will help us better understand and address workforce shortages, collect and analyze data across the telecommunications workforce required to deploy BEAD and other telecommunications projects, and define the full scope of occupations needed to deploy BEAD and other telecommunications projects.

As a committee member described, "workforce development is the top priority." The PRBP identified workforce concerns including labor shortages from outmigration and an aging population, skills mismatch, and lack of training opportunities. The surveys and interviews demonstrated that residents are aware of their lack of knowledge for successfully participating in the digital economy. One participant asked the big question, "How do we rethink future careers?"

Other listening session participants offered the following statements:

- Listening Session Participants

To transition the skilled workforce needed to meet all deployment goals, the PRBP will:

- Develop industry-driven training programs that include work-based learning opportunities.
- Provide financial incentives for workers to enroll in training programs.
  - Offer wrap-around services for workers to be successful in programs.
- Support broadband-adjacent workers transition their skills to the broadband industry, such as electricians.
- Create career exploration opportunities for K-12 students to support long-term talent development.
- Coordinate with key stakeholders and government agencies.

The PRBP will align workforce development efforts across sectors of the Puerto Rican economy and explore potential partnerships with a range of stakeholders, including the University of Puerto Rico, the Department of Education Community College System, and industry workforce and labor organizations. The Puerto Rico Broadband Program will consider expanding existing workforce initiatives hosted by other government offices. For example, the Department of Economic Development and Commerce (DDEC) has led a multi-year effort to bolster on-island opportunities in information technology. The PRBP

will evaluate efforts to integrate current support of information technology jobs and training with other career paths by exploring options for digital support applicable to all members of the workforce.

Through collaboration with industry and government, the PRBP will support efforts to sustain the workforce needed to ensure planned interventions lead to maintained resilient infrastructure. The PRBP has and will continue to convene broadband industry partners to coordinate workforce deployment needs.

5.3.7 Quality of Service Recurrent Monitoring Program

As all residents and businesses must be able to rely on high-speed, quality service, the PRBP will dedicate resources to ensure the quality is maintained for demanding use. The PRBP will develop a recurrent monitoring system to monitor sites across Puerto Rico. Rather than monthly snapshots of the network from speed tests, this system will provide real-time traffic updates of the network to aid in regulation and support more reliable service for residents.

5.3.8 Affordability Programs and Digital Equity Support

Puerto Rico has and will continue to integrate digital equity measures into all infrastructure projects. Throughout implementation of BEAD and other funding, the PRBP will work with Internet service providers to share adoption data and create affordable options for low-income households. As part of the comprehensive implementation strategy of all funding sources, the PRBP has developed programs to provide accessibility at an affordable price and knowledge of technology and digital tools to all residents.

The PRBP will drive enrollment in the federal Affordable Connectivity Program through the Outreach Grant awarded in March 2023. The ACP Outreach Grant Initiative will include direct mailing to eligible households, media campaigns, and in-person enrollment support. An additional device and service subsidy program will be available through the Government of Puerto Rico to supplement the ACP and further increase accessibility for residents who experience cost barriers to Internet and devices. The subsidy program model will maximize the benefit to Puerto Ricans and will be developed as part of the BEAD Initial Proposal.

In addition to subsidies for service and devices at home, Puerto Rico will enable community centers across Puerto Rico to host accessible, affordable programming for high-speed Internet, device access, and digital skills training. As the Public Wi-Fi Infrastructure Program enables free public Wi-Fi zones throughout Puerto Rico, the PRBP will continue to work with municipalities and community organizations to determine locations for regional multi-service centers and Internet community centers. These centers will be developed in strategic locations throughout Puerto Rico to ensure all residents, especially in unserved and underserved service areas, have access to new resources. The centers will be staffed by trained digital navigators to serve as guides for residents who need help using their own devices or accessing loaner equipment, connecting to the Internet, and finding new online resources for daily use.

For more information on the current state of digital equity in Puerto Rico, digital equity goals, and additional implementation strategies to close the digital divide, refer to the Digital Equity Plan.

5.3.9 Support and Coordination Activities

During development of major infrastructure and digital equity programming, the PRBP will ensure that it coordinates and supports efforts to expedite implementation and include a variety of stakeholders. Coordination activities include addressing environmental assessment and permitting, engaging small and medium enterprises, and encouraging schools and other entities to take advantage of Federal programs for increasing broadband adoption.

Development of this plan illuminated major obstacles to broadband deployment. As described in Section 4, the environmental assessment and permitting process in Puerto Rico involves multiple stakeholders and processes that cause many construction delays. The PRBP will work to decrease barriers to construction and make the process for installing hardened infrastructure easier, continuing to work closely with the Assembly, government agencies, and other key stakeholders. The primary task will be ensuring clear, consistent, and expeditious processes for utility pole and conduit access, environmental permitting, "dig once" regulations, and access to public rights-of-way. Easier access to permits will allow for faster deployment and economic development in the communities who need it most, especially for projects that have nominal environmental impacts.

To further support the development of the telecommunications industry in Puerto Rico, the PRBP will provide opportunities for the participation of small and medium enterprises. A range of participating service providers promotes competition and supports ongoing collaboration in the network infrastructure, leading to improved response times and more consistent service. These broadband industry partners will also provide the PRBP important information for coordinating broadband workforce needs.

To ensure every resident can access quality high-speed Internet, the PRBP will coordinate with existing programs and partners to encourage the adoption of service into buildings, including classrooms, libraries, and public housing units. The PRBP will encourage schools and libraries to take advantage of the E-Rate program. Category two services of the FCC's E-Rate program deliver Internet access including internal connections, basic maintenance of internal connections, and managed internal broadband services. Discounts for support depend on the level of poverty and whether the school or library is in an urban or rural area. The discounts range from 20 percent to 90 percent of the costs of eligible services.[43] By partnering with schools and libraries, the PRBP can increase the number of institutions that provide residents Internet access. The PRBP will continue to collect data on E-Rate enrollment throughout the implementation phase to ensure that Puerto Rico is taking advantage of all the available Federal funding opportunities that can aid in advancing its mission.

These plans require the ongoing participation of Liberty and Claro in their existing federal commitments under the Uniendo a Puerto Rico program. The PRBP has developed this strategic plan to supplement those plans and maximize the benefit for residents. The Puerto Rico Broadband Program will continue to develop measures to enforce Claro and Liberty's commitments to the FCC for the ongoing success of Puerto Rico's telecommunications infrastructure.

[43] E-Rate Program, FCC. Broadband USA: https://broadbandusa.ntia.doc.gov/resources/federal/federal-funding/federal-communications-commission-e-rate-program#:~:text=Program%20Overview,as%20part%20of%20a%20consortium.

5.4 Estimated Timeline & Cost for Universal Service

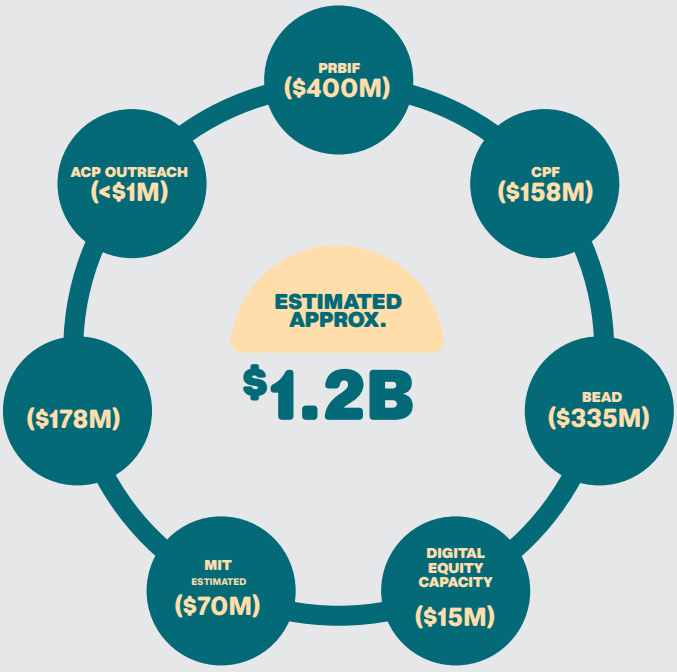
Puerto Rico is in a distinct situation because the existing FCC Uniendo program drives the timeline and cost for universal service throughout Puerto Rico. Two Internet service providers, Claro and Liberty, are mandated to build and deliver universal service by 2028 with $127.1 million in fixed broadband support. [44]

While these service providers are held to their federal funding commitments, the Puerto Rico Broadband Program anticipates some challenges may impact the estimated timeline. Providers may need to respond to severe natural environmental events—devastating hurricanes and earthquakes that jeopardize a well-planned timeline. Broadband workforce personnel are in short supply, and often existing local hires lack the skill set needed for broadband deployment. Further, permitting and right-of-way issues can stall construction. Strategies contained in this plan will mitigate these risks and increase the likelihood that Puerto Rico will achieve universal broadband service by 2028.

5.5 Alignment

The sweeping investments in broadband infrastructure and digital equity by Puerto Rico and the federal government will have a ripple effect across Puerto Rico, for its people and its government agencies. This section examines Puerto Rico's alignment with funding from the Federal Government and with other policy areas.

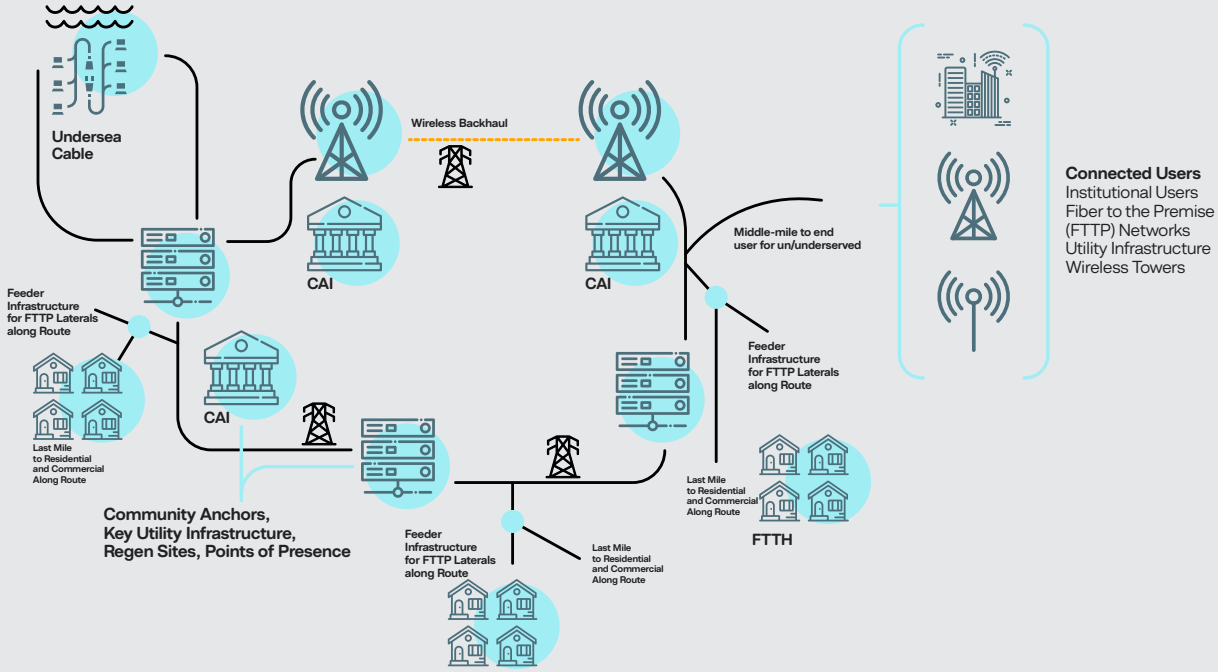
Figure 53: Puerto Rico's Preliminary Budget Illustrated



[44] See Section 3.1.2 for more on the FCC's Uniendo a Puerto Rico program.

The PRBP will leverage all available funding sources to advance Puerto Rico's vision. As shown in Figure 53, approximately $1.2 billion is available for broadband and digital equity activities in Puerto Rico. The scale of broadband infrastructure investment outlined in this plan is beyond the scale of the BEAD program, or any one of the funding sources shown below. The strategy of this plan will require the investments of one program to build on the investments of another. Furthermore, many of the investments that this plan foresees must literally be interconnected to each other and networks funded by private investment and pre-existing federal commitments. Undersea cable must be connected to underground fiber and conduit, connected to hardened towers and equipment, connected to resilient power, and so on.

Figure 54: Interconnected Infrastructure



Investments in interconnected, reliable, resilient, and high-speed infrastructure and services will align with Puerto Rico's pre-existing vision for its Smart Island initiative. A Smart Island:

- Supports connected schools and connected students.
- Provides greater opportunities to revitalize community buildings with economic activity.
- Attracts and retains workers and businesses.
- Brings improved telehealth services into rural community centers.

This will serve the needs of residents, businesses, institutions and businesses by enabling Smart Island applications, strengthening delivery of government, utility, transportation, and other public services. It allows Puerto Rico both to be more engaged with the wider world and do more for itself locally. The investments called for in this plan will unlock an opportunity for Puerto Rico to deliver on its Smart Island vision that is so much more than infrastructure alone. The PRBP will also leverage existing relationships

throughout the Government of Puerto Rico and the private sector to combine efforts for Internet network deployment and digital equity affordable access and knowledge.

Other alignment efforts include alignment with the Digital Equity Act and with other state policy priorities. As described in the Digital Equity Plan, the diversified set of broadband funding sources support two of the Puerto Rico Broadband Program's four pillars: accessibility and knowledge. Multiple Federal and Puerto Rico funding sources will complement each other to provide "wraparound" digital equity services hosted in Multi-service and Internet Community Centers. Residents using these centers will receive support for accessing other social services and benefits.

The PRBP is leveraging existing relationships throughout the Government of Puerto Rico and the private sector to combine efforts for Internet network deployment and digital equity affordable access and knowledge. Alignment across government entities will ensure that broadband deployment and digital equity initiatives also advance Puerto Rico's:

- Economic and workforce development goals, plans, and outcomes
- Educational outcomes
- Health outcomes
- Civic and social engagement; and
- Delivery of other essential services.

5.6 Technical Assistance

The technical assistance that Puerto Rico has already received from the federal government has been invaluable. During the development of the Digital Equity and Five-Year Broadband Action Plan, the PRBP met regularly with its NTIA Federal Program Officer. The Federal Program officer provided a line of communication from Puerto Rico to Washington, D.C. The FPO was responsive and able to answer planning questions quickly and effectively. Regular meetings are held bi-weekly remotely and in-person on a monthly basis to ensure close coordination of information and tasks necessary for the timely and accurate delivery of the plans.

Puerto Rico is in a unique position with respect to BEAD implementation. Current FCC's Uniendo a Puerto Rico Fund obligations require providers to deploy broadband infrastructure and offer speeds in excess of 100 Mbps download and 20 Mbps upload for every housing unit and small businesses in the Commonwealth. This enforceable federal universal service commitment prevents Puerto Rico from using BEAD funding for Unserved or Underserved Service Projects unless a waiver is granted.

Therefore, Puerto Rico presents a unique scenario that calls for understanding and applying the NTIA's guidance to the distinctive requirements of Puerto Rico's environment and population as compared to other parts of the United States. Puerto Rico will look forward to continuing technical assistance from NTIA in the form of awareness, sensitivity, urgency, and guidance to continue to thread the delicate needle of serving and supporting the existing commitments to Puerto Rico while ensuring the greatest benefits from BEAD and Digital Equity for Puerto Ricans. The PRBP plans to ensure all residents can rely on multiple paths for reliable, affordable Internet to homes, schools, businesses, government offices, and essential community areas. Guidance from the NTIA that accommodates Puerto Rico's unique situation will support the path forward.

SECTION 6

Conclusion

Affordable access to the Internet plays a critical role in the ways Puerto Ricans work, learn, receive health care, and participate in democracy. Full participation in the twenty-first century economy requires it. Yet, as the BEAD Notice of Funding Opportunity (NOFO) states:

Affordable, reliable, high-speed Internet access has remained elusive to many for too long, because they live in a location where no service is available, the speed or quality of the service available is unreliable, or the offering available is unaffordable or inadequate.[45]

Puerto Rico is no exception to the challenges described in the NOFO. Persistent poverty and natural disasters – Hurricanes Irma and María in 2017 and the earthquakes in and 2020—served as a wakeup call for Puerto Rico to strategize for future disasters that may level communications equipment and put communities out of broadband service. They recognize the need for durable communication networks that will sustain through future natural disasters. The FCC's Uniendo a Puerto Rico program, USDA's ReConnect program, and FEMA's disaster recovery programs jump started Puerto Rico's plans for an improved, resilient network designed to serve all Puerto Rican residents.

Over the next several years, the FCC's Uniendo program will provide universal service of at least 100/20 Mbps throughout Puerto Rico through two subsidized providers: Liberty and Claro. While universal service is certainly a notable achievement, for Puerto Rico it is merely a starting point; broadband infrastructure must also be made resilient, durable, and prepared to face the storms to come.

Following almost immediately after the earthquakes, came the COVID-19 pandemic which exacerbated certain inequities that have plagued Puerto Rico. The pandemic made clear that broadband is a necessity for all Puerto Ricans regardless of their age, race, or income, irrespective of where they live, what

[45] BEAD Notice of Funding Opportunity, NTIA, https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf

languages they speak, what resources they have at their disposal, and what specific challenges they may face in their daily lives. In the wake of the pandemic, the Puerto Rico government recognized that building strong, resilient infrastructure was part of the solution.

The Puerto Rico Broadband Program was instated by Governor Pedro R. Pierluisi to address Puerto Rico's needs for resilient, equitably distributed broadband infrastructure and the social supports required to access the Internet knowledgeably and safely. With historic and transformational broadband investments from the Federal Government, Puerto Ricans will have the opportunity to fully participate in the 21st century. Puerto Rico will weave its funding from Federal and local programs to achieve Internet for all:
The Puerto Rico Broadband Program has articulated four pillars that will guide how they deploy funds through a coordinated and holistic approach:

1) **Connectivity** to resilient infrastructure,
2) **Quality** and speed for demanding use,
3) **Accessibility** at an affordable price, and
4) **Knowledge** of technology and digital tools.

Throughout development of this Five-Year Action Plan and the Digital Equity Plan, the Puerto Rico Broadband Program and its partners worked together to deepen understanding of broadband needs and elevate the voices of Puerto Ricans regarding the digital divide. Their efforts included outreach, awareness, and data collection. The pillars above, as well as the strategies included in the plans, were informed by a Smart Island Summit outreach, regional listening sessions, stakeholder engagement, a Digital Inclusion survey, a Digital Equity phone survey, connectivity / optional speed tests, interviews, public meetings, and events. Stakeholders included Internet service providers, institutions of higher education and K-12, local governmental entities, including each municipality, and various commonwealth-wide agencies. Additionally, the Puerto Rico Broadband Program received input and advisement from the Broadband Advisory Council and the Digital Equity Advisory Subcommittee. The Puerto Rico Broadband Program is grateful for the time and energy that so many Puerto Ricans offered to support and inform this effort.
The four strategic pillars can be viewed as parallel, complementary, and interrelated. Pillars 1 and 2 focus on network deployment, infrastructure characteristics, and quality of service. Pillars 3 and 4 attend to the needs for Digital Equity, Digital Inclusion, and affordability.

Pillars 1 and 2 note that maintaining and repairing infrastructure, especially aerial cabling, has always been a challenge in hurricane-prone Puerto Rico. With recent funding from the IIJA BEAD Program, the ARPA Capital Projects Fund, and the Puerto Rico Broadband Infrastructure Fund (PRBIF), Puerto Rico plans to invest in hardened, resilient infrastructure that doesn't need to be rebuilt after every storm. Resilient underlying infrastructure, largely buried fiber and submarine fiber, will provide a strong backbone for last mile networks throughout Puerto Rico.

Pillars 3 and 4 address the extremely high level of need for affordable accessibility and knowledge of digital technology and digital tools. Puerto Rico ranks last among all the US states and territories in access to home Internet and ranks last in computer ownership. Twenty five percent (25%) of Puerto

Ricans do not have a computing device (compared with just under 7% US average). Just under half (50%) of Puerto Ricans use a desktop or laptop, compared to the U.S. average of three-quarters (75%). As one Listening Session Participant shared, ""People have virtually no knowledge whatsoever of how to use a computer, how to use a tablet, how to navigate to job search. The most they could know how to do is with their cell phone call the numbers they already have, which are already established. But in many cases, they do not know how to call [emergency services] or call their medical plans to coordinate a medical appointment or to coordinate a health matter." These findings may be a result of low income and poverty rates in Puerto Rico.

The Puerto Rico Broadband Program's listening sessions and outreach efforts were designed to meet the shared objectives of both the Digital Equity and Broadband Equity, Access, and Deployment (BEAD) programs. As part of that coordination, the Puerto Rico Broadband Program created an overlap in personnel between State Digital Equity planning teams and BEAD Program planning teams. These efforts reduced the burden and confusion on community stakeholders while fulfilling the local coordination, outreach, and stakeholder engagement requirements of both programs. These efforts clarified the goals, key strategies, and activities to deliver the four pillars based on Puerto Rico's vision.

The Puerto Rico Broadband Program's forthcoming implementation plan includes continued stakeholder engagement with Broadband Advisory Council, Partners, Socioeconomic and Community Development (ODSEC), Economic Development and Commerce, Socioeconomic Development of the Family (ADSEF), AARP, and more. The PRBP will continue to pair its outreach efforts with those of longstanding trusted government agencies, maximizing efficiency and drawing in more residents. Ongoing committees are: Puerto Rico Broadband Program committees, Labor/Workforce committees, Digital Equity Advisory Committee, Implementation partners, and data collection.

Key strategies to meet all four pillars include:

- Encouraging competition among ISPs
- Constructing resilient broadband infrastructure
- Eliminating barriers to broadband availability
- Sustaining a skilled broadband workforce
- Supply low-latency broadband
- Supply symmetrical 1G service to CAI's
- Conduct the multi-use underground fiber and conduit project
- Conduct submarine cable and landing programs
- Hardening existing infrastructure
- Hardening public safety telecommunications and government data site equipment
- Constructing public Wi-Fi infrastructure
- Conducting broadband workforce training and career pipeline planning
- Monitoring Quality of Service on a recurrent basis
- Establishing affordability programs and DE support
- Coordinating Multi-Service Centers and Community Computer Center Support.

Despite the challenges that Puerto Ricans face, the strong ties between residents and the resiliency of Puerto Rico's communities stand as true assets, holding the promise of positive change. Full participation in the global economy will require Puerto Ricans to adapt and support each other to realize the Internet's full potential.

By weaving together funding streams, Puerto Rico is building resilient, community-centered initiatives; integrating government agencies, partners, and stakeholders; and will soon begin delivering tailored broadband and digital equity services to all Puerto Rican residents and businesses.

The sweeping investments in broadband infrastructure and digital equity by Puerto Rico and the federal government will have a ripple effect for the territory's people and government agencies. This historic program will allow all Puerto Ricans the chance for enhanced civic and cultural participation, employment, lifelong learning, and access to essential services. This will be accomplished through continued partnership, engagement, and alignment toward realizing the vision:

All Puerto Ricans, regardless of their background or location, have access to the resources and opportunities necessary to thrive in the digital world and fully participate in modern society.

APPENDICES

Appendix A
List of Stakeholders Engaged

Internet Service Providers:

- Liberty Communications
- Claro Puerto Rico
- Neptuno
- Worldnet
- VPNet, Inc.
- Aeronet Wireless
- Osnet Wireless
- DM Wireless
- IT Auditors, Corp.
- SafeNet Corp.
- Freedom Networks
- Data Access
- T-Mobile

Organizations

- Estudios Técnicos
- Alianza Puertorriqueña de Telecomunicaciones
- Asociación Puertorriqueña de Diabetes
- Oficina de Protección y Defensa de las Personas con Impedimentos
- Asociación Mayagüezana de Personas con Impedimentos
- Asociación Salud PriMaría/Centros 330
- Tecno Abuelos

- Movimiento Una Sola Voz
- Asociación Alzheimer
- Next Level Innovation
- Internet Society
- Federación Central de Trabajadores (FCT)
- Federación Central de Trabajadores Local 481
- International Brotherhood of Electrical Workers 222
- HIMSS Puerto Rico
- AARP Puerto Rico
- VOCES
- Virtualizate

Government Agencies

- Oficina de Desarrollo Socioeconómico y Comunitario (ODSEC)
- Departamento de Corrección y Rehabilitación (DCR)
- Oficina del Procurador del Veterano (OPV)
- Universidad de Puerto Rico, Recinto de Mayagüez
- Universidad de Puerto Rico, Recinto de Bayamón
- Universidad de Puerto Rico, Recinto de Aguadilla
- Oficina del Procurador de Persona de Edad Avanzada (OPPEA)
- Oficina del Procurador del Paciente (OPP)
- Asuntos del Tercer Sector
- Negociado de Telecomunicaciones (NET)
- Autoridad de Acueductos y Alcantarillados (AAA)

Municipalities

- Adjuntas
- Aguada
- Aguadilla
- Aguas Buenas
- Aibonito
- Añasco
- Arecibo
- Arroyo
- Barceloneta
- Barranquitas
- Bayamón
- Cabo Rojo
- Caguas
- Camuy
- Canóvanas
- Carolina
- Cataño
- Cayey
- Ceiba
- Ciales
- Cidra
- Coamo
- Comerío
- Corozal
- Culebra
- Dorado
- Fajardo
- Florida
- Guánica
- Guayama
- Guayanilla
- Guaynabo
- Gurabo
- Hatillo
- Hormigueros
- Humacao
- Isabela
- Jayuya
- Juana Díaz
- Juncos
- Lajas
- Lares

- Las Marías
- Las Piedras
- Loíza
- Luquillo
- Manatí
- Maricao
- Maunabo
- Mayagüez
- Moca
- Morovis
- Naguabo
- Naranjito
- Orocovis
- Patillas
- Peñuelas
- Ponce
- Quebradillas
- Rincón
- Río Grande
- Sabana Grande
- Salinas
- San Germán
- San Juan
- San Lorenzo
- San Sebastián
- Santa Isabel
- Toa Alta
- Toa Baja
- Trujillo Alto
- Utuado
- Vega Alta
- Vega Baja
- Vieques
- Villalba
- Yabucoa
- Yauco