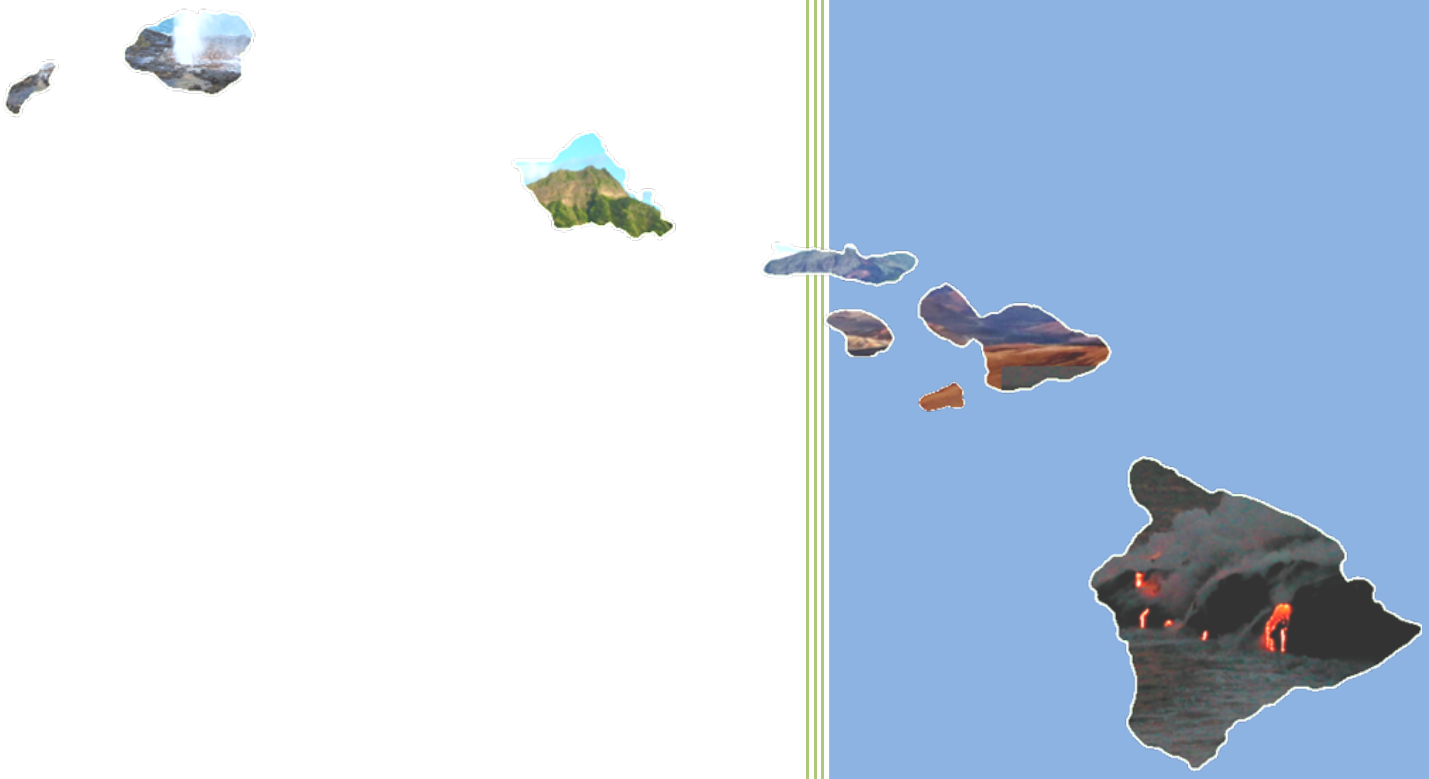
Hawaii Broadband Strategic Plan



Department of Commerce and Consumer Affairs

State of Hawaii

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Aloha,

We are pleased to present this State Broadband Strategic Plan, funded in part through an ARRA grant awarded to the Department of Commerce and Consumer Affairs by the National Telecommunications and Information Administration. The Plan builds upon recommendations made by the legislatively established Hawaii Broadband Task Force, as set forth in the Task Force's Final Report in December 2008, to achieve broadband capability comparable to the leading countries in the world.

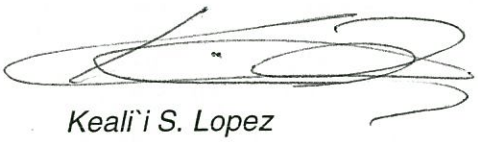
Since the date of that report, both the public and private sectors have taken steps towards implementation of the Task Force's recommendations. New laws were passed, which included legislation directing the Department to support both public and private efforts to meet the State's goals for broadband service availability statewide at world class speeds and comparable prices. The Department's activities have included promotion of the State's interests at the federal level and work with the State legislature, county governments, educational institutions and private stakeholders on activities to expedite broadband infrastructure deployment and to expand broadband adoption and use. At the same, wireline and wireless broadband service providers have continued to expand their broadband networks and deploy new technologies, which have resulted in wider availability of broadband services at faster speeds throughout the State.

Through the assistance of those who graciously provided information and comment, this Plan provides policymakers and other stakeholders with a comprehensive snapshot of Hawaii's broadband landscape and an overview of the unique challenges presented in this State as we continue to advance and expand upon the recommendations of the Task Force. This includes an overview of both State and provider measures implemented to date, as well as on-going initiatives such as Governor Abercrombie's Hawaii Broadband Initiative (HBI), which has proposed the ambitious goal of affordable, ubiquitous broadband at gigabit speeds by 2018. The Plan concludes with proposed strategies that may be best developed and implemented through cooperative efforts of both the public and private sectors to achieve the Task Force's recommendations as well as new recommendations that take into account current initiatives such as the HBI.

This Plan focuses on wireline broadband because of its more established and granular dataset, and because of the relatively recent increases in wireless broadband speeds and coverage. However, as the Department moves into its next two grant projects to build statewide broadband capacity and to increase broadband adoption and usage, the Department will expand its measurements and consider all technologies that may be used to ensure statewide broadband availability and access, particularly for remote and sparsely populated areas of the State. The Department will also continue to work collaboratively with other public and private stakeholders, including local planning teams in each county, to further refine and to execute recommendations outlined in the Plan that are within its purview. Clearly, a more fundamental discussion remains for leaders and policymakers of the State on the financial commitment necessary to ensure the State's competitiveness with the leading nations of the world.

In closing, we would like to express our appreciation to all of the individuals who reviewed this Plan on behalf of the government agencies and private companies listed in the Appendix, and especially to those who provided information and comment, which we have tried our best to incorporate. A special thanks to the Pacific Disaster Center for their assistance in the collection, reporting and mapping of data, and to the Department's dedicated broadband staff for their work in the drafting of this Plan.

Mahalo nui loa.



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EXECUTIVE SUMMARY

Broadband is the great infrastructure challenge of the early 21st century.

> *Like electricity a century ago, broadband is a foundation for economic growth, job creation, global competitiveness and a better way of life. It is enabling entire new industries and unlocking vast new possibilities for existing ones. It is changing how we educate children, deliver health care, manage energy, ensure public safety, engage government, and access, organize and disseminate knowledge.*
>
> *The National Broadband Plan*[1]

The first step to meet this 21st century challenge is to recognize and prioritize broadband as critical infrastructure. The State of Hawaii has taken actions towards this first step. In 2007, the Hawaii State Legislature formed the Hawaii Broadband Task Force and charged it "to remove barriers to broadband access, identify opportunities for increased broadband development and adoption, and enable the creation and deployment of new advanced communications technologies in Hawaii."[2] In December 2008, the Task Force issued its final report to the Governor and to the Legislature, outlining four recommendations to achieve world-class broadband capability in the State:

(1) Establish a forward-looking vision to make Hawaii globally competitive

(2) Create a one-stop broadband advancement authority

(3) Welcome trans-pacific submarine fiber to Hawaii

(4) Stimulate demand for broadband[3]

Although not as extensive as that recommended by the Task Force,[4] legislation followed in 2010 charging the Department of Commerce and Consumer Affairs (DCCA) with broadband

[1] Omnibus Broadband Initiative (OBI), FCC, Connecting America: The National Broadband Plan, GN Docket No. 09-51 at 3-5, 129 (2010) (National Broadband Plan) at xi.

[2] Act 2, First Special Session Laws of Hawaii 2007.

[3] *See* http://www.hbtf.org/files/Hawaii%20Broadband%20TaskForce%20Final%20Report.pdf.

development duties and creating the Broadband Assistance and Advisory Council (BAAC) to bring stakeholders' perspectives into the strategic process.[5] Legislation that year also established a full-time chief information officer (State CIO) and an information technology steering committee.[6]

Then, in August of 2011, Governor Neil Abercrombie launched the Hawaii Broadband Initiative (HBI) with the goal of ubiquitous gigabit (one gigabit per second) connectivity throughout Hawaii by 2018, and the ultimate purpose of ensuring that all of Hawaii's citizens have access to ultra high-speed broadband at affordable prices. Towards this end, the HBI directed State officials and agencies to work together and with other levels of government, the University of Hawaii (UH), broadband providers, and other stakeholders to create and implement plans, policies, and programs to achieve the goals of the Initiative. A year later, the Governor charged the State CIO to serve as the HBI Program Executive, and designated a State Chief Strategy Officer for Broadband and Telecommunications. Throughout, the various State agencies have continued their broadband activities, directed by statute, enabled by grants, or executed in furtherance of the HBI. These activities have included program related initiatives and projects as well as proposed legislation in furtherance of the HBI and other synergistic programs and initiatives.

In January 2010, the National Telecommunications & Information Administration (NTIA) awarded DCCA with a State Broadband Data and Development Program grant (now called the State Broadband Initiative (SBI)) to carry out broadband data collection and mapping, broadband development planning, and broadband adoption activities.[7] This State Broadband Strategic Plan was developed through this grant to provide information and a framework for the creation of policies and programs to address the challenges faced in meeting both state and national broadband goals. The Plan will be used to develop grant-funded work plans at the State and county levels to implement the recommended policies, programs, and activities to advance broadband access and use statewide. To best inform the Plan, provider and stakeholder review and input was sought through the BAAC members and participants, as well as from county officials and multiple state agencies.[8] Clearly, meeting the significant challenges ahead will require the combined and supportive efforts of private stakeholders, the counties and the State.

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[4] Legislation that would have created the Task Force's recommended "one-stop broadband advancement authority" in the DCCA was unsuccessfully introduced in 2009 and again in 2012. *See* S.B. 895 & H.B. 1077, Hawaii State Legislature 2009 (Reg. Sess.); S.B. 2786 & H.B. 2524, Hawaii State Legislature 2012 (Reg. Sess.).

[5] Act 199, Session Laws of Hawaii 2010 (recognizing that "advanced broadband services are essential infrastructure for an innovation economy and a knowledge society in the twenty-first century.").

[6] Act 200, Session Laws of Hawaii 2010.

[7] Award 15-50-M09057.

[8] *See* App. A.

The Plan begins with an overview of broadband and the State's current broadband landscape (Sections I and II), which includes available information on current broadband infrastructure (p. 11), broadband availability across the State (p. 29), and home adoption (p. 45). Section III then provides an overview of existing State broadband projects and initiatives (p. 63). Section IV provides a summary of the State's characteristics relevant to broadband deployment and adoption (p. 71). Section V sets forth, goals, objectives, and recommended actions to advance the State's broadband vision in three areas: *Availability, Adoption, and Application* (p. 89). The following summarizes the recommended goals and objectives to advance the State's efforts in each of these three areas, and the Plan's findings relevant to each.

AVAILABILITY

Goal 1: Ensure Availability of Broadband to All Hawaii Residents at Affordable Prices

Information collected reflects that Hawaii has very good broadband availability, due in large part to Oceanic Time Warner Cable's (Oceanic TWC) significantly high statewide cable television market penetration. Based upon current available information, statewide wireline broadband availability to households at speeds greater than 4 megabits per second (Mbps) for download and at least 1 Mbps for upload (4 Mbps/1 Mbps) is estimated to be in the lower 90% range. Moreover, service for most subscribers may be upgraded to speeds up to 50 Mbps download.

As may be expected, most of the areas of the State without service, or service below that speed threshold, are located primarily on the islands of Hawaii, Lanai, Molokai, and isolated areas of Maui. Both Oceanic TWC and Hawaiian Telcom are actively improving their systems through the addition of more fiber to these areas, but pockets of unserved or underserved areas will remain because of the distances to, and low population density of, these areas. Although the population size of these areas is small, providing high speed, affordable broadband services to these areas unquestionably presents the most substantial hurdles for broadband infrastructure deployment. Thus, while the gap in availability of high-speed service is decreasing, the challenge for ubiquitous access remains significant.

Hawaii's unique geography requires a wide range of infrastructure and technologies to provide broadband connectivity both across the State and with the rest of the world. In addition, with approximately 70% of residents residing on Oahu, the State's skewed population distribution presents a less economically viable market for providers in the much less densely populated areas of the islands outside of Oahu. Addressing the needs for transpacific and interisland undersea cables, reaching remote and difficult to reach areas of our islands, and keeping service affordable for higher speeds and in less densely populated areas, will require a series of

strategies to advance investment in broadband infrastructure, both to provide coverage for such areas and to increase capabilities for future growth in demand by residents and new industries.

Both the necessary physical infrastructure to provide such services and the economics to making service affordable must be addressed. As noted below, this Plan focuses on wireline broadband to the home, consistent with the approach taken to date by the Federal Communications Commission (FCC). It is clear, however, that with the expansion of wireless services and the continuing acceleration of speeds through advanced technologies, wireless broadband will play a critical role in reaching the State's goal that all of its residents have access to affordable broadband no matter where they work or live.

To reach this goal, this Plan sets forth recommended actions to: (1) bridge gaps in physical infrastructure to unserved and underserved areas; (2) lower costs to deploy broadband infrastructure through streamlining government processes, which may include consolidation of telecommunications responsibilities; (3) utilize government resources and partnerships to deploy shared government infrastructure to lower costs to expand and upgrade private networks; (4) drive broadband use through government programs and applications; and (5) increase the supply of transpacific submarine fiber connectivity.

ADOPTION: DIGITAL LITERACY AND INTERNET USE

Goal 2: Eliminate the Digital Divide and Promote Broadband Adoption

Accurate estimates of statewide broadband adoption rates in Hawaii in general, and home broadband adoption rates in particular, are difficult to make because detailed subscriber data is generally protected by providers. Based upon information that is available, it is estimated that overall State broadband adoption is between seventy to eighty percent (70-80%), with home broadband adoption falling within the middle of that range. Non-adoption of broadband in the home must be addressed to eliminate the "digital divide" and to ensure that all of the State's citizens have access to the benefits ubiquitous high speed broadband affords. Home broadband adoption is also a critical component in driving broadband infrastructure deployment statewide, both in terms of the number of households that use broadband services and the level of service to which they subscribe.

Although Hawaii has a good broadband adoption rate, more detailed data must be collected to better identify the non-adopters and the reasons for non-adoption. Equally important, is the

need to understand Hawaii subscribers' adoption of lower speed levels than what is currently offered. Available data reflects that the speeds being used by subscribers statewide are far below what is available to those subscribers. Moreover, for speeds greater than 10 Mbps, Hawaii's adoption rate at 6% is significantly lower than the national rate of 15.5% as well as that of many other states. Oceanic TWC reports that approximately 80% of its subscribers subscribe to its standard Internet service bundled with other services. Oceanic TWC's standard Internet service speed just recently increased from advertised speeds up to 10 Mbps to speeds up to 15 Mbps.

This Plan recommends activities to identify and remove barriers to access through digital literacy and access programs, and to ensure public awareness of the benefits of broadband to increase adoption and to improve the quality of life of our residents. Efforts are being made with the participation of the BAAC Adoption Work Group to collect data on non-adoption and general broadband usage and awareness. Once this data is collected, specific strategies can be tailored to promote and facilitate policies and programs for digital literacy and broadband adoption to supplement existing programs statewide.

APPLICATION: BROADBAND APPLIED FOR ECONOMIC GROWTH

Goal 3: Promote Broadband Industries and Applications for Economic Development

To fuel and accelerate the economic growth and diversification that broadband can provide, the State must have policies that support and promote industries and applications that increase demand for ultra high-speed broadband capability. The resulting increase in demand for broadband services will help to propel greater investment in broadband infrastructure. This Plan sets forth recommended actions to: (1) support ultra high-speed broadband access sites and areas on each island to foster a creativity and innovation economy; and (2) promote and support use of information technology and innovation to foster economic diversification and high quality job creation.

I.
Introduction

What is broadband? The term "broadband" has been defined in many ways throughout the evolution of telecommunications technology. Today, it is generally understood to refer to "advanced telecommunications capability."[9] More specifically, broadband is defined as a data transmission service that enables end users (i.e., customers) to access the Internet and use a variety of Internet applications at **established** speeds. The term "speed" is used to refer to the amount of data that may be transmitted per second, i.e., the amount of a telecommunication system's bandwidth that may be utilized by the end user to transmit data. It is measured in two directions: the speed at which an end user can download content from the Internet (the download or downstream speed) and the speed at which an end user can upload content to the Internet (the upload or upstream speed).

Confusion sometimes arises because the established threshold speeds considered to constitute "broadband" are not universally accepted. In addition, the threshold speeds established by different entities, such as the FCC, do not remain constant, but are increased from time to time to align with technology and consumer demands.[10] For purposes of its report to Congress on the status of the nation's broadband deployment, the FCC has, for its last three reports, maintained a speed benchmark of at least 4 Mbps for actual download and speeds of at least 1 Mbps for actual upload (4 Mbps/1 Mbps).[11] The FCC found that this speed generally "enables users to originate and receive high-quality voice, data, graphics, and video telecommunications using any technology" such as high-definition streaming video and basic video conferencing.[12]

Other benchmark speeds are used for other purposes. The NTIA, which collects and maps data on availability for the National Broadband Map under its State Broadband Initiative (SBI),[13] defines "broadband service" as data transmission with **advertised** speeds of at least 768 kbps downstream and 200 kbps upstream (768 kbps/200 kbps), although the NTIA also collects and reports data at other speed tiers under its SBI mapping grant program (the SBI Data).[14] The

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[9] Seventh Broadband Progress Report and Order on Reconsideration, FCC 11-78, ¶ 1 n.2 (May 20, 2011) (Seventh Broadband Progress Report).

[10] *Id.* ¶ 15 & n.85 (benchmark speeds set to align with current technology and how consumers currently use their service) (citing to National Broadband Plan at 21, 135).

[11] Eighth Broadband Progress Report, GN Docket No. 11-121, FCC 12-90, ¶¶ 18-19 (Aug. 14, 2012) (Eighth Broadband Progress Report); This 4 Mbps/1 Mbps standard was first set in the FCC's 2010 Sixth Broadband Progress Report. 2010 Sixth Broadband Progress Report, 25 FCC Rcd at 9563, ¶ 11. In raising its standard from its former standard of 200 kilobits per second (kbps) upload and download speeds (200 kbps/ 200 kbps), the Commission concluded that its broadband bandwidth threshold had not kept pace with the evolution of technology, which allowed the end user to originate and receive high-quality voice, data, graphics, and video telecommunications, and with consumer expectations. *Id.* at 9562, ¶ 10.

[12] Eighth Broadband Progress Report ¶ 19.

[13] http://www.broadbandmap.gov/.

[14] Seventh Broadband Progress Report ¶ 13 n. 79.

FCC itself also uses different standards for different purposes. For example, the FCC uses the threshold speeds of 3 Mbps downstream and 768 kbps upstream (3 Mbps/768 kbps) when collecting residential broadband subscribership data from fixed (cable, fiber and DSL) broadband service providers on its Form 477 (the Form 477 Data).[15] Further, the FCC uses the 3 Mbps/768 kbps tier as a proxy for its 4 Mbps/1 Mbps speed benchmark in assessing deployment for its report to Congress because that is the SBI Data speed tier that is closest to the FCC's speed benchmark.[16]

Thus, broadband standards, as well as the type of data collected, are often not uniform even within agencies attempting to monitor broadband availability and use. Further, the standards used are redefined from time to time to reflect the current usage and needs of consumers.[17] When determining whether to raise speed thresholds, each of these entities must weigh in the benefits of "having a consistent yardstick to gauge progress" for their specific programs.[18] For this and other reasons, the FCC has to date maintained the 4 Mbps/1 Mbps threshold speeds it established in 2010.[19]

These variations in threshold standards (as well as whether the threshold speeds are actual or advertised) make broadband estimations challenging as well as imperfect.[20] Further limitations exist because the generally self-reported provider data is usually disclosed at the census block level and is sometimes aggregated to the even larger census tract level, which tends to overstate coverage.[21] To date, providers have generally not made more detailed data regarding coverage areas publicly available because of expressed proprietary and confidentiality concerns. Accordingly, estimates drawn from available data must be viewed in light of these limitations. Consistent with the FCC's Eighth Report to Congress, this Plan uses the FCC's

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[15] Id. ¶¶ 28 & 30.

[16] Eighth Broadband Progress Report ¶ 29.

[17] Seventh Broadband Progress Report ¶ 14.

[18] *Id.* ¶ 15; Eighth Broadband Progress Report ¶ 19 (maintaining speed benchmark from prior years simplifies measurement of progress).

[19] Eighth Broadband Progress Report ¶ 20 (noting also that the National Broadband Plan recommended use of the 4 mbps/ 1 Mbps speed benchmark); Seventh Broadband Progress Report ¶ 15 & ¶ 1 n. 2.

[20] Seventh Broadband Progress Report ¶ 24. Note also that standards differ in that they may use advertised speeds or actual speeds. *Id*. at n. 110 (National Broadband Plan suggests that advertised speeds may overstate actual speeds) (citing National Broadband Plan at 40-42).

[21] *Id*.

4 Mbps/1 Mbps actual speed threshold, or the advertised speed of 3 Mbps/768 kbps as a proxy, to measure the current status of Hawaii's broadband deployment.[22]

[22] A recently enacted Hawaii telecommunications reporting statute defines broadband using FCC established thresholds. *See* Act 259, Session Laws of Hawaii 2012 ("Broadband access or broadband service" means an "always-on" service that includes but is not limited to computer processing capabilities, information provision, and computing interactivity with data transport, enabling end users to access the Internet and use a variety of applications at minimum speeds established by the Federal Communications Commission.").

II.
Hawaii's Broadband Landscape

This section provides a snapshot of the current broadband landscape across the State based upon information available as of the writing of this Plan. This information includes the SBI Data collected for Hawaii and analysis of that data by the FCC and the NTIA. It also includes data obtained from other available sources, including information from the State's broadband providers and results of tests taken on the State's SBI grant speed test. The intent of this section is to provide information on current broadband availability and adoption across the State, and to begin to identify the gaps in infrastructure and adoption that must be addressed by specific strategic plans, programs and policies in order to reach the State's broadband goals.

This section is divided into three subsections. Subsection A provides an overview of the State's existing telecommunications systems. It also provides a technical overview of the distinct segments of physical infrastructure required, and the types of technology used to provide broadband connectivity, in an island state. This subsection also includes an inventory of current transpacific and interisland broadband infrastructure. Subsections B and C provide an overview of broadband availability and adoption in the State, respectively, based upon available data. This analysis has been prepared to inform strategic plans to advance broadband capabilities and adoption, including individual county broadband plans.

A. Broadband Infrastructure in the State

Hawaii's unique geography requires a wide range of infrastructure and technologies to provide broadband connectivity both across the State and with the rest of the world. As a multi-island volcanic state in the middle of the Pacific Ocean, Hawaii must contend with thousands of miles of ocean between it and the nearest continent, miles of deep ocean channels separating its islands, soaring mountains, deep valleys, erupting volcanoes, and thick tropical forests. Economically feasible deployment of infrastructure to provide high-speed broadband across this State, especially to low population density areas, thus presents a more formidable challenge than that faced by most states that are part of one continental land mass, which allows for less costly options for connectivity within each state, with other states, and with the rest of the world. In contrast, Hawaii is reliant upon often costly transpacific and interisland submarine fiber connectivity, and intra-island solutions suitable for the mountainous and rugged volcanic terrain of our islands.

To identify and address the State's broadband infrastructure hurdles, the separate segments of physical infrastructure required, and the different technologies used to provide connection in each, must be understood. This section first discusses the broadband systems used to provide most consumer Internet access in the State, then provides an overview of the four distinct segments of physical infrastructure required for connectivity: (1) transpacific; (2) interisland;

(3) intra-island; and (4) "last mile." It includes discussion of the technologies used in each of the four segments, the current state of technology, and the primary benefits and limitations of each in Hawaii at this time.[23] Although this Plan acknowledges the continuing, rapid advancements in technology, it must address the infrastructure gaps and challenges, for the most part, based upon the known current state of the technologies as discussed below.

1. Broadband Systems Overview

Seven different types of technology systems are used to provide most consumer Internet access in the State. With the exception of satellite, these systems or their underlying technology are often used in combination to provide broadband services to consumers in Hawaii. At a minimum, these systems almost always connect at some point to a fiber based system that forms the "backbone" of a network and/or to fiber optic cables that transport data out of the State. For this reason as well as those noted below under Wireless Technologies, this Plan assesses broadband deployment and adoption of fixed terrestrial broadband (cable, DSL, fiber and microwave).[24]

(a) Wireline Technologies

(1) Cable System (cable television wireline based system). A cable broadband system operates utilizing cable television infrastructure. In Hawaii, cable systems are operated almost exclusively by Oceanic TWC.[25] The primary advantage of cable in Hawaii is that Oceanic TWC has extensive cable television infrastructure deployed throughout most of the State to service its almost 400,000 cable television subscribers statewide.[26] This number represents approximately 90% of Hawaii's television households.[27] This same

[23] A helpful overview of the various technologies is also included in a study written under contract with the U.S. Small Business Administration's (SBA) Office of Advocacy: The Impact of Broadband Speed and Price on Small Business, Columbia Telecommunications Corporation (Nov. 2010), *available at* http://archive.sba.gov/advo/research/rs373tot.pdf.

[24] *Cf.* 2012 Eighth Broadband Progress Report ¶¶ 31-43 (Although the progress report provides more data on mobile services than previous reports, it continues to measure broadband deployment and adoption of fixed terrestrial broadband services because of concerns about the ability of mobile and satellite technologies to provide services that meet the FCC speed benchmark and mobile data reliability.

[25] Limited cable systems are operated on military bases in Hawaii.

[26] Note that, although Hawaiian Telcom now offers television service, it is an Internet Protocol television (IPTV) system that operates on its DSL network.

[27] http://www.twcmedia.com/TWC/PB/CustomerCoveragePage.aspx?pageid=&state=HI (As of the first quarter of 2011, approximately 90% of Hawaii's television households were Oceanic TWC subscribers).

infrastructure can be utilized to provide high-speed broadband service to nearly all of those subscriber premises as well. Because of its widespread coverage and the broadband speeds that it is able to offer, Oceanic TWC currently provides service to a majority of the State's broadband subscribers, generally in conjunction with its provision of cable television services. A limitation of this system is that it carries less bandwidth than fiber, and Oceanic TWC's available bandwidth is also utilized to provide cable television services. However, evolving technologies to address bandwidth limitations continue to allow cable operators to deploy higher data speeds over existing cable networks.

(2) DSL System (copper telephone wireline based system). A Digital Subscriber Line (DSL) system operates using wireline copper cable infrastructure.[28] In Hawaii, the DSL system is operated almost exclusively by Hawaiian Telcom. The primary advantage of this system is that it can provide broadband service utilizing much of Hawaiian Telcom's existing and widespread telephone infrastructure. A limitation of this system is that it carries less bandwidth than fiber, and the age and configuration of Hawaiian Telcom's legacy infrastructure, which was designed for a different purpose, limit Hawaiian Telcom's current broadband coverage area and the speeds that it may provide with current technology. However, similar to improved cable system technologies that allow for greater speeds, evolving technologies continue to increase DSL speeds.

(3) Fiber System (fiber optic based system). Fiber optic communications systems utilize lasers to transmit light signals through fiber optic cables. Fiber optic cabling provides superior performance because it can provide a much higher total bandwidth than coaxial or copper cables and, in most cases, is limited only by the performance of the equipment connecting to the fiber. Fiber is used for most transpacific connectivity. It is also used in almost all of the various types of telecommunications network systems operated in Hawaii to provide both the interisland and on-island (terrestrial) "backbone" infrastructure. Both Oceanic TWC and Hawaiian Telcom have hybrid systems on all islands that include fiber backbone networks. In addition, both providers have fiber systems for business customers who use high-speed network services, and, in limited instances, for residential customers.[29] In addition, all of the wireless carriers in Hawaii have towers and antennas connected by fiber

[28] This report uses the term "DSL" generically to represent digital subscriber line technology. This technology is also generally referred to as "xDSL" to encompass various distinct types of DSL technology, including asymmetric DSL (ADSL), very high bit-rate DSL (VDSL), and others.

[29] The major facilities-based providers with their own intra and interisland physical backbone networks include Oceanic TWC, Hawaiian Telcom, tw telecom, Wavecom (now being acquired by Hawaiian Telcom) and Sandwich Isles Communications. These facilities-based providers use this backbone connectivity to offer their own broadband services and may also allow other wireline and wireless providers to utilize their networks for a fee. These providers can either own or lease bandwidth on both transpacific cables and interisland cables for their respective networks or can acquire Internet connectivity locally from upstream providers.

systems for traffic “backhaul” and are in the process of upgrading a majority of these sites to fiber.

(b) Wireless Technologies

(1) Terrestrial Microwave System (terrestrial microwave radio based system). Terrestrial microwave radio systems utilize high frequency radio waves to transmit broadband signals. Microwave tends to be used for trunk connections rather than end-user services. Because these radio waves only travel on a straight path, this system requires a direct line of sight between antenna sites to function properly. For economic reasons, certain providers and government agencies in Hawaii utilize, or have utilized, terrestrial microwave systems for interisland connections and to extend on-island broadband service to remote areas beyond the limits of their existing wireline infrastructure.

The primary advantage to terrestrial microwave is that it may be less expensive to deploy than wireline trunk solutions such as fiber, cable or copper. However, microwave supports less bandwidth than fiber,[30] may be difficult or expensive to maintain given that microwave antennas are often placed on mountaintops, and performance may degrade with certain weather conditions on the signal path. In addition, Hawaii’s rugged, mountainous terrain severely limits the availability of the line of sight paths required.

(2) Satellite Systems. Satellite systems use communications satellites for broadband transmissions. The primary advantage to satellite technology is that it may reach certain remote areas in Hawaii that do not currently have access to any other type of service. However, satellite service at comparable bandwidths is expensive and requires subscribers to purchase costly equipment in order to receive service. Moreover, satellite service performance in Hawaii is limited because, similar to microwave systems, a direct line of sight is required between the communications satellite and the dish antenna on the ground. Because most of the satellites are currently positioned primarily for coverage over the continents, the line of sight to these satellites is often low on the horizon and thus may be blocked by mountains and structures. In addition, the distance signals must travel to and from the satellite creates inherent delays (latency) in the delivery of the signals.[31] This latency may often result in data loss during transmission; the inability to establish a secure connection, such as a “Virtual Private Network” (VPN connection); or the inability to maintain a connection. Because of these current limitations, satellite is not a viable option to provide widespread

[30] According to Oceanic TWC, its Wave Internet service is currently rated at 5 Mbps download and 0.384 Mbps upload.

[31] For comparison, satellite signals must travel over 44,000 miles to Hawaii, while signals need only travel approximately 2,500 miles over fiber to the west coast of the U.S. mainland.

affordable, secure, reliable, high-speed broadband service in Hawaii at this time.[32] For this reason, this Plan excludes further discussion of satellite technology.[33]

(3) Wireless Systems (cellular or mobile wireless systems).

Wireless systems are operated in Hawaii by major national and local wireless providers, and coverage is fairly widespread in the populated areas across the State. As these systems use shared radio resources, performance may be impacted by the number and activity of subscribers utilizing the service at the same time. Wireless carriers continue to be impacted by demands for higher bandwidth and new services, and the growing mobility needs of their customers.

The most prevalent wireless coverage in the State uses 3G technology, which offers theoretical broadband peak speeds of up to 14 Mbps in the downlink and 5.8 Mbps in the uplink.[34] Most of the major wireless providers are currently transitioning from 3G to various types of 4G technology to deliver faster data speeds, although most of this coverage is currently available in areas where population density is high. Included in this transition are the recent deployments by Verizon and AT&T of new wireless service based on 4G LTE technology, which may deliver significantly higher data transmission speeds (theoretical speeds up to 300 Mbps downstream and 170 Mbps upstream).[35] T-Mobile and Sprint are beginning their upgrades to LTE and plan to be operational in 2013. Much higher speeds may be possible in the future as technology such as LTE-Advanced is developed and deployed based upon demand.[36]

The deployment of true 4G LTE networks both nationally and in Hawaii is rapidly progressing. Because of concerns that available data may overstate wireless speeds and deployment, and the need for separate standards on latency and usage for mobile services, the FCC has focused its reporting to date on wireline technologies.[37] However, the FCC has recently begun to report significantly more data on mobile services because of "recent growth in the coverage of higher-speed mobile networks and given the Commission's finding in the USF/Transformation

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[32] Direct-to-home (DTH) broadband Internet satellite services in Hawaii continue to be limited and substantially inferior to the services available to consumers in the rest of the United States. Direct broadcast satellite (DBS) video services are less affected by these limitations, but do require specialized equipment not required on the U.S. mainland.

[33] *Cf.* Eighth Broadband Progress Report ¶ 41 (excluding satellite from its deployment findings because "as of June 31, 2011, there was not a commercially available satellite offering that could provide 4 Mbps/ 1 Mbps broadband service to consumers.").

[34] 3GPP, http://www.3gpp.org/HSPA (defining High Speed Packet data Access (HSPA)).

[35] 3GPP, http://www.3gpp.org/LTE (defining LTE).

[36] LTE-Advanced has a peak downlink speed of 3 Gbps and peak uplink speed of 1.5 Gbps. http://www.3gpp.org/lte-advanced.

[37] Eighth Broadband Progress Report ¶¶ 35-40.

Order that mobile should be an independent universal service goal."[38] Specifically, "[r]ecognizing the growing impact of and demand for mobile services, the Commission's policy goal in the USF/ICC Transformation Order was to ensure Americans have access to *both* fixed and mobile broadband services."[39]

The FCC thus announced on September 5, 2012, the launch of Measuring Mobile America, the first nationwide mobile broadband performance measurement program. Building on the model for the FCC's ongoing Measuring Broadband America program, the first broad-scale study of actual home broadband performance throughout the United States, the FCC will work with wireless carriers, the public interest and research community, and other stakeholders to deliver consumers detailed information about mobile broadband performance.[40]

Wireless provider information obtained for purposes of DCCA's SBI grant has been mapped and shows the census blocks of the State with and without access to mobile broadband services at speeds of at least 768 kbps/200 kbps. These maps indicate very broad mobile broadband coverage over most of the populated areas of the State at this speed tier.[41] However, similar to comments expressed in the FCC's Eighth Broadband Progress Report on wireless data available,[42] there are concerns that the State data on mobile deployment collected to date is not sufficiently granular to allow conclusions regarding gaps in mobile broadband coverage in the State or the robustness of existing coverage. It should be noted that while 768 kbps was considered fast for wireless data service in Hawaii as recently as 2010, the mobile wireless broadband landscape has rapidly changed. After Verizon Wireless and AT&T Wireless made LTE service available in 2011 and 2012, respectively, customers of these companies have reported download speeds in certain areas in excess of 20 Mbps.

[38] *Id*. ¶ 32.

[39] *Id*. ¶ 34.

[40] http://www.fcc.gov/document/fcc-announces-measuring-mobile-america-program.

[41] http://bbmap.pdc.org/bbmap/.

[42] *See e.g.*, Eighth Broadband Progress Report ¶ 35.

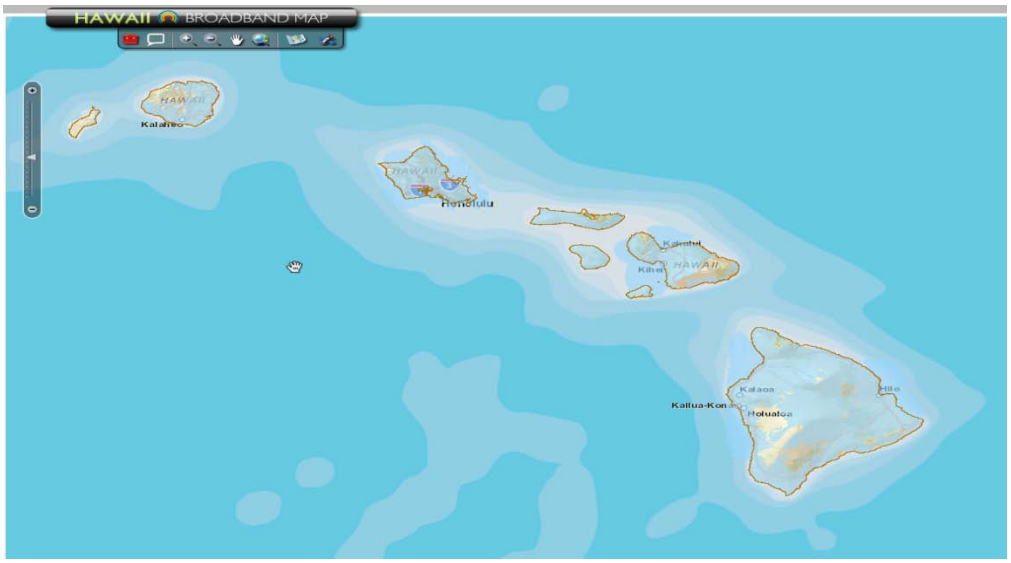

Figure II.1 Mobile Coverage (Light blue shading indicates reported mobile coverage by wireless providers)

DCCA will utilize resources in the next phase of its SBI grant to gather more granular data, in conjunction with local entities and providers, in order to better quantify mobile broadband deployment. Both AT&T and Verizon Wireless have stated that significant investments in the State have been made or are being planned to deploy faster mobile broadband networks and to extend coverage throughout the State, and that the removal of permitting and other delays to deployment would result in greater investment in network infrastructure.

In light of the current data set on mobile broadband, and because wireless networks in Hawaii also rely on much of the same backbone infrastructure as wireline technologies, the analysis of broadband deployment and adoption contained in this Plan focuses on wireline services and its more established dataset. Nevertheless, wireless technology, especially 4G LTE, is recognized as a significant evolutionary step for providing broadband services via an alternate delivery method (especially for last mile connectivity in areas unserved or underserved by current broadband wireline providers), and it is anticipated to play an important part in providing broadband service to all residents in the State. Moreover, it should be noted that most of the strategic goals and activities discussed in this Plan are, in fact, technology neutral.

(4) Wide Area WiFi Systems. Wireless wide area network (WWAN) systems are networks designed to provide wireless service to large areas by connecting separate wireless coverage areas (or cells) through the use of multiple outdoor wireless routers, with the operator of a WWAN acting as a wireless internet service provider. These WWAN systems, which can be publicly and privately operated, generally cover metropolitan areas and are growing significantly in number and size.

An example of this is the City & County of Honolulu, Department of Information Technology's, partnership with private sector businesses to establish the Kokua Wireless network, a free

island-wide WiFi Internet service.[43] This network is connected through hundreds of antennae installed on the buildings of private partner businesses.

Cellular carriers and other providers also offer "hotspots" of varying sizes. Hawaiian Telecom offers a network of over 200 WiFi locations statewide. Oceanic has "speed zone" hotspots, which will be converted as part of Time Warner Cable's planned expansion of its TWC WiFi network into Hawaii.[44] Time Warner Cable currently operates municipal WiFi networks in Los Angeles, Charlotte, Kansas City, and New York City, and is in the process of collaborating with other network owners to expand its TWC WiFi network to Long Island, Detroit, Bakersfield, Indianapolis, Orlando, and Tampa.[45]

2. Infrastructure Segments

Because of Hawaii's unique geography, four distinct segments comprise the broadband infrastructure in the State: (1) transpacific undersea cables; (2) interisland undersea cables; (3) on-island (terrestrial) infrastructure; and (4) "last mile" infrastructure.

(a) Transpacific Connectivity

Hawaii's broadband "lifeline" is transpacific connectivity, achieved primarily through the use of costly submarine fiber optic cable to the mainland U.S. and Asia.[46] While transpacific telecommunications cables once needed to land in Hawaii as a technological necessity, making Hawaii a crossroad for transpacific telecommunications,[47] advancements in submarine fiber optic technology now allow transpacific crossings to bypass Hawaii and connect Asia and North America directly. Primarily because of this, the only new general use transpacific fiber system that has landed in Hawaii since 2001 is the Asia America Gateway, which came into service in

[43] http://www1.honolulu.gov/honoluluhotzones.htm.

[44] http://www.oceanic.com/products/internet/road-runner/speed_zone.

[45] http://www.timewarnercable.com/en/residential-home/internet/features/twc-wifi-hotspots.html.

[46] *See* Hawaii Broadband Task Force Final Report at 9-10.

[47] Prior to the introduction of optical fiber technology, telecommunications signals were relayed over copper-based wires. Hawaii benefitted from the technical limitations on the distance that signals could be sent over copper wire, because transpacific copper wire cables connecting the mainland U.S. with Asia and the South Pacific had to be routed through Hawaii to provide a power connection to allow the signals to be regenerated before being sent on to its destination across the Pacific Ocean. New optical fiber technology does not have this distance limitation, allowing transpacific fiber cables to be routed directly between the mainland U.S. and Asia or the South Pacific, bypassing Hawaii.

2009.[48] There is no pending funded major transpacific system with current plans to land in Hawaii. Concerns regarding the adequacy of bandwidth available for out-of-state connectivity led the Broadband Task Force to recommend that the State take steps to encourage new fiber system landings in Hawaii.

Although Hawaii exhausted available capacity on the older transpacific cables at the end of the last century, the competitive market for transpacific connectivity, combined with advances in technology, has provided increased capacity on the existing modern transpacific fiber systems. These advancements, which have occurred within the last few years, have allowed, and will allow, providers to use existing cables to provide bandwidth many times greater than their initial design capacities. In fact, all of the primary fiber cables connecting Hawaii to Asia and to the U.S. mainland are being upgraded with advanced laser technology to allow greater amounts of data to be transmitted over the existing cables. Systems that currently transport data at 10 Gb per second are each being upgraded to transport 40 Gb per second, and planned further upgrades to some of these cables will allow transport at 100 Gb per second, a tenfold increase per laser. This effect is multiplied because the current transpacific fibers utilize wave division multiplexing (WDM) and have multiple lasers feeding each fiber. Further, each transpacific cable has multiple fibers.

It is believed that the increases in capacity will be sufficient to serve Hawaii in the near future, and that bandwidth cost is a more immediate concern as current cables reach capacity. Nevertheless, the combination of increased costs coupled with the expected exponential growth of demand for broadband capacity by both consumers and businesses, means that a strategy to upgrade this segment of the State's broadband infrastructure must be developed now. In addition, as the Asia market and its accompanying telecommunication needs grow, including demand for co-location services and back up services, some local telecom and data center businesses suggest that, with some encouragement, Hawaii could become a desired destination for such services. For this reason, the State has been asked to include in its efforts activities to increase transpacific capacity in order to capitalize on this future growth, and the State is in fact actively working on plans to do so.

Based upon available data on the costs of other similar transpacific cable projects planned or completed, the cost to lay a cable from Hawaii to the mainland U.S. or to Asia is estimated to be in the range of $250 million dollars.[49] Because current technology allows new transpacific fibers

[48] Additionally, new systems were installed from Australia and French Polynesia to Hawaii.

[49] The Asia-America Gateway (AAG) network, ready for service in 2010, is routed from Asia to Hawaii to California, and had an initial investment of $500 million. http://submarinenetworks.com/systems/trans-pacific/aag/aag-cable-system. The Trans-Pacific Express (TPE) network, ready for service in 2008, is routed from Asia to the U.S. mainland, and had an initial investment of $500 million. http://submarinenetworks.com/systems/trans-pacific/tpe/tpe-cable-system. The Unity network, ready for service in 2010, is routed from Japan to the U.S. mainland, and had an initial investment of $300 million. http://submarinenetworks.com/systems/trans-pacific/unity.

crossings to bypass Hawaii, and given the State's relatively small market, transpacific cable operators will likely require independent justification to include Hawaii landings in future transpacific fiber projects.

Transpacific Cable Systems

Broadband connection to and from Hawaii is provided through transpacific submarine cables that link the State to the mainland U.S., Asia, and the South Pacific. As set forth in more detail below, 6 transpacific fiber cable systems provide most of the State's connectivity through:

- 3 transpacific fiber cables from the mainland U.S.;
- 2 transpacific fiber cables from Asia; and
- 4 transpacific fiber cables from the South Pacific.

The following sets forth information on the existing systems, including dates the systems were "ready for service" (RFS), local landing sites, bandwidth capacities, and planned upgrades:[50]

Southern Cross Cable Network (RFS: November 2000)
Landing Points: Australia - Oregon - Kahe Point, Hawaii - California - Spencer Beach, Hawaii - Fiji - New Zealand

Asia-America Gateway (AAG) Cable System (RFS: November 2009)
Landing Points: Singapore - Philippines - Keawaula, Hawaii - Hong Kong - Malaysia - California - Thailand - Guam - Brunei - Vietnam

Japan-U.S. Cable Network (JUS) (RFS: September 2001)
Landing Points: Japan - Makaha, Hawaii - California - Japan - California - Japan

Telstra Endeavour (RFS: September 2008)
Landing Points: Keawaula, Hawaii - Australia

Honotua (RFS: September 2010)
Landing Points: Kawaihae, Hawaii - French Polynesia

American Samoa-Hawaii (ASH) (RFS: May 2009)
Landing Points: Keawaula, Hawaii - American Samoa

[50] Information on these cable systems was obtained from the International Cable Protection Committee (ICPC) website at http://www.iscpc.org/. The ICPC is made up of members from over sixty countries. Membership is limited to Submarine Cable Owners, Submarine Cable Maintenance Authorities, Submarine Cable System Manufacturers, Cable Ship Operators, Submarine Cable Route Survey Companies and Governments. More information on the transpacific systems is attached to this report as App. B.

Landing Sites

System	Location	Island
SCCN	Kahe Pt Spencer Beach	Oahu Hawaii Island
JUSCN	Makaha	Oahu
AAG	Keaweula	Oahu
Endeavor	Keaweula	Oahu
Honotua	Kawaihae	Hawaii Island

Transpacific Fiber Map

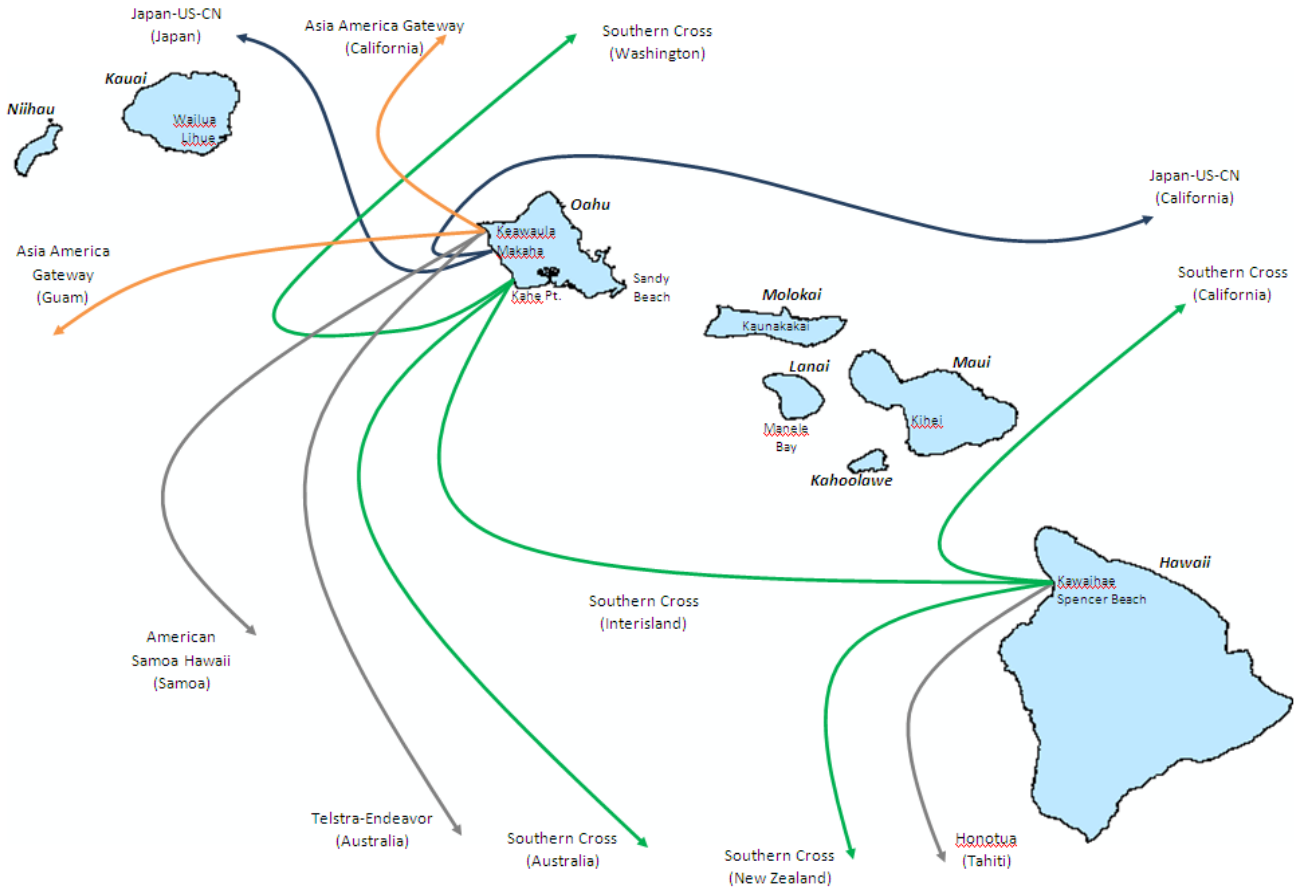

Figure II.2. Transpacific Fiber Map

Transpacific Bandwidth To & From Hawaii

Lit fiber bandwidth capacities and known upgrade information for existing transpacific cables:

Hawaii to U.S.

System	Route to	Current Capacity	Upgraded 100G Capacity	Plan Dates
Japan-US (JUS)[51]	CA	1.28T	6T	100G service - early 2013
Asia America Gateway (AAG)	CA	2.88T	5.2T	40G upgrade expected completion in Q3 2012[52]
Southern Cross (SX)[53]	CA/OR	1.6T	2.8T	Service extended to 2025+ 100G upgrade 4/2013
	Totals	**5.76T**	**14T**	

Hawaii to Asia

System	Route to	Current 10G Capacity	Upgraded 40G Capacity	
Japan-US (JUS)	Japan	320G	1.28T	
Asia America Gateway (AAG)	Asia	1.92T	5.2T	
	Totals	**2.24T**	**6.48T**	

Hawaii to the South Pacific

System	Route to	Current Capacity	Upgraded Capacity	
Southern Cross (SX)	AUS	1.6T	2.8T	Service extended to 2025+ 100G upgrade 4/2013
Endeavour[54]	SYD	1.28T		No pending upgrades
American Samoa Hawaii (ASH)	Samoa	1G		No pending upgrades
Honotua-	Tahiti	320G		No pending upgrades
	Totals	**3.201T**	**2.8T**	

[51] http://www.fujitsu.com/global/news/pr/archives/month/2008/20080327-01.html (Mar. 27, 2008); http://www.ciena.com/about/newsroom/press-releases/Japan-US-CN-Cable-Selects-Ciena-for-Trans-Pacific-100G-Submarine-Network.html (June 25, 2012).

[52] http://www.fiercetelecom.com/story/asia-america-gateway-cable-network-makes-its-40g-move-mitsubishi-electric/2011-11-10.

[53] http://www.southerncrosscables.com/Home/Industry/Insight/southern-cross-services-extended-to-2025; http://www.southerncrosscables.com/asset/cms/Whitepapers/SNW2012_SCCL_Upgrade_Case_Study.pdf.

[54] http://www.telstrawholesale.com.au/products/international/endeavour-cable/index.htm#tab-4 (2012).

(b) Interisland Connectivity

Unlike mainland U.S. states that can easily extend broadband infrastructure on poles or in conduits both intra-state and interstate, Hawaii must cross ocean channels to connect its islands. Microwave systems provide limited capacity where a provider does not have access to submarine fiber connectivity, or in some cases purposely for path resilience, but submarine fiber is currently and for the foreseeable future the only practical technology to enable reliable, high speed broadband access to broadband subscribers on all islands.

Interisland Cable Systems

Information on specific capacities and utilization of existing interisland cables is often considered proprietary by owners. Based upon inquiries made to various providers, it appears that there is sufficient interisland capacity for the near future. This is supported by the fact that the total interisland fiber count exceeds what is currently available on all the transpacific cables from the west coast to Hawaii combined.

However, access to existing interisland cables, the cost of connection, and meeting future interisland connectivity needs, are issues that have been raised and should be reviewed. At present, it does not appear that the current market has provided interisland cable operators with the incentive to upgrade equipment in order to supply anything beyond current capacity levels.

The State has the following inventory of interisland submarine fiber connectivity:

System	Route	Maintenance Authority	Capacity	Landing Sites/Length
HICS Hawaii Inter-Island Cable System[55] In Service: July 1994	Oahu, Maui, Hawaii, Kauai	Hawaiian Telcom	12 Strands 19,500 Gbps	Lihue Terminal, Wailua Point, Kauai -- Ko Olina Terminal, Kahe Point, Oahu/ 191.58km; Koko Head Terminal, Sandy Beach, Oahu; Kihei Terminal, Mokapu, Maui/164.64km; Kawaihae Terminal, Spencer Beach, Hawaii/125.12km
HIFN Hawaii Island Fibre Network[56] In Service: June 1997	Oahu, Maui, Hawaii, Kauai with spurs to Molokai, Lanai	Wavecom[57]	12 strands 10G WDM	Lihue, Kauai; Makaha, Oahu; Keawaula, Oahu; Sandy Beach, Oahu; Kihei, Maui; Manele Bay, Lanai; Kaunakakai, Molokai; Spencer Beach, Hawaii 529 km at 2.5 Gb/s/622 Mb/s.
	Oahu, Maui, Hawaii, Kauai	tw telecom	12 strands[58]10G WDM	Lihue, Kauai; Makaha, Oahu; Keawaula, Oahu; Sandy Beach, Oahu; Kihei, Maui; Spencer Beach
Southern Cross Cable Network[59] In Service: Nov 2000	Oahu, Hawaii		1.6T	Spencer Beach, Hawaii; Kahe Point, Oahu
SIC Sandwich Isles Communications[60]	Oahu, Maui, Molokai, Hawaii, Kauai	Paniolo Cable Company LLC	48 strands No WDM	

[55] Information on cable system, except for capacity, obtained from the ICPC website, *available at* http://www.iscpc.org/cabledb/Eastern_Pacific_Cable_db.htm.

[56] *Id*.

[57] Hawaiian Telcom has a pending application with the FCC to purchase Wavecom's interest. *See* WC Docket No. 12-206 (filed July 18, 2012). Wavecom's network also includes terrestrial (land-based) fiber, which includes 3 SONET fiber rings on Oahu. *Id*.

[58] Oceanic TWC leases 2 strands.

[59] *See* n.97.

[60] This cable is owned by Paniolo Cable Company LLC, a subsidiary of SIC.

Interisland Fiber Map

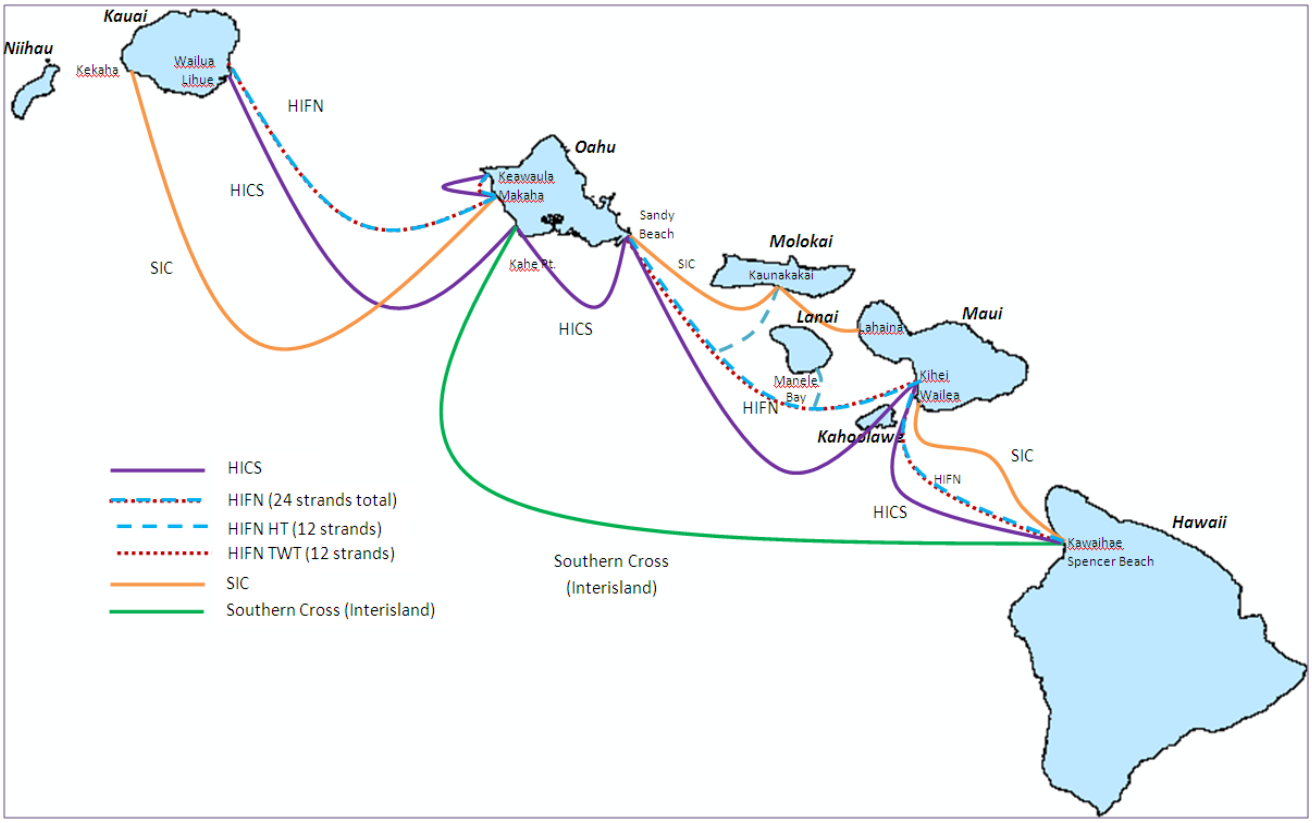

Figure II.3. Interisland Fiber Map

The State has the following microwave systems:

Interisland Microwave Systems

System	Service to	System Owner	Description
Wave Internet	Molokai, Lanai, Hana	Oceanic TWC	Used for Internet service and cable TV service
Hawaiian Telcom	Statewide	Hawaiian Telcom	Interisland system used in conjunction with its fiber facilities for network resiliency. Voice and data traffic are carried on this microwave network.
Anuenue Digital Microwave System	Statewide	State of Hawaii	Public-safety grade statewide microwave backhaul network

(c) On-Island Connectivity

Almost all of the telecommunications systems utilize fiber optic cabling for their on-island backbone infrastructure. Oceanic TWC's on-island backbone consists of a fiber optic based trunk system that connects its main distribution facility on each island, called a headend, to its area hub site and then to neighborhood nodes. These nodes form the connection points to its "last mile" segment of its network. Oceanic TWC is continually expanding its fiber backbone, pushing it closer to its subscribers' premises in order to maximize the use of its embedded legacy coaxial cable in this portion of its network.

Hawaiian Telcom similarly uses, and is extending, an on-island fiber backbone to carry high bandwidth traffic aggregated at its Central Office (CO) facilities to maximize use of its existing legacy telephone wire-based last mile network. In the older analog telephone system, the CO facilities were connected to the main switching facility by copper wire "trunk" connections. These copper wire "trunk" connections have been widely replaced by fiber optic connections, except in certain rural areas where subscribers are difficult to reach and there is lack of adequate demand to support the investment.

Hawaiian Telcom's current fiber backbone is part of a combination of next generation optical IP-based packet transport and SONET rings connecting Hawaiian Telcom's CO facilities spread throughout the State.[61] In support of its recently launched Internet protocol television (IPTV) service on Oahu, Hawaiian Telcom is extending its fiber optic backbone to nodes that are farther and farther away from the CO facilities, which will also allow it to extend its high-speed DSL coverage area with improved quality of service.

(d) "Last Mile" Connectivity

The term "last mile" describes the infrastructure segment that provides the final connection from a provider's central distribution point (e.g., neighborhood nodes or CO facility) to the subscriber's premises. The distance this "last mile" covers may be less than 100 feet in urban areas, while in rural and remote areas it may actually represent many miles. "Last mile" infrastructure is often the most costly and difficult segment to deploy, especially for the rural areas of the State where distances from a central distribution point are generally much greater

[61] The CO facilities are actual buildings, originally built in neighborhoods and business districts to house analog telephone switching equipment.

and population densities do not provide a sufficient market to support the deployment. DCCA has asked the BAAC's Economic Work Group for assistance in quantifying these "last mile" costs for future planning and policy-making purposes.

Cable

Oceanic TWC's cable system provides "last mile" connectivity utilizing cable television technology and infrastructure. Both data and cable television service are transmitted from Oceanic TWC's neighborhood nodes over the same copper coaxial cable (often referred to as "coax cable") to the subscriber premises. This coax cable then connects to a cable modem at the subscriber premises. Because of Oceanic TWC's market penetration for its cable television services, this is the most commonly used technology for "last mile" connections in Hawaii.

Although coax cable is capable of transmitting data at high speeds, only a portion of the cable's overall bandwidth is available for broadband service because it carries both cable television and broadband service. As Oceanic TWC continues to shift from analog to digital television channels, it will recover and reallocate bandwidth on its last-mile coax cable, a large portion of which will likely be used to increase the bandwidth available to its broadband subscribers, and thus increase broadband speeds. Oceanic TWC currently offers broadband service at advertised download speeds of up to 50 Mbps, utilizing current DOCSIS 3 technology that allows for bonding of up to four 6 MHz channels down and three up to create higher speeds. Newer systems being trialed, which may utilize up to 24 channels, could potentially provide speeds of up to 1.5 Gbps download and 150 Mbps upload.

DSL

Hawaiian Telcom's DSL system provides "last mile" connection through its legacy copper wireline network. Data is carried from neighborhood network nodes to subscriber premises over copper wiring originally designed and installed to carry "plain old telephone service" (POTS) to telephone subscribers. A significant advantage of Hawaiian Telcom's DSL service, thus, is its use of existing and extensive POTS infrastructure. At the same time, however, use of copper infrastructure that was not designed or installed to provide broadband service has significant inherent transmission limitations. The primary limitation is the fairly short distance that the DSL service can travel over copper wire between a network node and the subscriber premises, which is known as the loop distance. This distance must generally measure in the thousands of feet to achieve high data speeds, and the available bandwidth decreases as the loop distance increases.

The loop distance, moreover, is not measured in a straight line back and forth from the network distribution point to the subscriber premises. Instead, it is measured along the actual path that the copper cable runs, which is generally along the public rights of way (e.g., roadways) to the edge of the subscriber's property. This also results in instances in which broadband service

may be available to one home, but not available to a home just across the street. In addition to loop distance, the type and condition of existing copper wiring in most areas of the State, which is several decades old, may impede or could preclude broadband performance. Therefore, estimating DSL broadband performance based upon loop distances alone is likely to overstate performance in many areas of the State.

Ordinary telephone wiring, if in good condition, may currently allow a maximum speed of around 25 Mbps for a loop distance of 4000 feet. With the deployment of fiber extensions, Hawaiian Telcom's DSL "last mile" connectivity may be from either a CO facility or neighborhood node to a subscriber's home, which should greatly extend the availability of DSL service. Hawaiian Telcom currently offers an advertised DSL data rate of up to 50 Mbps, although this service is not widely available for the reasons noted above. As with other technologies, there are ongoing advances in technology within the telecommunications industry to increase DSL speed. Hawaiian Telcom has plans to extend its recently launched IPTV service to the islands outside of Oahu. Because its IPTV service was designed for a minimum 25 Mbps broadband connection, Hawaiian Telcom will also be able to offer Internet services at similar speed in those areas in which its IPTV service becomes available. Newer DSL technology used and other telephone network variables may allow for speeds up to 100 Mbps for distances less than 1000 feet.

Fiber

A third form of "last mile" technology is dedicated fiber optic cabling to the subscriber premises, referred to as fiber to the premise (FTTP).[62] Fiber optic cabling potentially offers the fastest performance because it can carry bandwidth many magnitudes higher than copper and, from a practical standpoint, its performance is limited only by the equipment connected to it. However, fiber has historically had higher installation and associated equipment costs, which has limited the use of fiber for "last mile" connectivity to a subscriber's home.[63]

To date, providers have generally installed fiber cabling selectively for businesses requiring higher bandwidth speed or for new residential subdivisions where facilities do not already exist or cannot provide the necessary bandwidth needed by customers, or where costs are offset by

[62] This is also sometimes referred to as fiber to the home (FTTH) where the subscriber premise is a residence.

[63] With technological advancements, the actual cost of fiber is now quite low. However, the installation costs remain high because the fragile nature of fiber precludes its installation in the same conduit or duct as copper wire. The hope is that changes in technology will someday allow fiber to be handled like copper wire, and therefore allow the sharing of conduits and ducts. In addition to this, as the demand for fiber increases, and technology improves, the cost of the electronics to utilize fiber technology will continue to decrease.

willing and able subdivision developers or individual subscribers.[64] FTTP is already widely deployed for business customers who use high-speed network services. Because technological advancements have significantly reduced the costs of fiber optic cabling and the costs of deployment, the use of FTTP for residential customers is expanding, particularly in high-end residential developments and higher density residential areas. FTTP is currently available from certain providers to most areas in the State.

Since 2007, Hawaiian Telcom has offered FTTP to developers of new residential developments, or what is commonly referred to as "Greenfield" developments. Hawaiian Telcom reports, however, that it has been a significant challenge to convince residential developers that the additional requirements to support the placement of fiber termination equipment, and any changes to the in-house wiring to maximize the availability high speed data in the home, will provide the developer with a viable economic return. In addition, with its recent offering of IPTV service, Hawaiian Telcom has begun to expand the use of FTTP to provide consumers with television service in areas where it may be more economical to do so than to upgrade its embedded copper plant.

B. Broadband Availability

Access to data that would allow the best estimates of broadband availability in Hawaii is currently unavailable because of broadband providers' proprietary and security concerns regarding their infrastructure and coverage areas. For example, cable coverage and speeds could be estimated based upon the distance between neighborhood nodes and potential subscribers, but Oceanic TWC maintains the exact locations of its available broadband infrastructure, including its neighborhood nodes, as confidential. Although this information would allow estimation of coverage using mapping data, such estimates would also be subject to limitations because of variations on quality of service due to the type and condition of cables and equipment used, etc., and industry financial viability standards applied that generally preclude service availability where the population density is less than 25 homes within a mile of existing infrastructure.

During the 2012 legislative session, Governor Abercrombie's administration introduced legislation that would require more detailed data from all telecommunications providers be made

[64] Some FTTP installations also exist in Hawaiian Homelands developments served by Sandwich Isles Communications.

available to the State, including data on statewide broadband penetration and infrastructure. The bill passed in a more limited form, and was signed into law as Act 259 on July 6, 2012. The Act requires telecommunications providers in the State (except for wireless carriers)[65] to report on the number of households, addresses, or tax map key parcels to which the providers cannot provide broadband service at threshold speeds set in the FCC's most recent broadband report issued to Congress. This information is to be provided as a percentage reflecting these numbers, aggregated at the census block level. Providers must also provide the monthly price charged for broadband service if purchased separately, without discounts. DCCA is required to keep reported information confidential, except for mapping information required by DCCA's SBI grant and aggregated data.

The reported data will help the State in its efforts to more accurately determine the status of broadband access in the State, including the number and location of unserved households. This will help the State to develop effective policies and initiatives to directly target unserved and underserved areas of the State, and potentially to qualify State projects for federal grant and loan programs. Act 259 requires providers to file the first reports by March 1, 2013, with subsequent reports to be made on every March 1 thereafter. Given the DCCA's current grant planning activities, DCCA has asked Oceanic TWC and Hawaiian Telcom for access to certain information regarding where service cannot be provided in advance of that date. DCCA has recently received data from Oceanic TWC, and is currently awaiting a response from Hawaiian Telcom. Act 259 requires DCCA to treat data received from providers as confidential information and therefore this information is not included in this Plan.

Again, and as is generally recognized by government and industry, estimates on coverage are at this time subject to limitations because available data is to a large extent self-reported by providers, and is in many instances not maintained by providers in the form and for the purposes of identifying areas of no coverage. Independent efforts should be made by the State and counties to better identify unserved and underserved households.

Information primarily provided by Oceanic TWC, supports a reasonable estimate of broadband availability to households statewide at speeds greater than 4 Mbps/1 Mbps in the lower 90% range. As may be expected, most of the areas of the State that have no service or service below that speed threshold are located on the neighbor islands, primarily on the islands of Hawaii, Lanai, Molokai, and isolated areas of Maui. Although the population of these areas is small, these areas unquestionably present the most substantial hurdles for broadband infrastructure deployment.

[65] Wireless providers must report the same information that is filed with the FCC.

1. SBI Mapping Data

DCCA's SBI grant projects include broadband data collection and mapping, broadband development planning, and broadband adoption activities. The data collection and mapping project is intended, in large part, to provide the NTIA, the FCC, and the State with data needed for broadband planning and deployment activities, and to monitor broadband deployment progress.

The SBI Data is gathered twice a year from willing broadband providers on the availability, speed, and location of broadband services offered, as well as on the broadband services available for community institutions, such as schools, libraries and hospitals.[66] This information is used by the State to create a State Broadband Map, by the NTIA to generate a National Broadband Map, and by the NTIA and the FCC to create broadband reports.[67] To date, data has been collected from the following wireline providers,[68] who provide services to the overwhelming majority of broadband subscribers in Hawaii:

1) Oceanic TWC
2) Hawaiian Telcom Communications, Inc.
3) Tw Telecom Holdings, Inc.[69]
4) Sandwich Isles Communications, Inc.
5) Trex Broadband, Inc. dba/BlueStreak Broadband
6) Pacific Light Net, Inc. dba/Wavecom Solutions[70]

For the most part, data has been provided at the census block level, i.e., providers have reported whether they are able to provide broadband service to a census block, and using advertised ability to deliver broadband speeds at various speed tiers. Again, data at the census block level may result in overstatements of service particularly in rural areas where the census blocks are large,[71] because providers may report broadband availability for an entire census

[66] The project team verifies broadband data as required by the NTIA.

[67] http://www.broadbandmap.gov/.

[68] Wireless providers who have provided data: Clearwire Corp., Verizon Communications, Inc., Sprint Nextel, AT&T, Inc., MOBI PCS, and T-Mobile USA, Inc.

[69] Tw telecom provides high speed broadband services to the business market, including government and wireless providers, throughout most of the urban areas of the State.

[70] Hawaiian Telcom is currently seeking approval to acquire this company.

[71] Rural census blocks in Hawaii can span from ocean to mountain top. This characteristic is unique to Hawaii and challenging when performing population analysis because people are not evenly distributed across an entire census block area.

block even where service is available to only a portion of that census block.[72] Therefore, the SBI Data likely overstates the actual number of households with broadband availability.[73] This is important to note because this data is used by the NTIA and the FCC to establish the State's broadband availability.

2. Availability of Broadband (Wireline)

Based upon current available data sources, wireline (cable, DSL and fiber) broadband service availability to households in the State at 3 Mbps /768 kbps or 4 Mbps /1 Mbps speeds is estimated to be in the lower 90% range. This estimate is based in large part on Oceanic TWC's estimates of its cable broadband coverage at approximately 96% of the State's households and businesses, which appears consistent with other available data.[74] Because Oceanic TWC's estimate is based upon business and residential cable passings in its database and is not a complete residential database, availability to households is reasonably likely to be lower. This broadband availability is at speeds in excess of both thresholds, as service for most of Oceanic's Internet service subscribers may be upgraded to speeds up to 50 Mbps.

The FCC, based upon the SBI Data, estimates that broadband at 3 Mbps /768 kbps is available to 98.5% of the State's population, with coverage in the rural areas at 82.3%.[75] The NTIA has estimated coverage for this same threshold speed (with wireless services included) at approximately 98%, with 78% coverage for rural areas.[76] In addition to inclusion of wireless services, these estimates are generally believed to overstate coverage because reporting is largely done at the census block level and is dependent upon the data reported by the providers in response to queries made.[77]

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[72] Seventh Broadband Progress Report App. F. at 74, n.26.

[73] Seventh Broadband Progress Report ¶ 24 and App. F (recognizing limitations of SBI Data collected by census block and with advertised speeds, resulting in imperfect deployment estimates).

[74] Oceanic TWC's cable coverage footprint, with few exceptions, encompasses Hawaiian Telcom's DSL coverage area.

[75] This estimate is based upon SBI Data as of June 2011. Eighth Broadband Progress Report ¶ 28 & App. C.

[76] http://www.broadbandmap.gov/download/BroadbandAvailabilityinRuralvsUrbanAreas.pdf (data as of Dec. 2011).

[77] *See* Seventh Broadband Progress Report App. F (noting limitations of SBI Data because it reports data aggregated to a minimum geographic area, which is largely census blocks for SBI. "Because no information is reported below that level of aggregation, most of our analyses necessarily depend on the simplifying assumption that all end-user locations in a reported geographic area have access to the reported type and speed of broadband."). The FCC has also recognized that its "identification of unserved areas may be overstated to the extent that providers did not submit data or submitted incomplete data" or where providers over-reported their deployment of broadband. *Id.* ¶¶ 9 & 13.

(a) Cable Availability

Cable broadband service coverage is the most widespread in Hawaii because Oceanic TWC is able to leverage its cable television market dominance to provide broadband service using the same infrastructure. Upon request, Oceanic TWC provided its estimated statewide and county coverage information, current as of May 2012. These figures represent the percentage of the total number of residential and business addresses in its system (excluding hotels rooms)[78] that are able to subscribe to Oceanic TWC's high speed data services:

City & County of Honolulu	96%
Hawaii County	94%
Maui County	95%
Kauai County	98%
STATE	**96%**

These coverage estimates are generally consistent with other data submitted to DCCA under Oceanic TWC's cable television franchise agreements with the State.[79] Much of this data concerning service availability is considered to be confidential proprietary business information, and thus restricted from disclosure. Oceanic TWC currently offers two residential broadband services, Internet and Wave Internet Service:

(1) Internet residential cable modem service (formerly Road Runner). This service is available to most areas of Oahu, Kauai, Maui and Hawaii Island. Oceanic currently offers the following residential broadband service plans:[80]

Internet Plans:	Advertised Speeds Down	Advertised Speeds Up
Lite Internet	Up to 1.5 Mbps	Up to 1 Mbps
Basic Internet	Up to 3 Mbps	Up to 1 Mbps
Standard Internet	Up to 15 Mbps	Up to 1 Mbps
Turbo Internet	Up to 20 Mbps	Up to 2 Mbps
Extreme Internet	Up to 30 Mbps	Up to 5 Mbps
Ultimate Internet	Up to 50 Mbps	Up to 5 Mbps

[78] This includes all potential known subscribers, including addresses for military bases and Hawaiian Home Lands.

[79] *See generally* Haw. Rev. Stat. § 440G-8 (Supp. 2011).

[80] Business cable modem service and business dedicated Internet access via fiber is also offered.

Oceanic TWC's Standard Internet plan has the highest subscription rate with approximately 80% of subscribers opting for this level of service bundled with other services. The Standard Internet Plan's advertised speed of up to 10 Mbps was increased to 15 Mbps at the end November 2012. According to Oceanic TWC, almost all Internet plan subscribers may upgrade to speeds up to 50 Mbps.

(2) Wave Internet Service (Molokai, Lanai, and Hana). This service is offered for Molokai, Lanai, and the small isolated community of Hana on Maui. It operates using microwave technology for interisland connectivity, with last mile connectivity over cable modem equipment. The current service offered is Wave Plus, which offers advertised speeds of up to 5 Mbps down and 384 kbps up. This service cannot currently be upgraded. However, Oceanic TWC has been working to obtain fiber connectivity to these areas primarily because of the inherent limitations of microwave technology that do not allow for robust interisland connectivity.

(b) DSL Availability

Based upon the SBI Data, NTIA reports that DSL broadband service at greater than 3 Mbps download speed is available to approximately sixty-six percent (66%) of the State's population, and reports the following percentages by urban versus rural areas of the State:[81]

Population	Urban/Rural	DSL
111,629	Rural	18.9%
1,250,408	Urban	69.8%

These figures are likely higher than actual coverage again because of the data collection methodology. Hawaiian Telcom is working on system changes to provide a more accurate estimate of DSL availability statewide because of the many variables that affect its ability to provide DSL broadband service, such as the type of copper wire that exists to a subscriber's premises, the condition of that wire, and the actual distance between either a CO facility or node and the subscriber premises.[82] These factors also affect the speed and quality of connectivity.

[81] http://www.broadbandmap.gov/download/Broadband%20Availability%20in%20Rural%20vs%20Urban%20Areas.pdf (data as of Dec. 2011).

[82] The actual distance the wire travels, i.e., the actual path a telephone line runs along rights of way such as streets to a subscriber's residence, correlates to the broadband service speed that current technology can deliver under normal conditions.

Hawaiian Telcom offers the following DSL services:

Internet Plans:	Advertised Speeds Down	Advertised Speeds Up
Basic	Up to 7 Mbps	Up to 11 Mbps
Advantage	Up to 1 Mbps	Up to 1 Mbps
Premium	Up to 15 Mbps	Up to 1 Mbps
Extreme	Up to 20 Mbps	Up to 3 Mbps Upgrades to 5 & 10 Mbps available
Ultimate	Up to 25 Mbps	Up to 3 Mbps Upgrades to 5 & 10 Mbps available
Elite	Up to 50 Mbps	Up to 3 Mbps Upgrades to 5 & 10 Mbps available

Hawaiian Telcom is also actively planning improvements to its DSL service to all of the islands. Moreover, Hawaiian Telcom's entry into the television service market has led to more fiber deployments and shorter copper loops, increasing the bandwidth speeds available to its customers. Currently, Hawaiian Telcom's television service is only available in certain areas of Oahu (such as Mililani, Ewa, Kaimuki, and Hawaii Kai) where the subscriber premises are located in sufficiently close proximity to a node. Customers able to subscribe to this television service may also subscribe, at a minimum, to Ultimate DSL service with advertised speeds up to 25 Mbps.

(c) Unserved and Underserved Areas

Efforts are being made to accurately map unserved areas of the State, as well as underserved areas that have less robust service, in order to create effective plans to address and monitor infrastructure needs. Obtaining reliable and current data is a continuing challenge.

For the underserved areas of Molokai, Lanai and Hana, ongoing efforts by broadband providers should significantly increase speeds in the near future. Oceanic TWC currently provides broadband service for Molokai, Lanai and Hana utilizing microwave technology for interisland connectivity, but has been working to obtain fiber to these areas. Hawaiian Telcom deployed its DSL service to Lanai earlier this year and is also actively planning improvements to its DSL service to Molokai. With the acquisition of the interisland cables of Wavecom, which includes submarine fiber spurs from Maui to Lanai and to Molokai, Hawaiian Telcom is looking to further upgrade its infrastructure to Lanai and Molokai to provide higher bandwidth services and build a

more resilient network. In addition, UH, through its BTOP[83] grant, is actively working to provide improved broadband capability to Hana, Maui. This project may provide a roadmap for effective deployment for rural areas because its success may require deployment of a combination of technologies, agreement among private parties (Oceanic TWC, Hawaiian Telcom and Maui Electric Company), and the cooperative efforts of government at both the state and county levels. Given the difficulty of this project and the end date for the BTOP grant in 2013, work to better connect Hana may need to be completed outside the scope of the BTOP grant.

Although these islands and communities will likely see substantial service improvement in the near future, making that service available to individual residences is still a substantial undertaking as it is for other rural areas of the State. To better identify gaps in infrastructure, DCCA is working with PDC to further refine the SBI data on areas of the State where no residential broadband service is available. More aggressive efforts are planned to obtain detailed information and to verify availability in the rural areas of the State that may currently be labeled as "served" that in fact do not have access to broadband service or services at higher speeds.

Through verification efforts to date, PDC has made some refinements to the State coverage map for the State's planning purposes. For example, PDC has verified with providers reports of "no service" made by residents through the State's broadband mapping website. Such reports have been made by residents primarily on Hawaii Island.

Captain Cook, HI 96704:	Mamalahoa Hwy.
Hilo, HI 96720:	Kaiwiki Rd.; Hoaka Rd.; Kamaehu Rd.
Kula, HI 96790:	HC1
Kurtistown, HI 96760:	Opeapea Rd.; Huina Rd.
Mountain View, HI 96749:	Punawai Ave. (Eden Roc) St.; A O Rd. (Rd. 2); Pikake St. Fern Acres; Uhini Ana Rd.; Palainui Ave.; North Kulani Rd.
Ninole, HI 96773:	Mamalahoa Hwy.
Pahoa, HI 96778:	Lanai St.; Mapuana Ave.; Kapoho farm lots,
Volcano, HI 96785:	Ho'olehua Rd; Huakai St.; Elepaio; Mokuna St.
Waipahu, HI 96797:	Loaa St.

Adding reported information to the most current SBI Data mapped at the 768 kbps download threshold speed, the following maps were created that reflect the census blocks of each island that do not have wireline broadband service at that threshold speed: As explained above, however, these maps will generally not reflect areas without broadband service that are located within a partially served census block.

[83] The Broadband Technology Opportunities Program (BTOP), administered by the NTIA, was funded with $4.7 billion by the ARRA to, among other things, support the deployment of broadband infrastructure to connect "community anchor institutions" such as schools, libraries, hospitals, and public safety facilities. http://www2.ntia.doc.gov/about.

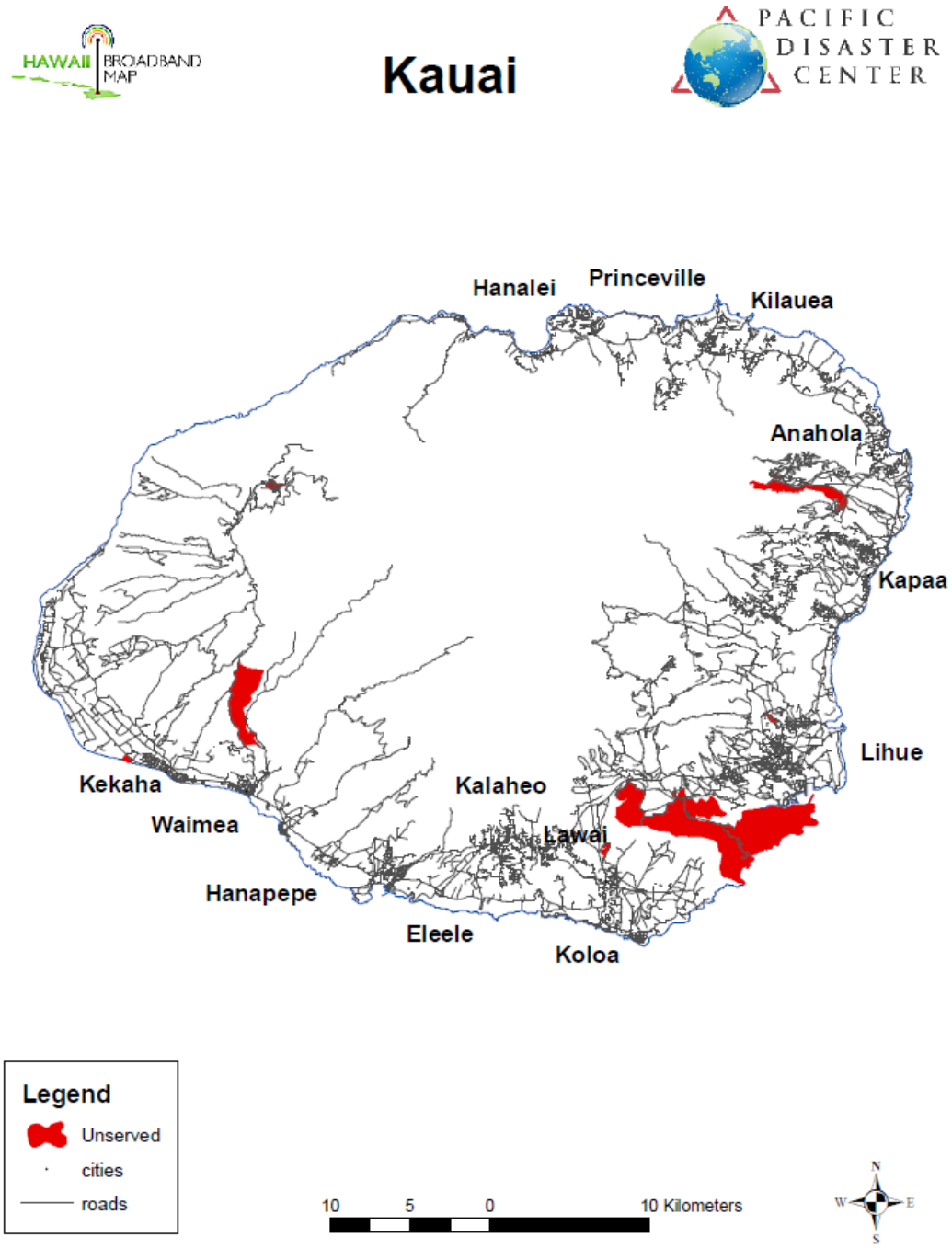

Figure II.4. Kauai Unserved Areas

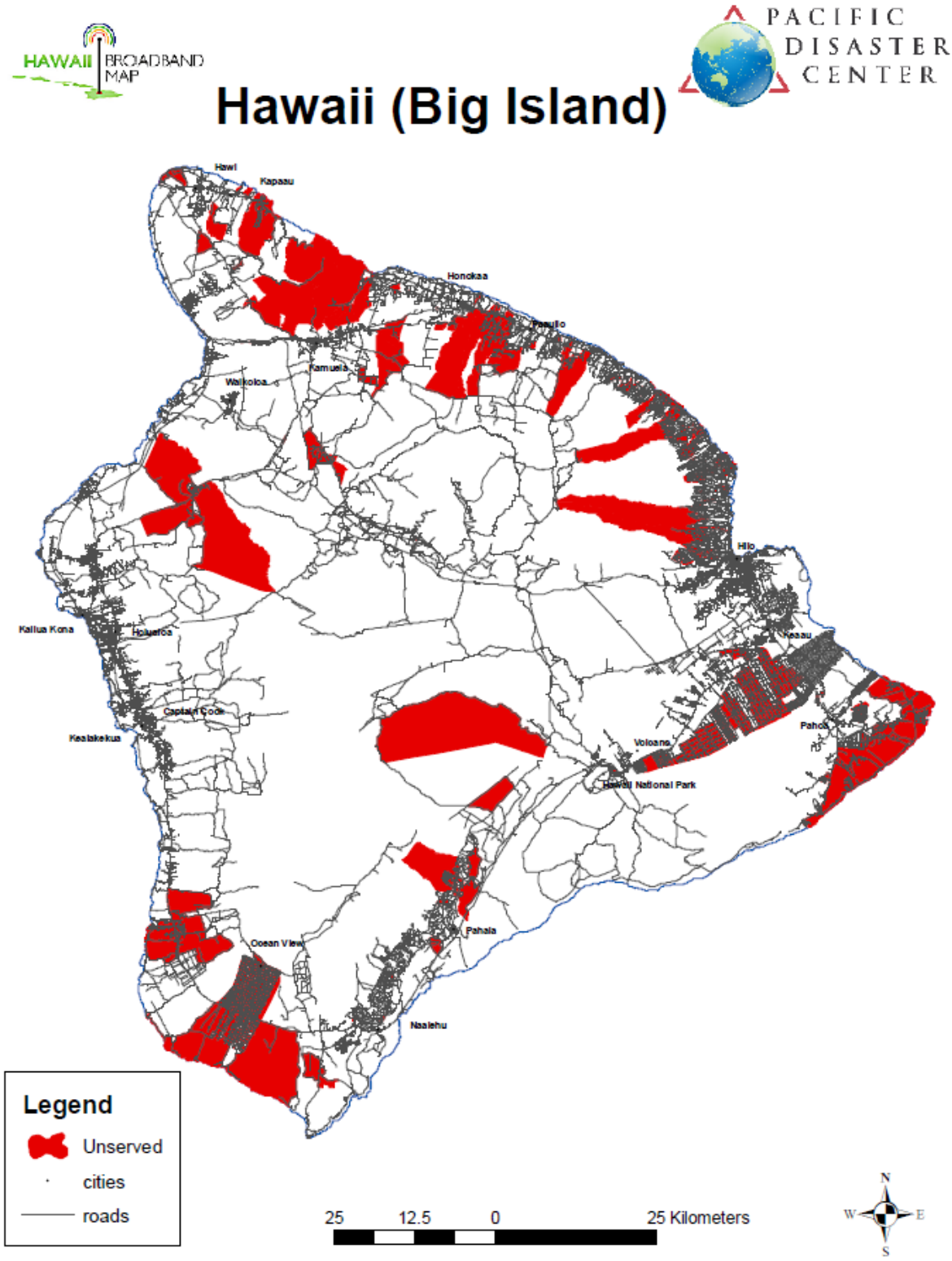

Figure II.5. Hawaii Island Unserved Areas

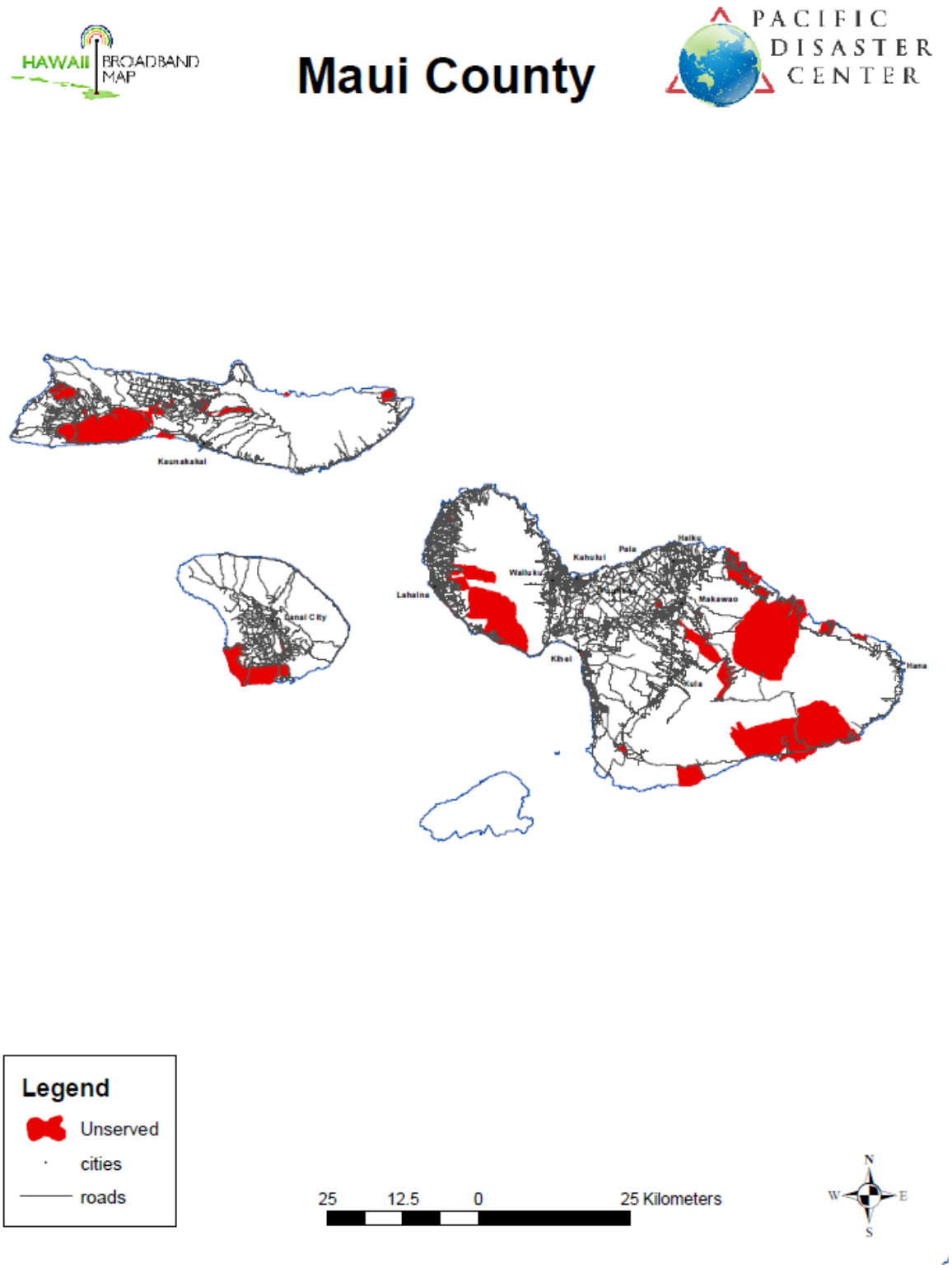

Figure II.6. Maui County Unserved Areas

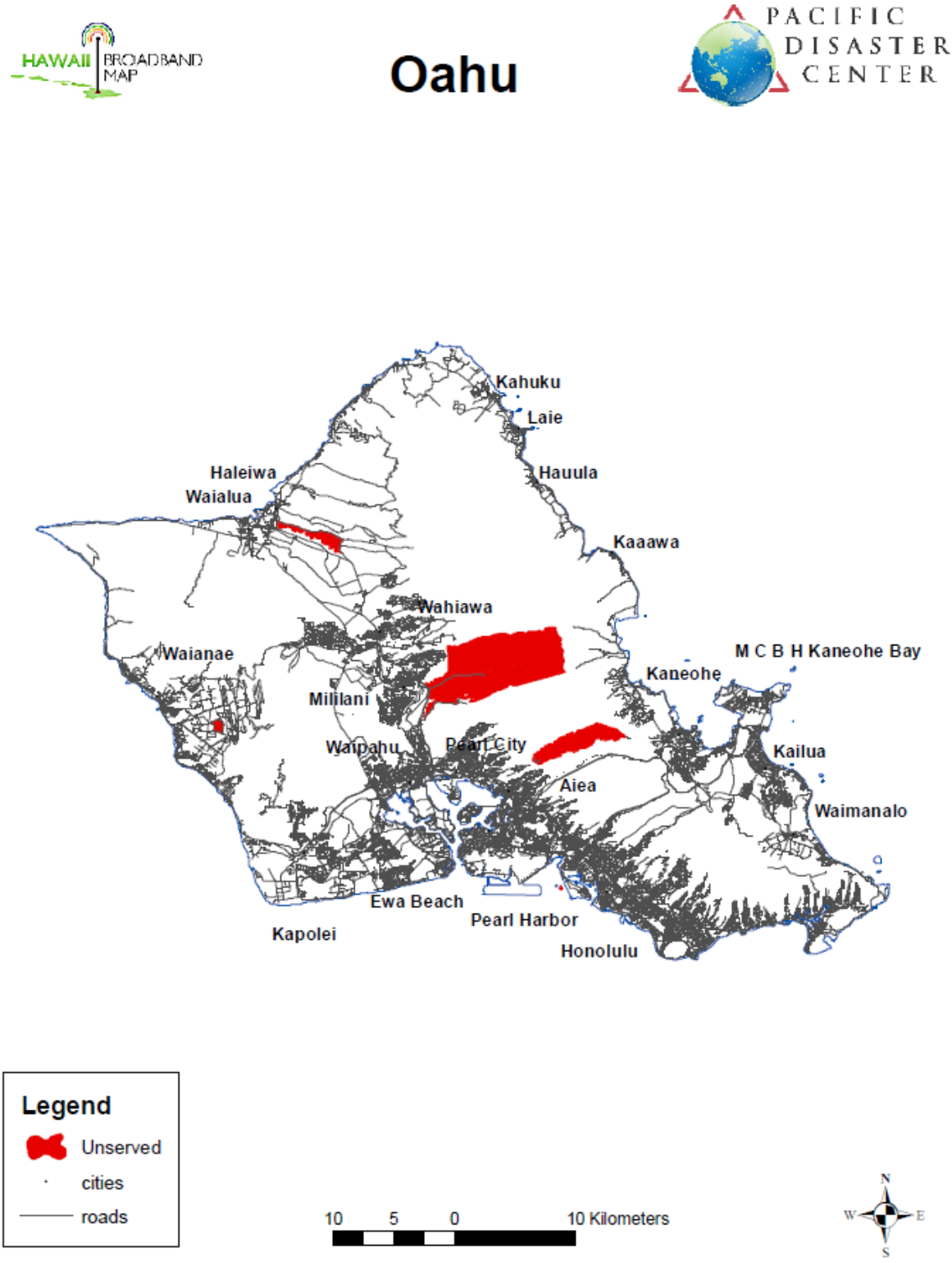

Figure II.7. Oahu Unserved Areas

(d) Broadband Performance in the State - Speed Test Data

DCCA's SBI grant activities included the creation of a speed test to measure the availability and performance of broadband across the State. In January of 2012, a dedicated Hawaii Speed Test website[84] was officially launched as part of HBI, and a media campaign launched to increase awareness of, and participation in, the speed test. The speed test allows Internet users to determine their Internet speed, and in the process provides the State with benchmark data on its broadband coverage.[85] The benchmark data collected will, among other things, allow the State to measure improvements in statewide coverage and speeds and consumer use patterns.

To provide a consistent indication of performance for connections outside the State in order to measure the State's progress, all tests are routed to the same test target site located in Texas. This is based upon the assumption that routing tests out of state, rather than to an in-state server, provides more representative results of typical end-user Internet usage that may be more useful to determining the State's capacity to connect with the rest of the world.[86] The difference in where a test is routed (e.g., across town[87] versus beyond Hawaii) may account for the substantial disparity consumers may see in speed test results using different test sites. It is acknowledged, however, that results from any speed test taken is affected by many network conditions and variables, including end-user hardware, network congestion, time-of-day and day-of-week variabilities, and internal network factors such as cabling and router configurations. Despite these limitations, the speed test results do provide useful indicators of speeds and an independent source of broadband performance data.

The following table shows speed test data for a total of 20,128 tests performed from wired networks from January 25 through May 25, 2012. The speed test allows the identification of IP addresses and IP locations from which tests are initiated, but does not identify the physical location of the device used to take the test. The tests taken reflect a statewide average speed for wireline networks during that period of 4.85 Mbps downstream and 1.33 Mbps upstream. This downstream average of 4.85 Mbps is in line with the 5.418 Mbps estimate independently reported for Q1 2012 by Akamai, an Internet content delivery firm.[88]

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[84] http://www.hawaiispeedtest.net.

[85] Office of the Governor of the State of Hawaii; 31 Jan. 2012; Press Release: State Launches Internet Speed Test Site: Participant Will Aid in Hawaii's Broadband Initiative, *available at* http://hawaii.gov/gov/newsroom/press-releases/state-launches-internet-speed-test-site.

[86] There are many situations in which Internet traffic does not need to go out of state because of the more and more prevalent use of caching of data in-state, i.e., the temporary storage of frequently-used data in-state to speed access.

[87] This is referred to as a "local loop."

[88] http://www.akamai.com/stateoftheinternet/.

Location	Number of Tests Performed	Wireline (Fixed Terrestrial)	
		Average Dn (Mbps)	Average Up (Mbps)
Island of Kauai	682	5.14	0.97
Island of Oahu	14,965	6.26	1.04
Island of Maui	1,836	4.01	0.84
Island of Molokai	383	2.95	0.36
Island of Lanai	23	6.95	4.01
Island of Hawaii	2,239	4.33	1.10
Statewide (mean)	**20,128**	**4.85**	**1.33**

The following two tables show the number of cable wireline broadband tests taken and speed averages by island for business lines and for residential lines:

Location	Number of Tests Performed	Cable Modem (Business Only)	
		Average Dn (Mbps)	Average Up (Mbps)
Island of Kauai	12	4.98	0.98
Island of Oahu	264	5.13	1.00
Island of Maui	45	4.25	0.93
Island of Molokai	0	-	-
Island of Lanai	0	-	-
Island of Hawaii	182	4.77	0.93
Statewide (mean)	**503**	**4.92**	**0.97**

Location	Number of Tests Performed	Cable Modem (Residential Only)	
		Average Dn (Mbps)	Average Up (Mbps)
Island of Kauai	435	5.59	0.92
Island of Oahu	5,610	6.58	1.05
Island of Maui	584	5.56	0.96
Island of Molokai	330	2.21	0.35
Island of Lanai	0	-	-
Island of Hawaii	948	6.39	0.99
Statewide (mean)	**7,907**	**6.24**	**1.00**

The following table shows the number of DSL wireline broadband tests taken and speed averages by island:

Location	Number of Tests Performed	DSL	
		Average Dn (Mbps)	Average Up (Mbps)
Island of Kauai	196	3.37	0.66
Island of Oahu	4,215	4.71	0.76
Island of Maui	749	3.19	0.69
Island of Molokai	0	-	-
Island of Lanai	0	-	-
Island of Hawaii	887	2.17	0.56
Statewide (mean)	**6,047**	**4.11**	**0.72**

The following table reflects **all** wireline tests taken that fall within the designated speed tiers:

All Wireline Download Speed		Count	Percent of Tests Taken
< 768 Kbps		1,470	7.30%
>= 768 Kbps	< 1.5 Mbps	2,844	14.13%
>= 1.5 Mbps	< 3.0 Mbps	3,901	19.38%
>= 3.0 Mbps	< 5.0 Mbps	3,583	17.80%
>= 5.0 Mbps	< 7.0 Mbps	4,190	20.82%
>= 7.0 Mbps	< 10.0 Mbps	2,764	13.73%
>= 10.0 Mbps		1,376	6.84%
>= 15.0 Mbps		660	3.28%
>= 25.0 Mbps		191	0.95%
>= 50.0 Mbps		1	0.00%
>= 100.0 Mbps		1	0.00%

As shown by this table, approximately sixty-three percent (63%) of the wireline tests taken to date reflect speeds of 3 Mbps or greater. This percentage is relatively consistent with the report from Akamai for Q1 2012, which indicates that 55% of Hawaii connections are at 4 Mbps or faster. Results and detail on the location of the speed tests taken are attached to this Plan as Appendix C. The State continues to promote the speed test to collect additional data.

(e) Comparative Broadband Speeds and Pricing

Comparative pricing with selected cities around the world reflects that the cost for broadband in Hawaii is very high for the speed of service received. A recent report from the New America Foundation[89] provides survey price data for broadband services in 22 cities around the world. For comparison purposes, the survey chose a price point for broadband services within the budget of most consumers of $35 per month (adjusted for purchasing power parity), and then looked at the type of service available for that price in those cities.

The following chart provides a comparison of Hawaii rates and service to select cities included in the report around the $35 per month price point.[90]

City	Service Provider	Price/Month	Max. Download Speed (Mbps)
Honolulu	Hawaiian Telcom	$38[91]	15
Honolulu	Oceanic TWC	$32	3[92]
Amsterdam	Tele2	$38	50
Copenhagen	ComX	$38	40
Hong Kong	3 in HK	$38	500
Paris	Free	$35[93]	100
San Francisco	Webpass	$38	200
Seoul	LGplus	$32[94]	100
Toronto	Ananac	$33	28

It is notable that gigabit downstream speed is available in some areas of the U.S. The most widely known gigabit project is the Google Fiber project[95] in Kansas City, Kansas and Missouri. Unbundled gigabit Internet service is available in select areas of that city for $70 per month. The EPB Fi-Speed Internet[96] service in Chattanooga, Tennessee also provides gigabit service in its area for $300 per month.

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89 *The Cost of Connectivity*, *available at* http://newamerica.net/publications/policy/the_cost_of_connectivity.

90 *Id*.

91 This price is for unbundled service.

92 Oceanic TWC offers unbundled service with downstream speeds of up to 15 Mbps for $50/month.

93 This price includes Internet access, telephone service, and television service.

94 This price includes Internet access, telephone service, and television service.

95 https://fiber.google.com/about/.

96 https://epbfi.com/enroll/packages/#/fi-speed-internet-100.

C. Home Broadband Adoption

Based upon subscriber account numbers and other available information, it is estimated that statewide home broadband adoption is around 75% of all households. As with availability estimates, accurate estimates of statewide adoption are difficult because of restrictions on the public disclosure of certain subscriber data, such as the FCC's restriction on disclosure of provider subscriber data it receives where the data cannot be sufficiently aggregated to ensure the confidentiality of individual provider data. However, the State's largest residential providers, Oceanic TWC and Hawaiian Telcom have shared their business and residential subscriber account numbers aggregated at the state level. An accurate estimate of residential adoption cannot be accurately made, however, because Oceanic TWC does not maintain separate counts for residential and business accounts.

Non-adoption of broadband in the home must be addressed to eliminate any "digital divide" and to ensure that all of the State's citizens have access to the benefits ubiquitous high speed broadband affords. Home broadband adoption is also a critical component in driving broadband deployment, both in terms of the number of households that use broadband services and the level of service to which they subscribe.

1. Estimates of Adoption

A reasonable estimate of State broadband adoption is roughly between 70-80%, with home broadband adoption falling within the middle of that range. This estimate is based upon the following available information, each subject to some qualification: (1) Oceanic TWC information and estimate (70-80% adoption rate); (2) Oceanic TWC and Hawaiian Telcom high speed Internet subscriber accounts of 393,800; (3) FCC estimate based upon FCC Form 477 Data (75% adoption rate); and (3) NTIA estimate based upon census survey data (69% adoption rate).

(a) State Broadband Provider Information

Both Oceanic TWC and Hawaiian Telcom have provided statewide subscriber information.[97] Hawaiian Telcom reports subscriber accounts of 105,800,[98] with approximately 80% of those

[97] For proprietary reasons, Oceanic TWC chooses not to publicly disclose its subscriber numbers for each county.

[98] On November 8, 2012, Hawaiian Telcom reported 105,800 high speed Internet business and residential subscribers, a 3.8% increase over the previous year, *available at* http://www.hawaiiantel.com/Portals/1/Hawaiian%20Telcom%20Reports%20Third%20Quarter%202012%20Results.

being residential accounts. Based upon Hawaiian Telcom's reported subscriber numbers and Oceanic TWC's Internet subscriber accounts of 288,000,[99] Oceanic TWC has estimated broadband adoption statewide at approximately 70-80% of businesses and households.[100] Because residential broadband subscribers constitute a much higher proportion of Oceanic TWC's subscribers,[101] home broadband penetration may reasonably be estimated to be in the middle of this range.

(b) FCC Estimate Based Upon Form 477 Data

Every six months, broadband providers must submit certain subscriber data to the FCC (the Form 477 Data). Specifically, facilities-based broadband providers (i.e., wireline providers) must report basic service information to the FCC that includes "by census tract, the total number of broadband subscribers, the proportion of subscribers that are residential subscribers, and the number of subscribers broken down by speed tier and technology."[102] Although this is likely the most detailed data made available by providers on home broadband adoption, the FCC maintains the confidentiality of individual provider data for proprietary reasons and only releases information to the extent that it can be aggregated to protect that confidentiality. The FCC has also acknowledged that its collection process at the census-track level can create significant errors in the accuracy of the data reported.[103]

Because Hawaii effectively has only two residential wireline providers, much of the data that is made publicly available for other states, and the FCC's analysis of that data, is withheld because the Hawaii data cannot be sufficiently aggregated to maintain individual provider confidentiality.[104] This includes Form 477 Data reflecting the actual numbers of residential fixed connections by census tract, and the FCC's estimation of adoption based upon that data, which

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[99] There are other Internet providers in the State. However, most of these providers offer only business Internet and their subscriber numbers would likely not significantly affect estimates of statewide broadband penetration. These other providers include tw telecom, Tri-net Solutions, Hawaii Dalogix Telecom, and UH.

[100] To calculate this percentage, Oceanic TWC used the total number of residential and business addresses in its database (cable passings), minus the number of vacant housing units (64,170) reported in the 2010 census data. It should be noted that Oceanic TWC's database of cable passings was not structured for purposes of accurately determining household adoption rates, and therefore may understate or overstate the total number of businesses or households.

[101] Oceanic TWC has stated that precise estimation is difficult given various factors relating to its systems.

[102] Seventh Broadband Progress Report ¶ 28.

[103] *Id*. ¶ 29.

[104] As noted above, the State has other wireline providers, but their subscriber numbers are not numerically significant enough to allow sufficient aggregation of data.

is released for most other states at the state level.[105] The FCC, thus, has not released its estimate of home broadband adoption for Hawaii.

An estimate was made for Hawaii, however, by the Investigative Reporting Workshop at the American University School of Communication, based upon its study of broadband connection for all fifty states using publicly available Form 477 Data.[106] In a recent, widely circulated online article reporting on its study, the Workshop ranked Hawaii the most connected state in the nation, estimating Hawaii's home broadband adoption rate at 74%.[107]

For Hawaii, the publicly available subscriber data used consisted of county and census tract specific subscribership data in five broad category ranges: no broadband connections; 0 - 20% of households have broadband connections; 20 - 40% of households have broadband connections; 40 - 60% of households have broadband connections; 60 - 80% of households have broadband connections; 80+% of households have broadband connections.[108]

(c) NTIA - U.S. Census Bureau CPS Survey Estimate

In February 2011, the NTIA issued a report entitled "Digital Nation Expanding Internet Usage" (the NTIA 2011 Report).[109] The report is based upon data collected through December 2010 in the U.S. Census Bureau's 2010 Current Population Survey (CPS) on broadband Internet adoption among Americans, particularly at home.[110] The report, among other things, examined adoption variations by demographic groups and geographic areas, and the major reasons Americans do not access broadband Internet at home.

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[105] *See* Seventh Broadband Progress Report Apps. C-F; *see also* Federal Communications Commission, Wireline Competition Bureau, June 2012, *Internet Access Services: Status as of June 30, 2011* (IAS Report), Table 15 & 16.

[106] Broadband connection was measured at the 768 kbps/ 200 kbps standard.

[107] Dunbar, John; 23 Mar. 2012; *Connected: The Media and Broadband Project – Poverty Stretches the Digital Divide*; American University School of Administration: Investigative Reporting Workshop, *available at* http://investigativereportingworkshop.org/investigations/broadband-adoption/story/poverty-stretches-digital-divide/.

[108] A full description of the methodology used may be found at: http://investigativereportingworkshop.org/investigations/broadband-adoption/story/methodology-broadband/. The source data used was aggregated from the FCC, U.S. Census Bureau, and USDA, *available at* http://investigativereportingworkshop.org/investigations/broadband-adoption/story/data-broadband-files/.

[109] U.S. Department of Commerce: National Telecommunications and Information Administration *Digital Nation: Expanding Internet Usage: NTIA Research Preview*; U.S. Department of Commerce (Feb. 2011) (NTIA 2011 Report), *available at* http://www.ntia.doc.gov/report/2011/digital-nation-expanding-internet-usage-ntia-research-preview.

[110] A special Internet Use Supplement survey, which is wholly or partially funded by the NTIA, was attached to the CPS, surveying fifty-four thousand (54,000) households. NTIA 2011 Report at 6 & n.7.

The NTIA 2011 Report also reviewed broadband use among the states.[111] For Hawaii, the report estimated that the percentage of households using broadband in the home was approximately 69%.[112] This rate is consistent with the nationwide broadband adoption rate, which the report estimated to be 68.2% of households as of October 2010. The following table included in the report reflects estimated home broadband usage by state:

Households Using Broadband in the Home by State, 2010

State	% w/ Broadband Internet	90% Confidence Interval Upper Bound	90% Confidence Interval Lower Bound	State	% w/ Broadband Internet	90% Confidence Interval Upper Bound	90% Confidence Interval Lower Bound
Utah	79.7	81.9	77.6	Illinois	68.7	70.3	67.2
New Hampshire	77.8	80.3	75.3	Georgia	68.6	70.4	66.8
Washington	76.7	78.6	74.8	Delaware	68.4	71.1	65.7
Massachusetts	75.9	77.9	73.9	Iowa	67.5	70.2	64.8
Connecticut	74.8	77.3	72.3	Maine	67.4	70.3	64.5
Oregon	74.7	77.2	72.2	Pennsylvania	67.4	69.0	65.8
Kansas	74.6	77.1	72.1	Texas	66.8	68.0	65.6
Nevada	74.2	76.7	71.7	Michigan	66.3	68.1	64.5
Arizona	74.2	76.3	72.1	South Dakota	65.5	68.0	63.0
Maryland	74.1	76.4	71.9	North Carolina	65.1	67.0	63.2
Alaska	73.4	76.0	70.8	Missouri	64.3	66.7	62.0
New Jersey	73.3	75.2	71.4	Ohio	63.9	65.6	62.2
California	73.1	74.0	72.2	Oklahoma	62.5	65.2	59.8
Wyoming	72.9	75.5	70.3	Montana	61.4	64.0	58.8
Idaho	72.0	74.5	69.5	Louisiana	60.5	63.2	57.8
District of Columbia	71.7	74.2	69.2	South Carolina	59.5	62.2	56.8
Colorado	71.6	74.0	69.2	Tennessee	59.5	61.8	57.2
North Dakota	70.9	73.4	68.4	West Virginia	59.1	61.7	56.5
Rhode Island	70.7	73.4	68.0	Indiana	58.8	61.1	56.5
Minnesota	70.6	72.9	68.3	Kentucky	57.8	60.6	55.0
Wisconsin	70.5	72.8	68.3	New Mexico	57.7	60.5	54.9
Florida	70.2	71.4	69.0	Alabama	55.5	58.2	52.9
Virginia	69.5	71.5	67.5	Arkansas	52.4	55.1	49.7
Vermont	69.2	72.0	66.4	Mississippi	51.7	54.5	48.9
Hawaii	69.2	71.9	66.5	**Note:** States are ordered by estimated household broadband usage rate for ease of understanding and not as a ranking. Rates should be understood in the context of their associated confidence intervals.			
New York	69.0	70.3	67.7				
Nebraska	68.9	71.6	66.2				

Figure II.8. NTIA 2011 Report: Home Broadband Adoption by State

In summary, based upon available information on adoption and the various estimates discussed above, it appears reasonable to estimate that approximately 25% of households in Hawaii do

[111] The 2010 (CPS) used a less stringent definition of broadband, finding that a household with at least one of the following Internet access services had broadband: DSL, cable modem, fiber optics, mobile broadband plan for a computer or a cell phone, satellite, or 'come other service.'" NTIA 2011 Report at n.1.

[112] *Id*. at 17, Fig. 11; *see also Exploring the Digital Nation Computer and Internet Usage at Home*, prepared by the NTIA and the Economics and Statistics Administration, U.S. Department of Commerce (Nov. 2011) (augmenting the NTIA 2011 Report), *available at* http://www.ntia.doc.gov/files/ntia/publications/exploring_the_digital_nation_computer_and_internet_use_at_home_11092011.pdf.

not access broadband Internet via wireline services at home. Consistent with the national trend, it also appears that the number of non-adopting households in the State continues to decline: Both Oceanic TWC and Hawaiian Telcom have recently experienced year-over-year growth of around 4-5% of their subscriber base.[113] Discussions of the BAAC Adoption Work Group have lead to plans to collect adoption data through a survey process as well as through an outreach program to interview individuals on topics such as their broadband usage and their awareness of broadband applications. The intent of these activities is to collect data that can be used to design programs to (1) encourage non-adopters to adopt broadband services; and (2) encourage and promote higher usage at faster speeds.

(d) Speeds Used by Subscribers

Broadband adoption in a region can be measured using different metrics. One metric, discussed above, is the percentage of eligible households and businesses that subscribe to broadband service. Another metric used is the speed of service that is being utilized by those subscribers. Internet content delivery firm, Akamai, currently collects and reports data on nationwide adoption of broadband at two speed tiers: 4 Mbps or faster and 10 Mbps or faster.[114] As shown on the table and graph below, Akamai's data indicates that approximately 60% of Hawaii Internet connections are at 4 Mbps or faster, which is slightly above the U.S. average of 57% of all U.S. Internet connections at that same speed. Several other states and South Korea are also included below for comparison purposes.

	High Adoption (>10 Mbps)	Adoption (>4 Mbps)	Connection Speed Mbps	Ave. Peak Connection Speed
HI	6.60%	60.20%	5.769	29.746
CA	17.30%	57.90%	7.217	29.696
RI	28.70%	82.00%	8.986	33.6
TX	9.90%	48.50%	5.443	23.372
WA	24.20%	69.20%	8.278	32.724
WI	12.60%	60.30%	6.762	26.4
US	15.50%	57.30%	6.614	27.108
S. Korea	48.60%	83.60%	14.207	46.896

[113] This statement is based upon representation by Oceanic TWC, and by Hawaiian Telcom's reporting of its Third Quarter 2012 results, *available at* http://www.hawaiiantel.com/Portals/1/Hawaiian%20Telcom%20Reports%20Third%20Quarter%202012%20Results.pdf.

[114] http://www.akamai.com/stateoftheinternet/; *see* https://blogs.akamai.com/2011/11/the-future-internet.html (general discussion of methodology).

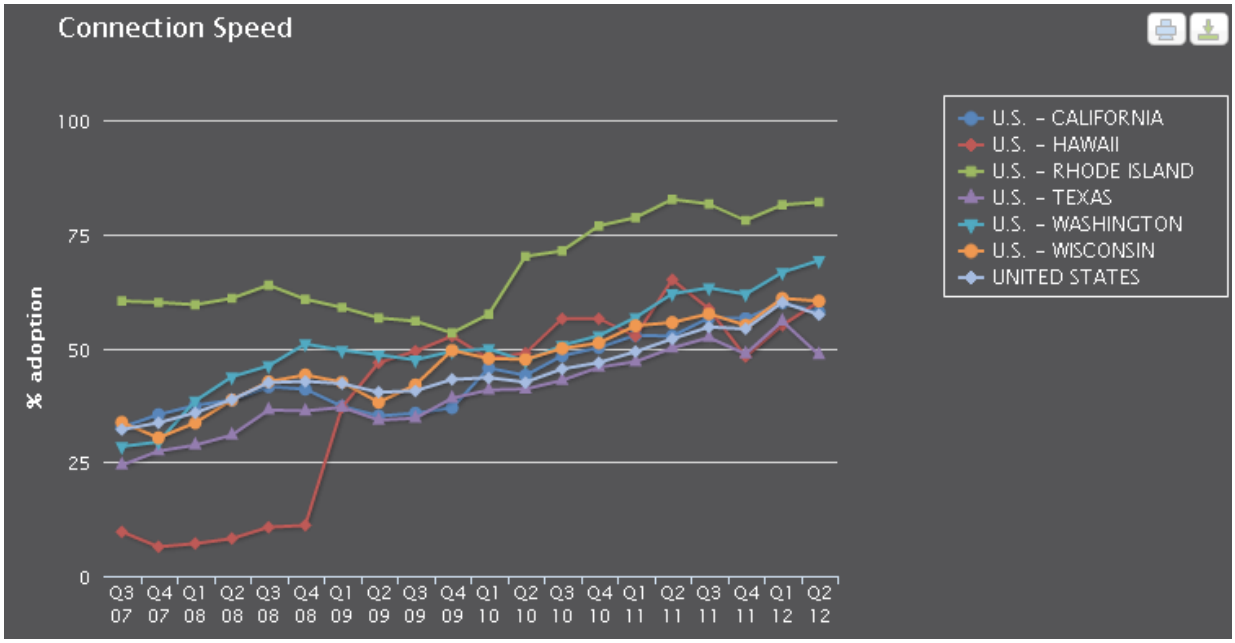

Figure II.9. Akamai – Broadband Adoption at 4 Mbps or Faster

Although Hawaii's broadband access at the 4 Mbps level is near the U.S. average, its adoption at the 10 Mbps level is quite different. Hawaii's adoption rate at the 10 Mbps level of service is 6%, which is less than half of the 15% U.S. adoption rate as a whole, and as shown in the graph below, significantly lower than states such as California (17%), Rhode Island (28%), and Washington (24%). Hawaii, and the U.S. as a whole, lags even farther behind the 48% adoption level by South Korea.

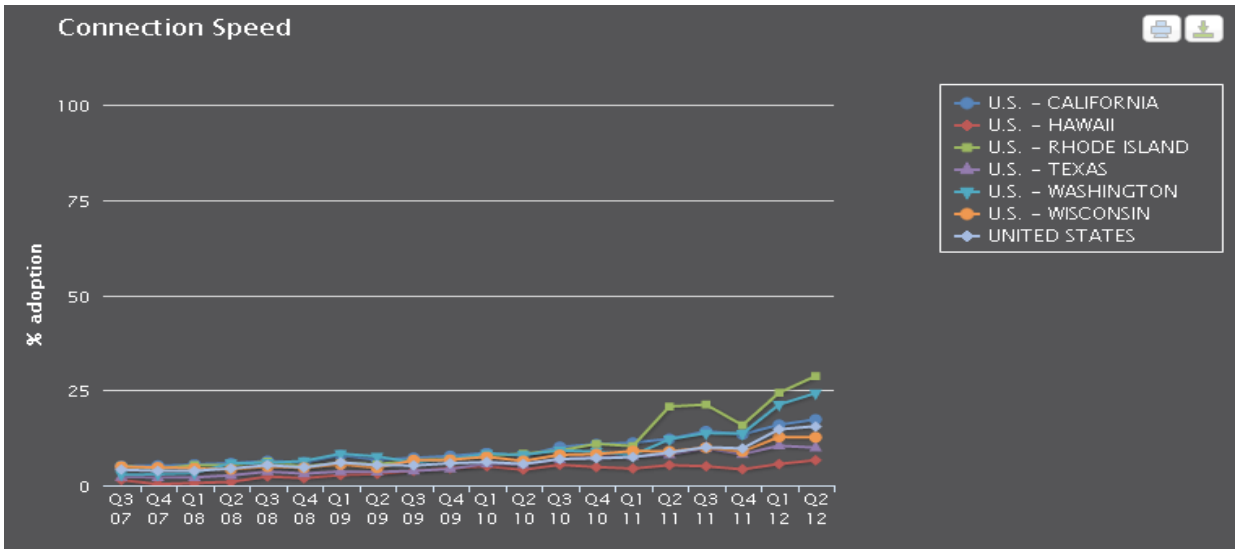

Figure II.10. Akamai - Broadband Adoption at 10 Mbps or faster

As shown below, Akamai's data indicates that Hawaii has an average broadband connection speed of 5.7 Mbps, which is lower than the national average of 6.6 Mbps, and significantly lower than states such as California (7.2 Mbps), Rhode Island (8.9 Mbps), and Washington (8.2 Mbps). And again, the U.S. pales in comparison to South Korea, which has an average connection speed of 14 Mbps.

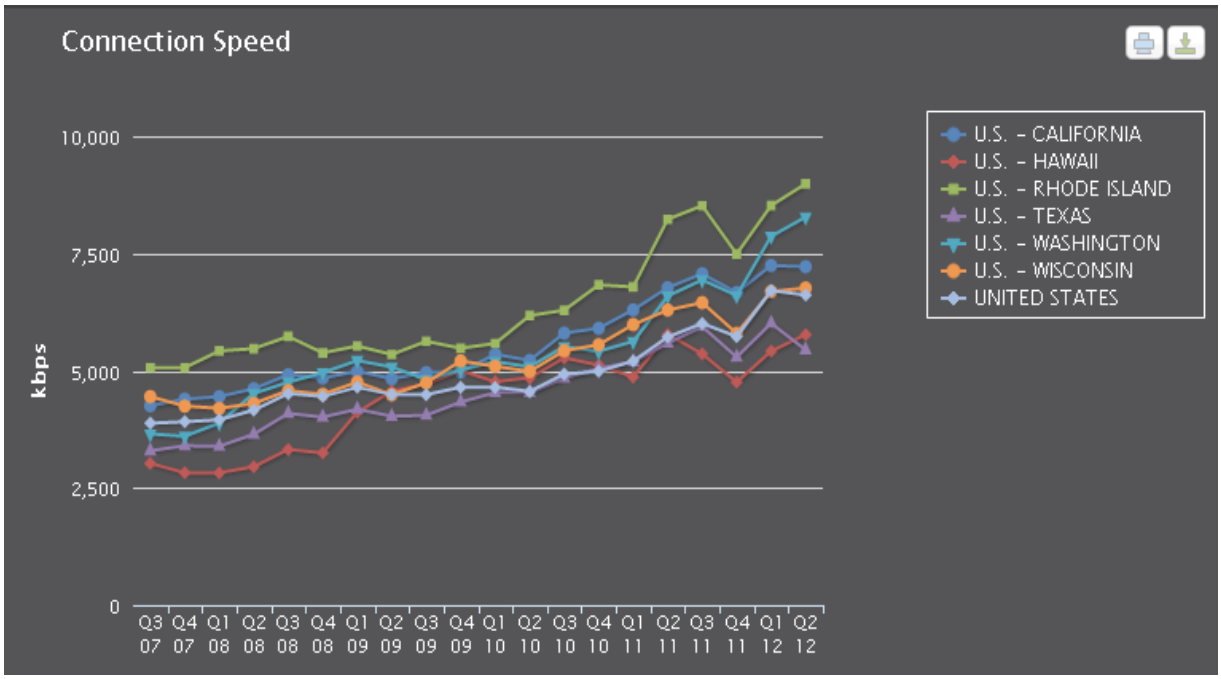

Figure II.11. Akamai - Average Broadband Connection Speeds by State

Consistent with statements made by providers in Hawaii, the Akamai data appears to reflect that, although higher speeds are available to most subscribers statewide, most subscribers have opted for lower speed levels. Thus, while broadband and adoption in Hawaii is considered high, important broadband metrics such as higher speed adoption rates and average connection speed do not compare well with other U.S. states or a country such as South Korea, which is at the forefront. Broadband providers have stated that subscriptions in Hawaii for higher speed services (20 Mbps+) are low, therefore providing little business incentive for providers to develop infrastructure for even higher speed broadband services.

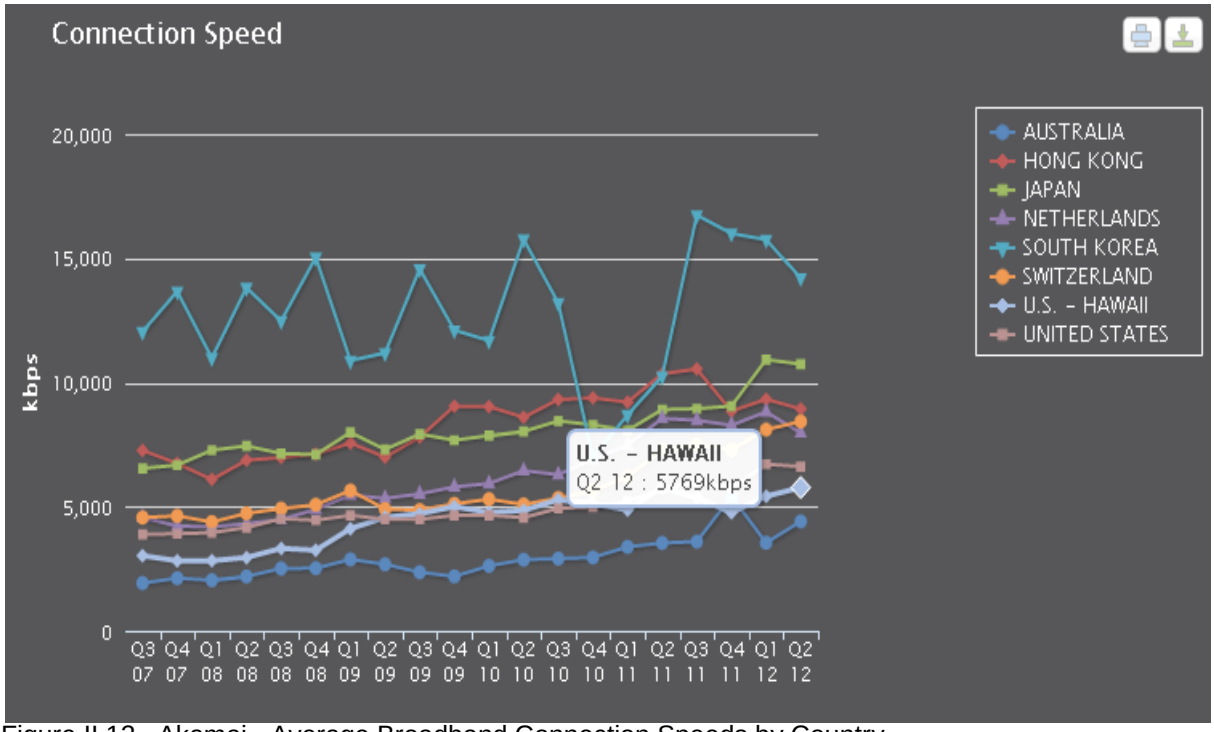

Figure II.12. Akamai - Average Broadband Connection Speeds by Country

2. Understanding Non-Adoption of Home Broadband

The NTIA 2011 Report found that the "nationwide trend toward increased adoption of broadband Internet connections is observable among virtually all demographic groups, with year-over-year growth present almost universally."[115] However, the report also concluded that, although non-adoption rates continue to drop to less than one third of the nation, "too many people with low incomes, less education, or disabilities, as well as unemployed individuals or seniors, certain minorities, and non-family households, are on the wrong side of the divide."[116] For policymakers, non-adoption of broadband in the home must be given special attention to ensure that no citizens are, because of their circumstances, left behind.[117]

Households surveyed in the 2010 CPS for the NTIA 2011 Report, which included Hawaii,[118] gave the following reasons for non-adoption of home broadband:[119]

Don't Need/Not Interested	45.6%
Too Expensive	25.3%
No/Inadequate Computer	14.2%
Not Available	3.1%
Can Use Elsewhere	4.9%
Other	6.9%

Notably, the Report found that the top ranked reason for non-adoption across all socioeconomic measures generally was "don't need/not interested."[120] Thus, a substantial percentage of households apparently do not have home broadband by choice. Strategic plans must encompass these potential adopters, in addition to those that do not adopt for socioeconomic reasons, to ensure equal access to the opportunities and quality of life that such access may afford. To provide additional insights for policymakers, the report disaggregated non-users into three subcategories: (1) households that do not use Internet anywhere; (2) households that do not have an Internet connection, but have users outside the home; and (3) households with only

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[115] NTIA 2011 Report at 8; *see also id*. at 28 (home broadband access increased almost 5 percentage points since 2009).

[116] *Id*. at 28.

[117] NTIA 2011 Report at 19.

[118] No publicly available survey on non-adoption of home broadband solely directed to Hawaii households has been located.

[119] NTIA 2011 Report at 20 & Fig. 14.

[120] *Id*. at 20-24.

a dial-up connection. The reasons for non-adoption for these groups are shown in the figures below.

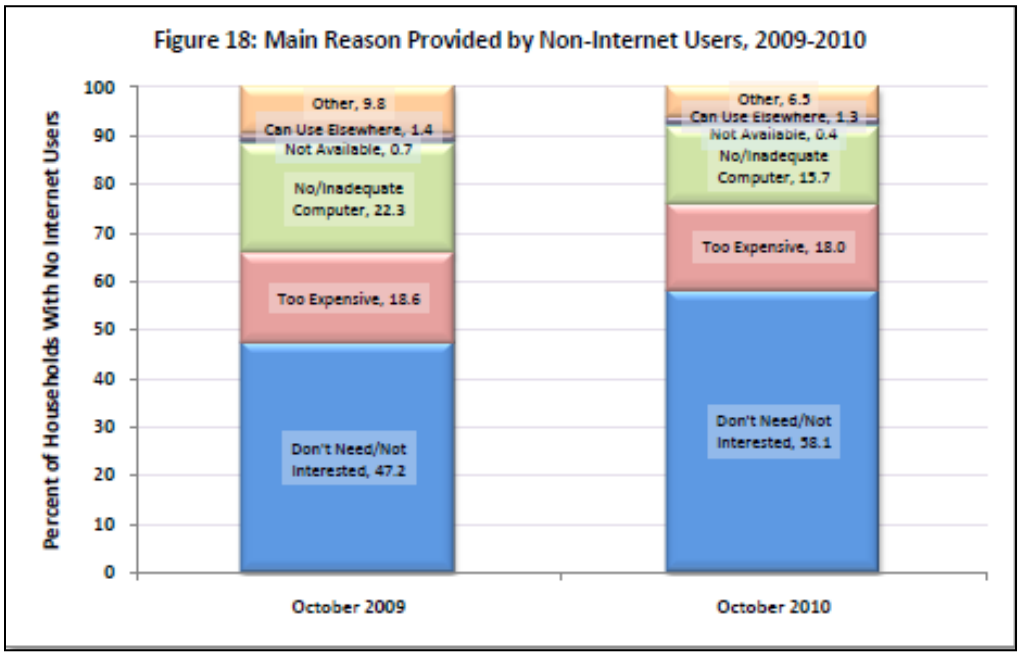


Figure II.13. NTIA 2011 Report Graph of Non-Internet Users Reasons for Non-Use

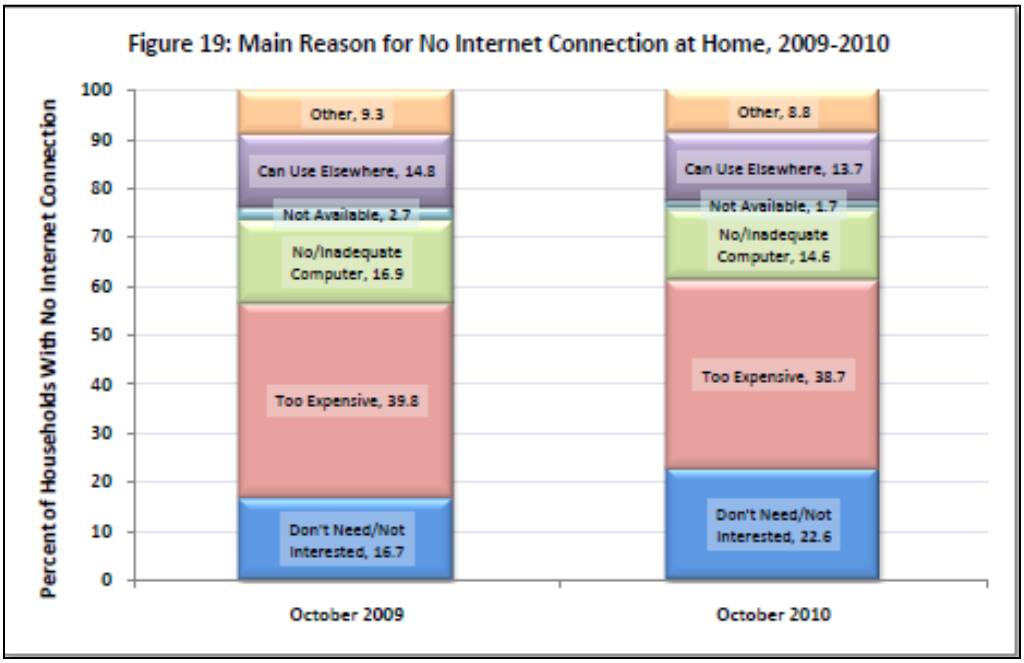


Figure II.14. NTIA 2011 Report Graph of Reasons for No Home Internet Connection

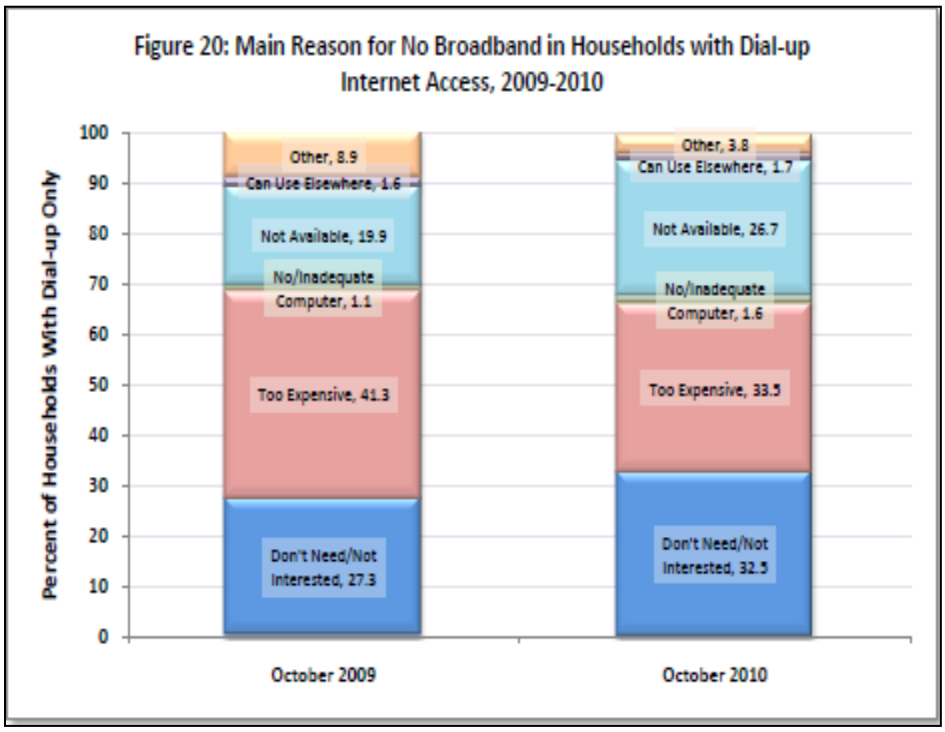


Figure II.15. NTIA 2011 Report Graph of Dial-Up Users Reasons for No Broadband

The NTIA 2011 Report also included discussion of the socio-economic factors that create adoption disparities, in general, and the most significant demographic differences for non-adoption, in particular.[121] This national data provides some useful insight in identifying target groups for adoption-related policies and programs. As may be expected, "[b]udgetary and equipment concerns appeared to be important deterrents to broadband adoption among low-income households[.]"[122] Although persons age fifty-five and older exhibited one of the largest growth rates (4.0 percentage points), they continued to have the lowest adoption rate at around

[121] The report analyzed use under the following socio-economic factors: (1) use by family income;.(2) use by education; (3) use by age; (4) use by race and ethnicity; (5) use by employment status; (6) use by household type; (7) use by gender; (8) use by disability status; and (9) use by location (urban vs. rural).

[122] *Id*. at 21.

fifty percent (50%). In summary, low adoption groups included households with the following socioeconomic traits:

- family income of less than fifty thousand dollars ($50,000)[123]
- less than some college education[124]
- unemployed or not in the labor force
- single parent or non-family households
- non-white or Asian households[125]
- disabilities
- over 55 years of age

Hawaii has the following socio-economic characteristics identified under the NTIA 2011 Report as indicators for low adoption rates:[126]

	State	Honolulu	Hawaii	Kauai	Maui		Lanai	Molokai
Age[127]								
% ≥55 years old	27.25%	26.54%	30.36%	30.12%	26.69%			
Income[128]								

[123] The survey showed usage by income levels as follows:

(1) 32.1% of households with income <$15,000 use broadband,
(2) 42.6% of households with income from $15,000-24,999 use broadband,
(3) 50.6% of households with income from $25,000-34,999 use broadband,
(4) 63.4% of households with income from $35,000-49,999 use broadband,
(5) 73.6% of households with income from $50,000-74,999 use broadband,
(6) 80.8% of households with income from $75,000-99,999 use broadband,
(7) 85.5% of households with income from $100,000-149,999 use broadband, and
(8) 89.6% of households with income >$150,000 use broadband.

[124] The survey showed usage by education level as follows:

(1) 15.2% of persons with 0-8 years of schooling use broadband in the home,
(2) 29.5% of persons with some high school education use broadband in the home,
(3) 51.4% of persons with a High School diploma use broadband in the home,
(4) 71.8% of persons with some college education use broadband in the home, and
(5) 84.2% of persons with at least a Bachelor's Degree use broadband in the home.

[125] The NTIA 2011 Report found that almost seventy percent (70%) of White Non-Hispanic and Asian households use broadband in the home. NTIA 2011 Report at 11.

[126] *See also* Eighth Broadband Progress Report ¶ 122.

[127] 2011 State of Hawaii Data Book, Department of Business, Economic Development & Tourism, State of Hawaii (2011 State of Hawaii Data Book) § 1.33, *available at* http://hawaii.gov/dbedt/info/economic/databook/db2011/.

	State	Honolulu	Hawaii	Kauai	Maui		Lanai	Molokai
<100% of Federal Poverty Level (FPL)	9.60%	8.80%	14.40%	8.80%	8.90%		2.90%	17.90%
Households receiving SNAP[129]	8.40%	7.60%	12.60%	8.50%	7.50%		11.80%	16.90%
Median household income[130]	$66,420	$70,093	$54,996	$62,531	$63,989			
Education								
% of adults without high school diploma, GED, or alternative[131]	10.10%	10.10%	9.08%	10.10%	10.70%			
% of adults without college experience[132]	31.05%							
% adults with bachelor's degree or higher	29.5%	31.9%	24.8%	20.2%	24.9%			
Ethnicity[133]								
White Non-Hispanic + Asian persons	64.5%	65.8%	57.1%	65.3%	65.2%			
Hispanic + non-White + non-Asian	35.5%	34.2%	42.9%	34.7%	34.8%			
Employment status[134]								
Unemployed	7.30%							
Not in labor force	36.45%							
Household Dynamics[135]								
Single parent households	11.00%	9.74%	13.86%	12.88%	14.37%			
Non-family households	31.06%	29.96%	33.82%	30.52%	34.18%			

[128] Department of Health (DOH) State of Hawaii Primary Care Needs Assessment Data Book 2012, *available at* http://hawaii.gov/health/doc/pcna2012databook.pdf.

[129] Supplemental Nutrition Assistance Program (named the Food Stamp Program until 2008). The terms "stamp" and "coupon" have been replaced by "card" or "EBT" (Electronic Benefit Transfer).

[130] U.S. Census Bureau, State & County QuickFacts, *available at* http://quickfacts.census.gov/qfd/states/15000.html.

[131] 2011 State of Hawaii Data Book § 3.04.

[132] *Id*. § 3.02.

[133] U.S. Census Bureau State & County QuickFacts.

[134] 2011 State of Hawaii Data Book § 12.04.

[135] *Id*. § 1.49.

Population growth in many areas of Hawaii designated as socio-economic high-risk profile areas was significant in the last decade, as shown in the population charts for each county in Section IV.F below. The following two maps reflect the socio-economic risk ranking for primary medical care service areas of the State by the Hawaii Department of Health, Family Health Services Division, and population statistics for those areas of residents living below 100% of the Federal Poverty Level by the Department of Health. A ranking of service areas of the State based upon the Department of Health's socio-economic risk index is attached as Appendix D.

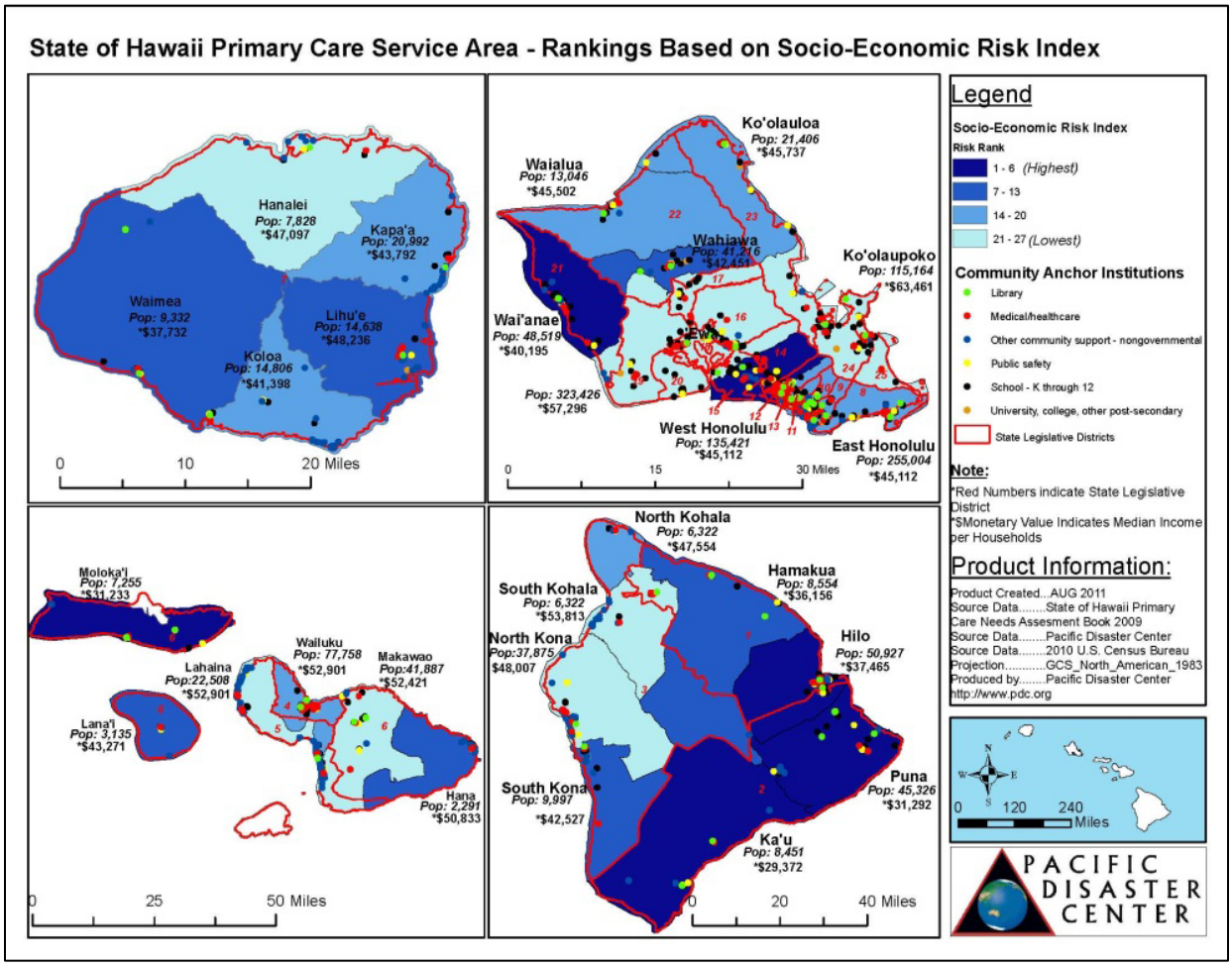


Figure II.16: Socio-Economic Risk Index by Primary Care Service Area

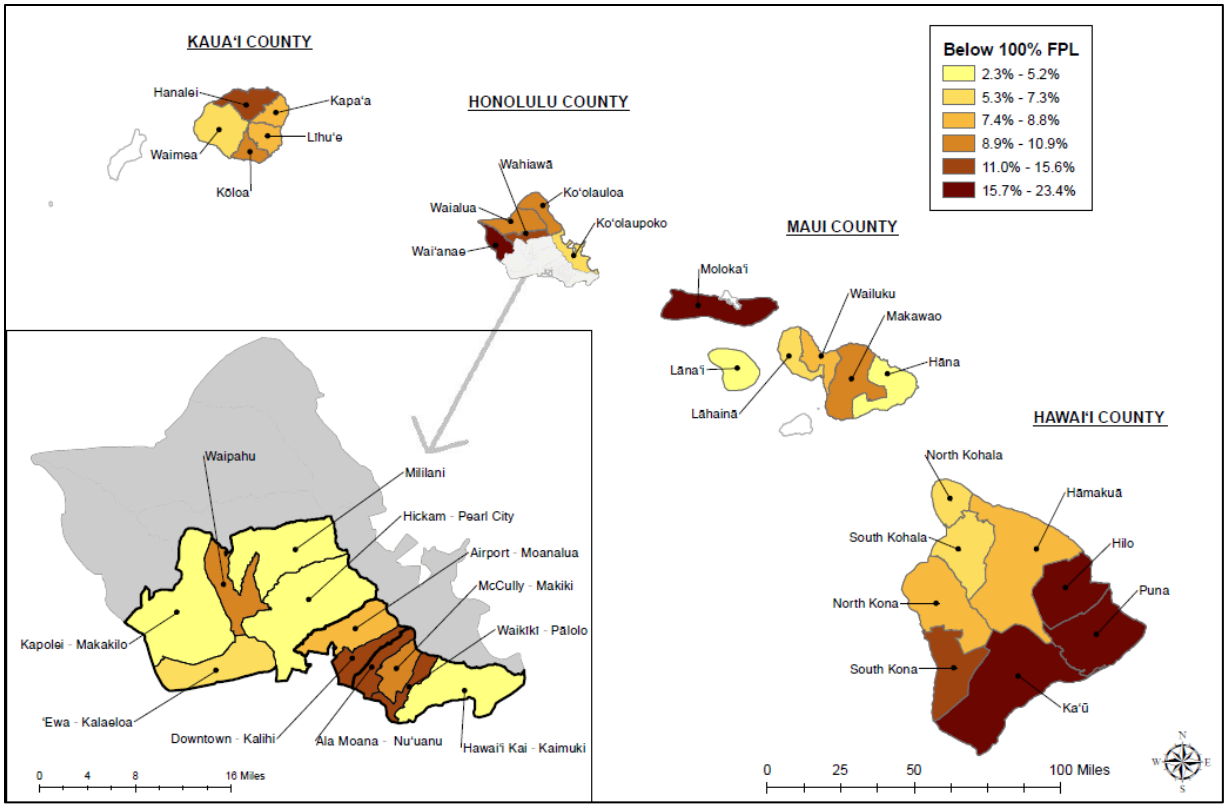


Figure II.17. Population Below 100% of Federal Poverty Level by Primary Care Service Area.[136]

As reflected above, there are small to moderate differences of adult educational attainment levels across the four major Hawaii counties and somewhat larger differences in median household income. The percentage of residents 25 or older, with a high school diploma, is similar for all four counties (88.3% to 90.5%). There is a more noticeable difference between the counties for attainment of a college degree, ranging from 22.7% of residents (less than one in four residents) to 31.1% (nearly one third of residents). There is a relatively large variance in median household income between the counties ranging from a low of $55K to a high of $70K. Although the median income for Hawaii residents may appear high relative to other states, this median must be weighted because of Hawaii's high cost of living, which makes it consistently rank as one of the most expensive states in which to live.[137] Other socioeconomic factors that may affect home broadband adoption in Hawaii, which should be reviewed, include cultural dynamics due to a large multi-ethnic immigrant population,[138] physical isolation of communities particularly on the outer islands, and resident spending habits.

[136] DOH State of Hawaii Primary Care Needs Assessment Data Book 2012 at 57, Maps 3-12.

[137] 2011 State of Hawaii Data Book Table 14.11. Hawaii had a cost of living index of 81.6 in 2009. *Id*. Table 14.17.

[138] Intended residents arriving in Hawaii averages approximately 50,000 persons a year. *Id*. Table 1.60.

3. Community Anchor Institutions

Community Anchor Institutions (CAI) are defined by the NTIA[139] as schools, libraries, medical and healthcare providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations and entities. These CAI's can provide additional computer and Internet access, which can help increase broadband access and adoption levels especially in rural communities where broadband availability or access is most scarce. UH is, through its BTOP "Access for All" grant and in partnership with the Hawaii State Public Library System, the State Department of Education, and the State Executive Branch, providing 693 new public access broadband-connected computers in over 60 public facilities, including every public library and community college and their remote education centers on the State's six major islands.

CAI data was collected for the State under the DCCA's SBI grant in order to create a CAI database and location maps.[140] The current database reflects the following 1,306 CAIs:

Community Anchor Institution Type	Count
Schools – K through 12	367
Libraries	56
Medical/Healthcare	212
Public Safety	95
Universities, Colleges, other Post-Secondary	44
Other Community Support[141] – Non-governmental	532
TOTAL	**1,306**

Maps depicting currently identified locations and types of CAIs by island may be found under the individual county descriptions at Section IV.F of this Plan. Increased mapping is planned to identify State facilities, restaurant lounges, malls and coffee shops with advertised free Wi-Fi. Hawaii-registered businesses that meet the criteria for CAI's will also be placed on the map.

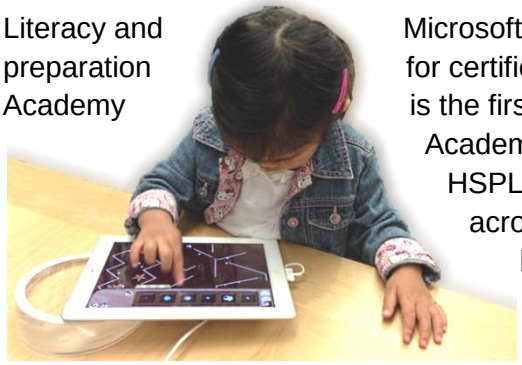
[139] "Community Anchor Institutions" are defined as "[s]chools, libraries, medical and healthcare providers, public safety entities, community colleges and other institutions of higher education, and other community support organizations and entities. Federal Register; 8 July 2009; Federal Register: Notices: Department of Commerce, NTIA Notice of Funds Availability (NOFA) for the State Broadband Data and Development Grant Program; Federal Register, Vol. 74. No. 129, *available at* http://www.ntia.doc.gov/files/ntia/publications/fr_broadbandmappingnofa_090708.pdf.

[140] Data was collected using various State databases (i.e. schools, libraries, public safety) and other sources (downloads from InfoUSA, a commercial subscription database that contains nationwide business listings and business information), and verified by personal telephone calls and information collected from CAI websites. The CAI database as delivered to the NTIA on April 1, 2012, and is routinely amended, updated and verified.

[141] This includes hotels, restaurants and coffee houses that offer free Wi-Fi.

CAIs are also valuable, accessible training facilities for digital literacy and adoption programs. In the next phase of its SBI grant projects, DCCA will collect more information on the many meaningful programs and projects planned or underway in the State in order to determine how to best support and supplement these efforts to address identified gaps in digital literacy and adoption. In particular, DCCA's technical assistance grant project will focus on digital literacy and adoption programs at the local level. The CAIs, such as the public libraries and various community organizations on each island, will be important partners in these efforts. The following exemplify the types of programs in the State currently being undertaken.

In 2011, the Hawaii State Public Library System (HSPLS), in partnership with Microsoft Corp., became the first statewide public library system in the world to offer online Digital Literacy and Microsoft IT Academy program for technology training and preparation for certifications for its library patrons.[142] "The Microsoft IT Academy is the first training program to launch under the HSPLS HI Tech Academy initiative and is expected to reach nearly one million HSPLS card holders, from keiki (children) to kupuna (elders), across the State of Hawaii."[143] It offers online, self-paced learning that can be accessed at the HSPLS libraries or remotely through the library system's website, www.librarieshawaii.org.[144]



The Microsoft IT Academy program includes training in Microsoft products, such as Excel, Word, and PowerPoint, in addition to advanced subjects such as programming, Web development and database development, which helps users to qualify for and acquire industry-recognized Microsoft certifications.[145] "More than 1,500 courses [are] available, ranging from beginner (learning to use the mouse), to intermediate (Microsoft Office), to highly technical (network architecture and design), and some Certifications can be used for college credit at more than 1,500 schools across the country, including the UH, Hawaii Pacific University and Chaminade University."[146] The Microsoft IT Academy program and the digital literacy program will equip Hawaii's employed, underemployed and unemployed workers with the 21st-century technical skills needed to become more employable and to participate and

142 https://www.microsoft.com/en-us/news/press/2011/nov11/11-10HawaiiITAPR.aspx.

143 http://www.friendsofthelibraryofhawaii.org/index.php/whats-new/blog/42-announcement/165-hitechacademy.

144 *Id*.

145 *Id.*

146 http://www.friendsofthelibraryofhawaii.org/index.php/whats-new/blog/42-announcement/165-hitechacademy.

succeed in the global workforce.[147] Program funding is provided by the federal Library Services and Technology Act.

The Hawaii State Public Library System is also preparing to launch a new laptop loan program that will provide 300 rugged laptop computers with wireless broadband service for library patrons to take home and use free of charge. The 3G wireless data connectivity for Internet access will also be provided free of charge. The primary intent is to provide these computers and Internet access to take the Microsoft IT Academy online courses, but other uses are also allowed.

Like public libraries, the designated Public, Education and Government (PEG) Access providers for each county can offer accessible training facilities and programs for their communities. In 2011, Akakū: Maui Community Television, the PEG access provider in Maui County, was selected as one of seven CAIs in the western United States to receive funds through a BTOP grant awarded to Zero Divide, a media think tank, to conduct a 30-month broadband adoption program in Maui County to provide youth aged 25 and under training in broadband literacy using mobile journalism platforms. Akakū utilized the $147,857 received to launch Akakū's Youth Broadband Education and Awareness Mentoring Program (YBEAM). Through partnerships, YBEAM educates and trains underserved Maui County youth on broadband digital literacy and broadband mobile journalism production to strategic youth organizations and public charter schools on Maui, Molokai, and Lanai. Akakū provides WiFi enabled devices for all program youth and partners. As of September 2012, the program has trained 1159 youth. Akaku-trained YBEAM youth subsequently become community resources for broader community training on broadband literacy. The YBEAM program also creates internships and jobs for broadband literate certified program graduates.

[147] https://www.microsoft.com/en-us/news/press/2011/nov11/11-10HawaiiITAPR.aspx.

III.
State Broadband Activities

A. State and County Projects and Programs

The State and counties have many ongoing projects and programs to advance deployment of broadband infrastructure and to promote broadband services. Many of these activities are being funded in large part through various ARRA[148] and other federal grant programs (BTOP, NSF, SBI, HHIE, PSGP, HITECH Act, Affordable Care Act). The State's current or planned projects and programs include the following:

1. Mapping and Planning

DCCA, through a SBI grant ($4,349,940), is undertaking projects that include broadband data collection and mapping (with subrecipient PDC) to identify available broadband services throughout the State, and broadband infrastructure development and adoption planning at the State and local levels. Collected data is used by the State for broadband planning and deployment activities, and by the NTIA and FCC to determine and monitor broadband deployment and to create the National Broadband Map. Under the grant, DCCA will oversee planning projects for statewide broadband infrastructure capacity building and for technology planning activities at the local level, which will include digital literacy and broadband adoption programs.

2. Hawaii Institutional Network

The United States Congress assigned to state and local governments authority to require franchisees to develop and maintain Institutional Networks ("INETs") for governmental and educational purposes. *See* 47 U.S.C. § 541(b)(3)(D). Pursuant to this authority, DCCA requires recipients of cable franchises in Hawaii to contribute and maintain broadband capacity for a statewide INET that connects State and county government buildings, community anchor institutions and accredited educational institutions, enabling the provision of broadband video, voice and data services throughout the islands. DCCA continues to use its authority to grant and renew cable franchises to expand the reach of the statewide INET, further facilitating the broadband capabilities of state and local government agencies and educational institutions. Dedicated construction of INET links by cable franchisees has also resulted in new infrastructure that could be used by cable system operators to bring broadband to additional consumers.

[148] American Recovery and Reinvestment Act of 2009.

3. Broadband Assistance and Development

Act 199 (SLH 2010) made DCCA the responsible State entity to advance the State's broadband capabilities and use. Through this broadband authority and its cable television regulatory authority, DCCA acts to protect and advocate the State's interests in federal funding programs for broadband infrastructure and services, to strengthen the State's INET and provide equitable benefits for the State and counties, and to promote and support the goals of the HBI. Under Act 199, DCCA convened the BAAC and is working in collaboration with the BAAC, broadband providers, and other interested stakeholders to advance broadband infrastructure deployment, and to develop and support broadband adoption initiatives and programs that will drive use of high speed broadband. The BAAC has formed working groups, which are working on broadband adoption activities, permitting streamlining for broadband infrastructure deployment, and economic issues related to deployment. DCCA seeks to leverage the expertise of these groups in carrying out DCCA's additional planning and other activities under its SBI grant.

4. Schools and Libraries Projects

(a) UH BTOP Fiber Connectivity. Through its Broadband Technology Opportunities Program (BTOP) grant ($33,972,800), UH is deploying and enhancing direct fiber optic connectivity to all public K-12 schools including public charter schools, UH, the community colleges and their remote distance learning centers, and all public libraries on six islands. The project plans to provide 10 Gbps connectivity to institutions of higher education, 1 Gbps connectivity to K-12 schools and libraries, and backbone infrastructure to Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii Island with 10 Gbps capacity inter-island circuits. The completion deadline for this project is August 31, 2013.

(b) Enabling Hawaii to COMPETE. This is a UH project to acquire and implement two 10 Gbps circuits from Hawaii to the West Coast to improve connectivity to U.S. national cyber infrastructure for all members of Hawaii's statewide research and education community and their national and international collaborators.

(c) Connecting the Islands: Cyber Connectivity for Science and Technology in Hawaii. This is a UH project to provide 10 Gbps connectivity for science & technology research and education among UH-Hilo, UH-Manoa, Kapiolani CC and the Maui High Performance Computing Center.

(d) Access for All: Hawaii Statewide Public Computing Centers. This is a UH project, in partnership with the Hawaii State Public Library System, the State Department of Education, and the State Executive Branch, to provide 693 new public access broadband-connected computers in over 60 public facilities including every public library and community college and their remote education centers on the six major islands of the State. The project will serve vulnerable populations by increasing capacity and usage at public computer centers, including facilities at community colleges not previously open to non-students and

facilities, which have experienced long wait times and bandwidth constraints due to increased demand for broadband access.

5. Public Safety Projects

(a) Anuenue Digital Microwave System. This public safety grade microwave backhaul network system is being upgraded. The State constructed this $23 million network in close collaboration with the U.S. Coast Guard. Designed to meet the unique topography and climate challenges of the Hawaiian Islands, Anuenue's towers can remain operational in 110 MPH winds and are built to survive the 155 MPH winds of a Category 4 hurricane. In addition to the U.S. Coast Guard and State Department of Defense, users of the Anuenue system include the Hawaii Departments of Public Safety, Transportation, Health and Land and Natural Resources, as well as federal users from the National Oceanographic and Atmospheric Administration (NOAA), the Federal Aviation Administration (FAA), and the U.S. Army. As local government partners, the four counties within the State contribute communications assets that provide backhaul and radio infrastructure used by many of those same federal, state, and non-governmental organizations.

(b) Port Security Grant Program Maritime Wireless Network System. This wireless broadband network is currently under construction. It will be used to enhance local security and surveillance services with respect to data and video capability at each of the commercial harbors in the State. This system will connect all commercial ports in the State and allow real time security and surveillance data to be sent to a central control center on Oahu.

(c) FirstNet Public Safety Network. This is a nationwide, interoperable public safety broadband network based upon a single, national network architecture. First Responder Network Authority (FirstNet) is an independent federal authority within NTIA charged to build, deploy and operate this network in consultation with federal, state and local stakeholders. The State's Office of Information and Management Technology (OIMT) and Department of Defense are working with First Net to develop the State's network to public safety specifications with multiple backup and redundancy capability to ensure operation 24/7 with advanced data capability using 4G LTE technology.

6. Health IT Projects

(a) Hawaii Health Information Exchange. The Hawaii Health Information Exchange (HIE), a non-profit entity established in 2006 by leading health care stakeholders in Hawaii, was designated by the State under the Health Information Technology for Economic and Clinical Health Act (HITECH Act) to develop and implement a statewide health information exchange that will ultimately feed into the national health information network. The HIE promotes the conversion to, and use of, electronic health records, and is charged with developing common standards for such records among patients, physicians, health institutions and insurers.

(b) Hawaii Health Connector. The Hawaii Health Connector is the State's certified online health insurance exchange. The Connector will serve as an impartial, electronic marketplace where users can easily compare the cost, coverage, and value of plans offered by all participating health insurers. In August of 2012, the Hawai'i Health Connector received a $61.8 million grant for Hawai'i's health insurance exchange from the U.S. Department of Health and Human Services. Hawai'i was the first state in the nation to declare its intent to set up a state-certified health insurance exchange and its Congressional delegation, headed by Senator Daniel Inouye, has been in the lead of the national effort.[149]

(c) Hawaii County Beacon Project. The County of Hawaii was one of 17 communities across the nation selected for implementation of this grant project ($16,091,390). This is a Health Information Technology (HIT) project to build and strengthen health IT infrastructure and information exchange capabilities, and to use HIT to continuously improve healthcare quality, cost-efficiency, and population health in Hawaii County. The Hawaii Island Beacon Community's (HIBC) goal is to improve the health of the Hawaii Island residents through implementation of a series of health care system improvements and interventions across independent hospitals, physicians, and physician groups and in partnership with public and private health insurers.

7. State IT Projects

(a) OneNet. This project will position State government network infrastructure for higher capacity needs such as cloud computing, high bandwidth applications, and centralization of computing services.

(b) Shared Services (E-Mail as a Service in the Cloud). This project will migrate from in-house services currently managing email for State employees to cloud based services.

(c) Data Center Consolidation. This project proposes to consolidate the current 25 departmental server environments to "5 fully connected, fully load shared, fully redundant data centers (two in Oahu, and one in each in Kaua'i, Hawai'i, and Maui)."[150]

(d) Unified Communications. A proposed pilot project would integrate telephones, video conferencing, messaging and data sharing.

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[149] http://www.hawaiihealthconnector.com/uploads/HHC61.8MGrant82312F.pdf.

[150] OIMT Business and IT/IRM Transformation Plan: Projects (Oct. 2012) at 24.

8. Energy Projects

(a) Enhancing State Government Energy Assurance Capabilities and Planning for Smart Grid Resiliency. The objectives of this initiative of the Department of Business, Economic Development & Tourism was to: 1) strengthen and expand State and local government energy assurance planning and resiliency efforts by incorporating response actions for new energy portfolios and Smart Grid applications; 2) create jobs; and 3) build in-house State and local government energy assurance expertise. The initiative focuses on building regional energy assurance capability to allow the State to better coordinate and communicate state-wide and with one another, on energy security, reliability, and emergency response issues.

9. Honolulu Wi-Fi Project.

(a) Kokua Wireless. This is a community based program that offers free municipal Wi-Fi on the island of Oahu. This program began in 2005 as a collaborative project between Tri-Net Solutions Honolulu and the City and County of Honolulu, to encourage businesses to share their internet access by purchasing a customized Wi-Fi antenna from the project for $250. The process gained momentum and now has nearly 200 nodes. Kokua Wireless Wi-Fi nodes are currently available on the islands of Hawaii, Kauai, Maui, and Oahu. Businesses receive free advertising in exchange for participation. Every 30 minutes, the internet connection is refreshed to prevent illegal downloading. When the user is reconnected, they are routed to the website of one of the businesses housing an antenna. The initiative is being expanded to Ala Moana Regional Park and Kapiolani Park. This project was recently named by KPMG as one of the world's 100 most innovative and inspiring urban infrastructure projects.[151]

B. State Broadband Initiatives

The State has established the following broadband-related initiatives:

1. Hawaii Broadband Initiative

The HBI, introduced above, provides an overarching initiative that directs the State's officials and agencies to work with other federal and county bodies, UH, broadband providers, and

[151] KMPG: Infrastructure 100 World Cities Edition, *available at* http://www.kpmg.com/Global/en/WhatWeDo/Special-Interests/infra100-world-cities/Pages/communications-project-profiles.aspx#c04.

private stakeholders to identify hurdles and to take action to achieve ubiquitous access to 1 Gbps broadband service at affordable rates throughout Hawaii by 2018. The HBI consolidates the State administration's efforts through the Office of Information of Management and Technology.

To assist in this effort, the Legislature in 2012 authorized the issuance of $100,000,000 in special purpose revenue bonds through Act 242 to assist Clearcom, Inc., or an affiliate in planning, permitting, designing, constructing, equipping, and operating broadband infrastructure throughout the State.

2. Hawaii Healthcare Transformation Initiative

As a central component of his New Day in Hawaii agenda, Governor Abercrombie established the Hawaii Healthcare Transformation Initiative (HHTI), to be lead by the Governor's Office of Healthcare Transformation. HHTI is a public-private partnership that aims to engage stakeholders in identifying strategies that will result in a significant, positive change in how we deliver and pay for care, use information for continuous improvement, and shape public policy and programs to support these changes. The program is primarily focused at the outset on health information technology (HIT) issues. This includes creating systems and databases to collect and share health information of patients and cost information as well as interactive systems linking physicians and other healthcare providers with patients. Federal funding sources for healthcare-related programs include the HITECH Act, Affordable Care Act, HHIE, and the Hawaii County Beacon grant.

3. Transformation Initiative

This initiative directed the CIO to transform the State's IT environment to realize the Governor's New Day vision to leverage modern technologies and streamline business processes to improve the delivery of government programs and services to the people of Hawaii. A Business and Information Technology (IT)/Information Resource Management (IRM) Transformation Plan, issued by the CIO, provides a 12-year roadmap that directs a transition to a future environment that is more cost-efficient, digital, and mobile-accessible, and a consolidation of the State's 743 fragmented legacy systems into fewer, integrated, enterprise-wide solutions that facilitate improved information sharing.

IV.
Unique State Characteristics

This section provides a general overview of unique State characteristics relevant to broadband deployment and adoption, and specific challenges Hawaii faces in achieving ubiquitous high speed broadband for all of its residents.

A. Geography and Environment

Hawaii's unique geography and environment create unique and difficult challenges for the deployment and maintenance of broadband infrastructure.[152] Hawaii is a volcanic island state comprised of seven main populated islands (Niihau, Kauai, Oahu, Molokai, Lanai, Maui, and Hawaii Island). It has a land mass of 6,422.6 square miles, which makes it the fourth smallest state in the nation.[153] Located in the middle of the Pacific Ocean, it is "the most isolated population center on Earth."[154]

Distances from Hawaii[155]

U.S. Mainland (California)	2,390 miles
Japan	3,850 miles
China	4,900 miles
Australia	5,070 miles

The State's six main populated islands are also separated by deep ocean channels of up to 75 miles in distance. These measured distances between the islands and across the Pacific, moreover, are shorter than the distance of the actual path submarine fiber must take along the ocean floor.[156] The long distances and the deep ocean channels between islands, which are more than 10,000 feet deep at points, require specially equipped ships and crews for cable deployment. However, the State has no permanently stationed deep sea cable laying ships capable of handling fiber optic cables. This means that the deployment, maintenance, and emergency response related to deep ocean communication cables is costly and may be slow,

[152] Much of the following information on the difficulties the State's geography and environment presents to providers was shared by Hawaiian Telcom in response to a DCCA query.

[153] 2010 Census Hawaii Profile, U.S. Census Bureau, available at http://www.census.gov/geo/www/guidestloc/st15_hi.html.

[154] *Id*.

[155] *Id*.; 2011 State of Hawaii Data Book.

[156] Distances range from 3700 to 6800 miles to landing points in Asia and Australia.

particularly in response to emergency situations. Although repairs are not often needed, annual maintenance contracts with undersea repair companies are necessary to ensure timely restoration of service when a repair is needed. In addition, the State's geographic isolation creates expense, difficulties, and delays in obtaining necessary supplies and equipment from outside the State. These issues are exacerbated when any interruption in transpacific transportation occurs, such as labor strikes affecting the airline and ocean shipping industry.

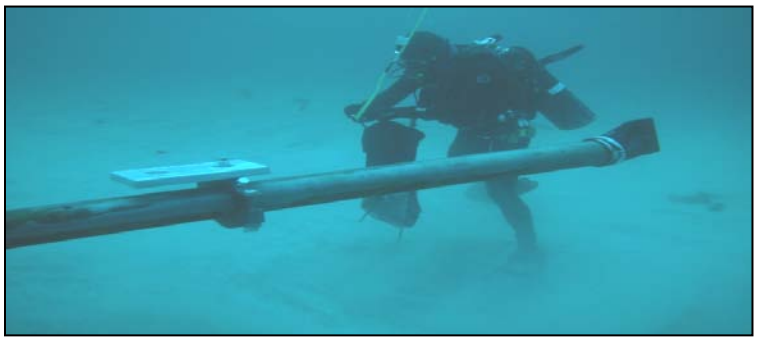

Figure IV.1. Diver working on off-shore conduit facilities that shield fiber cables from surf zone damage and protect coral reef habitats from potential harm due to cable trenching or drift.

Hawaii's surface terrain also present challenges for terrestrial communications infrastructure in a variety of ways. Because the islands were formed by volcanoes, the islands have perhaps the most diverse conditions in the world in a relatively small set of land masses. Hawaii has several mountains that are between 10,000 and 14,000 feet high from the depths of the ocean (Haleakala, Maui – 10,023; Mauna Loa, Hawaii – 13,678; Mauna Kea, Hawaii – 13,796). The islands also have many gulches and valleys creating an uneven terrain that makes some areas inaccessible to land-based vehicles or that restricts the size and weight of vehicles that may be used to transport people and materials to deployment sites. Providers seeking to deploy and maintain infrastructure must deal with everything from rocky moon-like landscapes to lush sub-tropical forests to lava flows.[157] In some rural and remote areas of the islands, providers must also overcome the lack of commercial electricity.

Even the rain water, soil, and ground itself present unique challenges in Hawaii. Hawaii's low mineral content "soft water" and the chemical composition of soil in some areas create conditions that make it difficult to ground equipment. In some cases, soil conditioning is required to create appropriate grounding conditions. In addition, there is the informally named "blue rock" found in the dense interior of old, thick lava flows. The U.S. Geological Service notes: "Blue rock" is the bane of contractors, especially road builders and pipeline installers,

[157] Each island has its own unique geography, from active volcanoes to rain forests. The geographical features of each island are discussed in more detail in Section IV below.

because it is difficult to break. The largest bulldozers and backhoes are regularly humbled by this dense rock, causing contractors to revert to expensive drilling and blasting techniques."[158]

While lava flows are perhaps the most spectacular and most publicized threat, there are other threats, both big and small, that create issues for designing, deploying, and maintaining a communications infrastructure. Hawaii is subject to an annual hurricane season from June to November of each year. Hurricane Iniki passed through the islands of Niihau, Kauai, and Oahu with wind gusts of over 100 mph in 1982. Ten years later, the most powerful recorded hurricane to strike the Hawaiian Islands caused nearly $2 billion dollars of damage in 1992. It was classified as a Category 4 hurricane with winds of up to 145 mph.

Hawaii has seen large scale damage and loss of life from tsunamis in 1946, 1952, 1957, 1960, and 1975.[159] It has also been threatened by tsunamis in recent times because of massive earthquakes in Chile (2010) and Japan (2011). Large earthquakes are another threat. The most recent was a 6.7 magnitude earthquake that occurred on the west coast of Hawaii Island on October 15, 2006, which caused property damage and large scale power outages. Salt water may not have the visual impact of lava flows and tsunamis, but over time, its presence results in corrosion damage to galvanized equipment in locations near the ocean. These areas thus generally require the use of more costly equipment fabricated from stainless steel.

B. Population Demographics

Hawaii's total population is 1,360,301 persons.[160] This population is highly concentrated on the island of Oahu, where approximately 70% of the population resides. The remaining 30% of the population is spread throughout the rest of the State. Hawaii also has a large visitor population because of its significant tourism industry. It is estimated that in 2011 Hawaii had an average of 185,824 visitors present in the State per day, and 7,147,397 visitors in 2011 who stayed overnight or

[158] Lava rocks come in many colors, USGS Hawaiian Volcano Observatory, Oct. 19, 2000, *available at* http://hvo.wr.usgs.gov/volcanowatch/archive/2000/00_10_19.html.

[159] Hawaii Tsunami Events, Pacific Disaster Center, *available at* http://www.pdc.org/iweb/tsunami_history.jsp.

[160] This includes the approximately 100,000 military personnel and dependents that reside in the State. 2011 State Data Book Table 1.03. The U.S. military does not own or operate its own broadband infrastructure in Hawaii, but generally relies on commercial broadband availability and capability.

longer.[161] The State's four counties are roughly designated by island:

- County of Kauai (the islands of Kauai and Niihau)[162]
- City and County of Honolulu (the island of Oahu)
- County of Maui (the islands of Maui, Molokai, Lanai);[163]
- County Hawaii (the island of Hawaii)

The population density by county and by island is as follows:[164]

County and island	Resident population1/	Land Area (square miles)	Population Density (per sq. mile)
State Total	1,360,301	6,422.63	211.8
County			
Honolulu	953,207	600.74	1,586.7
Hawaii	185,079	4,028.42	45.9
Maui 3/	154,924	1,173.51	132.0
Kauai	67,091	619.96	108.2
Island			
Oahu	953,207	597.64	1,594.9
Hawaii	185,079	4,028.42	45.9
Maui	144,444	771.99	187.1
Lanai	3,135	141.07	22.2
Molokai	7,345	260.46	28.2
Kauai	66,921	552.35	121.2
Niihau	170	67.60	2.5

[161] *Id*. Table 7.03.

[162] The island of Niihau is privately owned, and has a population of 130 persons. Census 2010 Data.

[163] Maui County also includes the island of Kahoolawe, which is uninhabited because of the presence of unexploded ordnance remaining from its former use by the U.S. Military for munitions targeting exercises.

[164] This table is excerpted from the 2011 State Data Book Table 1.11. Notes:

1/ The resident population is defined as the number of persons whose usual place of residence is in an area, regardless of physical location on the estimate or census date. It includes military personnel stationed or homeported in the area and residents temporarily absent, but excludes visitors present. 3/ Maui County includes Kalawao County (Kalaupapa Settlement).

For the period between the years 2000 and 2010, the County of Hawaii experienced the largest annual growth followed by the County of Maui:[165]

Date	State Total	City and County of Honolulu	Hawaii County	Kauai County	Maui County 1/
Annual average growth:					
1990-2000	0.9	0.4	2.1	1.3	2.4
2000-2010	1.2	0.9	2.2	1.4	1.9
2010-2011	0.8	0.8	0.7	0.7	1.1

Approximately 92% of the State's population (1,250,408 persons) live in the roughly 5% of the State's land area designated as urban.

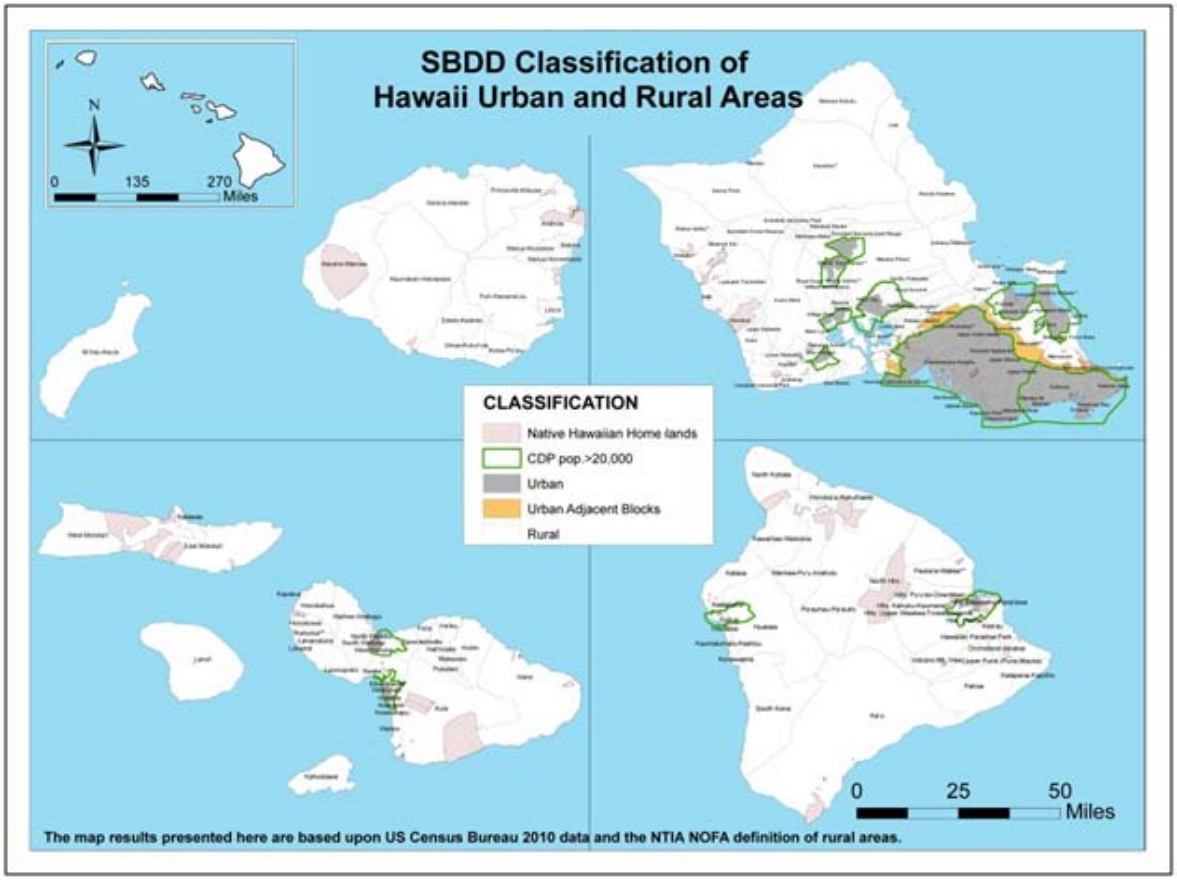

Figure IV.2. Map of State with Urban/Rural Area Classifications

[165] *Id*. Table 1.07.

The State Land Use Commission has classified the State's land area for use as follows:[166]

Urban Use	4.8%
Rural Use	0.3%
Agricultural Use	46.9%
Conservation Use	48%

Hawaii has a very multi-ethnic population, which reflects a large immigrant population[167] from Asia and the South Pacific:

10% Native Hawaiian and Other Pacific Islander
24.7% White
38.6% Asian
23.6% Two or more races
3.1% Other

C. Hawaiian Home Lands

In 1921, the U.S. Congress enacted the Hawaiian Homes Commission Act, which reserved 200,000 acres of land in the State for the sole use of the native Hawaiian population. Pursuant to the Act, the State Department of Hawaiian Home Lands (DHHL) was created and a Hawaiian Homes Commission formed to oversee this land, designated as the Hawaiian Home Lands.[168] The Hawaiian Home Lands include 7 properties in Kauai County, 13 properties in the City & County of Honolulu, 17 properties in Maui County (Maui – 11, Molokai – 5, Lanai – 1), and 19 properties in Hawaii County.[169] Persons of Hawaiian ancestry may receive 99 year leases for Hawaiian Home Land lots (with a maximum extension of 199 years), for residential, pastoral and agricultural purposes.

Sandwich Isles Communications, Inc. (SIC) is a rural telephone company licensed by the DHHL to provide telecommunications services for the Hawaiian Home Lands.[170] It receives substantial

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166 *Id*. Table 6.03.

167 In 2010, 18.2 percent of the State's population (234,085 persons) was born in a foreign country. *Id*. Table 1.44.

168 Department of Hawaiian Home Lands; 18 June 2012; *Lessee-Handbook*; Hawaiian Homes Commission, Department of Hawaiian Home Lands, *available at* http://www.hawaiianhomelands.org/wp-content/uploads/2011/09/Lessee-Handbook.pdf.

169 Department of Hawaiian Home Lands; 2012; Maps of Properties; Hawaiian Homes Commission, Department of Home Lands, *available at* http://hawaii.gov/dhhl/maps.

170 http://www.sandwichisles.com/SIC.html.

federal subsidies through the Universal Service Fund to provide telephone services for approximately 2,000 households on the Hawaiian Home Lands. Sandwich Isles Broadband Services, an affiliated company, resells telecommunications and broadband services to Hawaiian Home Lands statewide.[171] Oceanic TWC also provides broadband service to the Hawaiian Home Lands.

SIC leases interisland capacity from an interisland submarine cable network owned by Paniolo, LLC, an SIC affiliate. "The Paniolo cable network 'is approximately a 358 mile undersea and overland fiber optic cable system linking the islands of Kauai, Oahu, Molokai, Maui and Hawaii in the State of Hawaii. The Paniolo network consists of four (4) Undersea Components and six (6) Overland Components, including but not limited to beach landings, terminal buildings and central office electronics.'"[172] Because of SIC's specific role in providing services, this Plan does not specifically address broadband deployment for the Hawaiian Home Lands.

D. State's Role in Land Use Regulation and Education

Hawaii's state government plays a major role in areas that are carried out by counties or municipalities in most, if not all, of the other U.S. states: land use regulation and education. Land use in Hawaii is the most regulated of all the fifty states.[173] Providers seeking to deploy broadband infrastructure must contend with layers of permitting and approvals at both the State and county levels.[174] According to many providers, the State and county permitting and approval processes for infrastructure deployment can take years, even for upgrades to existing infrastructure.[175] For this reason, the streamlining of permitting and approval processes is of even greater import in this State than others.

Hawaii is also unique in that it is the only state with a single public school district encompassing the entire State. This system, administered through a State Department of Education (DOE) by

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171 http://www.sandwichisles.com/SIBS.html.

172 *Sandwich Isles Communications, Inc. Petition for Declaratory Ruling,* WC Docket No. 09-133, Declaratory Ruling, 25 FCC Rcd 13647, 13648, ¶ 5 (Sept. 29, 2010).

173 D. Callies, *Regulating Paradise,* at 1 (2nd ed. 2010).

174 *See id.* at 3-5.

175 With one exception, bills introduced by various parties in the past few legislative sessions that attempt to shorten review times or exempt certain activities from the permitting and approval processes at both the State and county levels have not been enacted by the Legislature. *See* Act 151, Session Laws of Hawaii 2011 (creating limited exemption for deployment of telecommunications cables).

an appointed State Board of Education, was created to ensure that each public school in the State has access to the same level of resources and support. For broadband adoption, this unified system can create advantages in the implementation of programs across the State and disadvantages because of the limited financial resources of the DOE that must be spread across all schools for implementation of such programs.

E. Limited Competition

Hawaii's remote location and relatively small market has resulted in limited competition in broadband service providers and transpacific backhaul providers. Two providers dominate the residential market: Oceanic TWC, the incumbent cable television provider, with approximately 288,000 subscribers and Hawaiian Telcom, the State's primary Incumbent Local Exchange Carrier (ILEC),[176] with approximately 105,000 subscribers.

The State has a number of small providers that offer broadband services, in addition to the wireless carriers. These include companies such as Bluestreak Broadband, which owns and operates a wireless metro Oahu broadband network providing both middle mile and last mile connectivity. Many smaller companies, such as NetEnterprise, DataHouse, SystemMetrics, and Servpac, are able to offer broadband service using Hawaiian Telcom's cables and/or collocation space in their central offices, because Hawaiian Telcom is required to open up and unbundle their network for other providers to use.[177] Tw telecom and Wavecom Solutions also compete in the business and government market.

Hawaii also has few transpacific and interisland cable operators that provide connectivity between islands and to points outside of the State. The limited competition between providers presents fewer options for Hawaii consumers and may impact the costs of the broadband services that they can receive.

[176] The Incumbent Local Exchange Carrier (ILEC) is the company that was providing "local" telephone service in a particular area on February 8, 1996, the date the Telecommunications Act of 1996 was enacted into law. *See* 47 C.F.R. § 51.5.

[177] By leasing space and using Hawaiian Telcom's copper, these companies only have to invest in the electronics to provide broadband service.

F. Characteristics Specific to Each County

1. City and County of Honolulu

The City and County of Honolulu, which is the smallest in land area of the four counties with approximately 600.74 square miles of land area, is home to roughly 70% of the State's total population.[178] This county encompasses the island of Oahu. The island has two mountain ranges, separated by a vast central plain. A large portion of the island's population lives in this central plain and in the coastal areas. Because of the population density on this island, it has been economically feasible to build out broadband infrastructure in virtually all areas on the island, except for a very few sparsely populated areas.

[178] 2011 State Data Book Table 1.06.

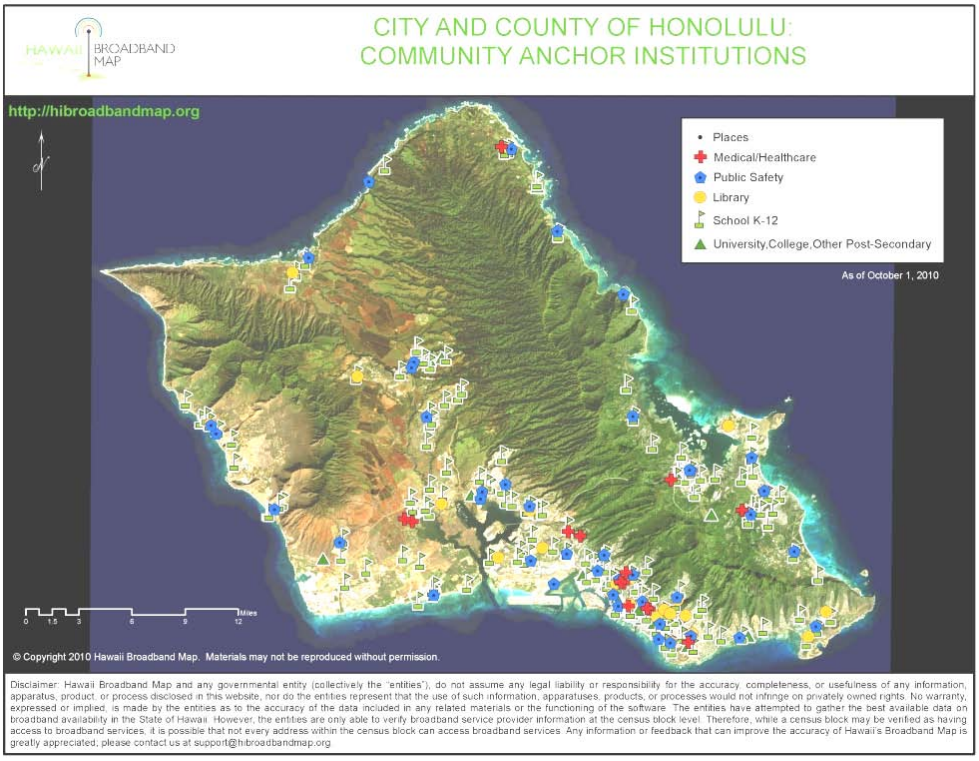

Figure IV.3. Map of Oahu with CAIs

The following table reflects the resident population for the county and by district, and the percentage change between 2000 and 2010.[179]

County and district	April 1, 2010	Percent Change 2000 to 2010
State total	1,360,301	12.3
C&C of Honolulu	**953,207**	**8.8**
Honolulu	390,738	5.0
Koolaupoko	115,164	-2.4
Koolauloa	21,406	13.3
Waialua	13,046	-7.0
Wahiawa	41,216	7.4
Waianae	48,519	14.8
Ewa	323,118	18.7

[179] *Id*. Table 1.12.

As of the latest Census 2010 data, the county's population demographic is composed of 9.5% Native Hawaiian and Pacific Islander, 20.8% White, 43.9% Asian and 25.8% Other. The age demographic is composed of 22.1% under the age of 18 and 14.5% over the age of 65, with 63.7% of the population between the ages of 18 and 65. Approximately 8.8% of the population lies beneath the poverty level.

2. County of Maui

The County of Maui is comprised primarily of the three populated islands of Maui, Lanai, and Molokai. It is the second largest county in size, with approximately 1,161.52 square miles of land area. Maui County's population comprises roughly 11% of the State's total population.

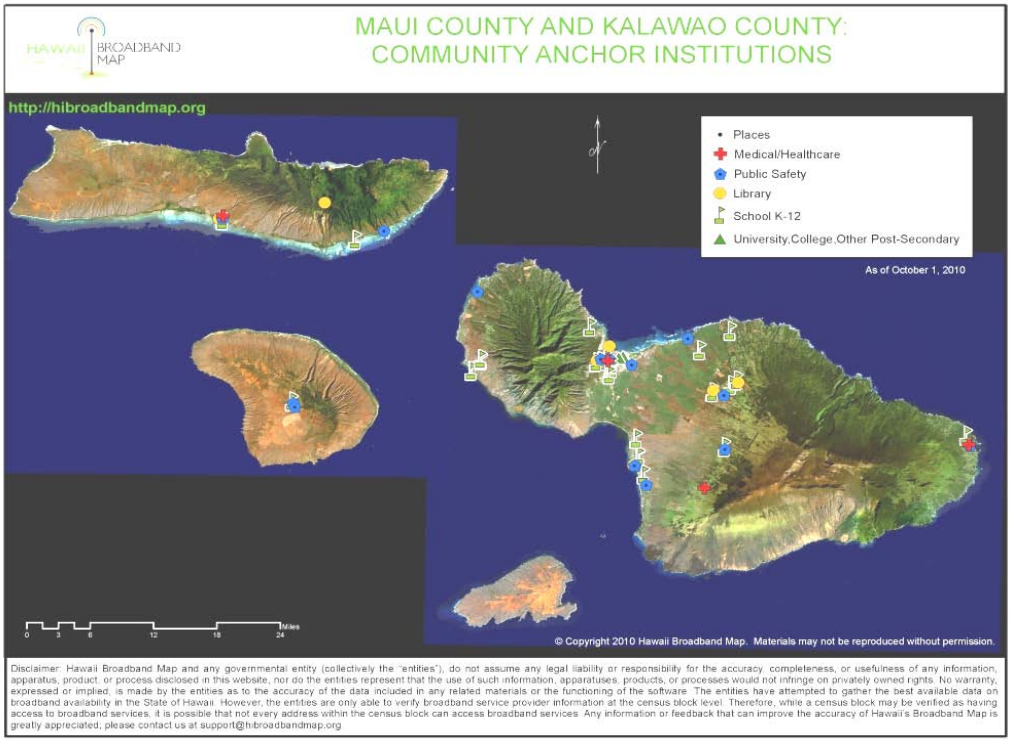

Figure IV.4. Map of Maui County with CAIs

Between 2000 and 2010, Maui County experienced a 20.9% increase in population. The following table reflects the resident population for the county and by district, and the percentage change between 2000 and 2010.[180]

County and district	April 1, 2010	Percent Change 2000 to 2010
State total	1,360,301	12.3
Maui County	154,924	20.8
Hana	2,291	23.5
Makawao	41,887	14.8
Wailuku	78,110	27.3
Lahaina	22,156	23.3
Lanai	3,135	-1.8
Molokai[181]	7,345	-0.8

As of the latest Census 2010 data, the county's population demographic is composed of 10.4% Native Hawaiian and Pacific Islander, 34.4% White, 28.8% Asian and 26.4% Other. The age demographic is composed of 23.1% under the age of 18 and 12.8% over the age of 65, with 63.7% of the population between the ages of 18 and 65. Approximately 8.9% of the population lies beneath the poverty level.

Island of Maui

Maui is the third most populated island, and is the second largest of the Hawaiian Islands. Maui's population is concentrated along the coastal areas, and on an interior plain (the isthmus or "neck" area) that separates the two volcanic mountains that make up the island. This interior plain, along with most of the coastal areas, are readily accessible and have widespread broadband connectivity. However, there are very remote areas on Maui on the slopes of the volcanic mountains or in isolated coastal areas to which it is very difficult to extend broadband infrastructure.

[180] *Id*. Table 1.12.

[181] This includes numbers for Kalawao.

Island of Molokai

Molokai, the fifth largest of the Hawaiian Islands, is sparsely populated with less than 8,000 residents. This island has a mountain range that spans most of the north coast as it drops dramatically to the sea. Kalaupapa Settlement is on this northern coast. The island has a populated central plain area, but the remainder of the population is spread out over the island. Existing broadband infrastructure primarily runs along the highways. The relatively small population makes it a difficult business case to extend the current broadband infrastructure to more residents.

Island of Lanai

Lanai is a small island that is only 140 square miles. One individual privately owns 98% of the island, with the remaining 2% owned by the State of Hawaii. The island consists of a central mountain range that radiates out to the coast, much like Kauai, but on a much smaller scale. Formerly an island-wide pineapple plantation, Lanai is home to a little over 3,000 residents. Because of its plantation legacy, most of the population is located in one area in the central part of the island, making it relatively easy to provide broadband service for most of the residents. However, the remaining low density of residents living outside of this central area makes it very costly to provide service to those residents.

3. County of Hawaii

The County of Hawaii encompasses the island of Hawaii, and is the largest of the four counties in area, with approximately 4,029 square miles of land area. It is the second most populated county with approximately 14% of the State's population. There are concentrated population centers on the east and west side of the island. However, with more land area than all of the other islands combined, most of the island has a very low population density. The island is dominated by two massive volcanic mountains in the center of the island. With some of the most active volcanoes in the world, it has had frequent lava flows as well as 44 earthquakes with a magnitude of 5.0 or greater between 1974 and 2011.[182]

[182] County of Hawaii Data Book, *available at* http://records.co.hawaii.hi.us/WebLink/DocView.aspx?id=62172&dbid=1.

Providing island-wide broadband infrastructure is very challenging because of these active volcanoes, the very rugged lava rock terrain, the low population density, and the long distances between scattered, isolated pockets of homes. The bulk of the island's infrastructure must be placed "in the air" on utility poles. This places the infrastructure at risk with vehicular accidents and during catastrophes such as hurricanes, thus creating a strong need for backhaul network redundancy. Oceanic TWC and Hawaiian Telcom have, or are in the process of completing rings from Hilo to Kona, circling around the Hamakua Coast and over the Saddle Road that runs between the volcanic mountains of Mauna Kea and Mauna Loa. Currently, however, the inability to traverse the Hawaii Volcanoes National Park prevents a true fiber ring around the island. There are two off-island cable landing paths near Kawaihae Harbor in West Hawaii. This is of concern because a natural catastrophe affecting that area, such as a hurricane or tsunami, would place the island's off-island connectivity at risk, and thus may impact advanced broadband service offerings.

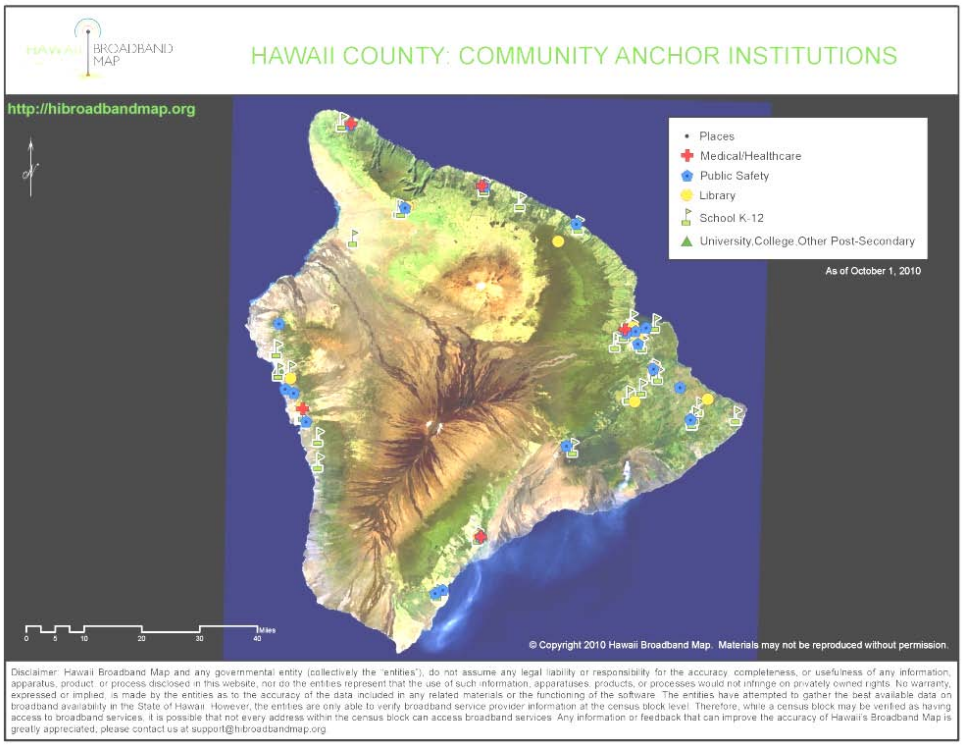

Figure IV.5. Map of Hawaii County with CAIs

As discussed at Section III.A.4(3), Hawaii County was one of 17 communities across the nation selected for a Health Information Technology (HIT) grant to build, strength and use HIT

infrastructure and capabilities in the healthcare area (the Beacon Project). Hawaii County also participated in a federal pilot project that provided wireless broadband based on 4G LTE technology for research and public safety applications.

According to the Census 2010 data, Hawaii County had the largest percentage growth between 2000 and 2010, experiencing a 24.5% increase in population. The following table reflects the resident population and percentage change for the county and by district between 2000 and 2010.[183]

County and district	April 1, 2010	Percent change 2000 to 2010
State total	1,360,301	12.3
Hawaii County	185,079	24.5
Puna	45,326	44.6
South Hilo	50,927	7.5
North Hilo	2,041	18.7
Hamakua	6,513	6.6
North Kohala	6,322	4.7
South Kohala	17,627	34.2
North Kona	37,875	32.7
South Kona	9,997	16.4
Ka'u	8,451	45.0

As of the latest Census 2010 data, the county's population demographic is composed of 12.1% Native Hawaiian and Pacific Islander, 33.7% White, 22.2% Asian and 32% Other. The age demographic is comprised of 22.8% under the age of 18 and 14.5% over the age of 65, with 62.7% of the population between the ages of 18 and 65. Hawaii Island has the second highest percentage of population (14.4%) of the islands living beneath the poverty level.

[183] 2011 State Data Book Table 1.12.

4. County of Kauai

The County of Kauai consists of the oldest islands of Kauai and Niihau, and is the second smallest of the four counties in size. It has approximately 619.96 square miles of land area and is home to roughly 5% of the State's population.

The island of Kauai consists of large mountain ranges in the central part of the island that radiate out to the shoreline areas. Most of the population is distributed along the coast and in towns that were formerly the center of sugar plantations, surrounded by fertile land. Because of the mountainous terrain, most of the broadband infrastructure is concentrated along the coastal and interior highways, which is where most of the population is distributed. However, this mountainous terrain makes it difficult to build out broadband infrastructure to reach several rural areas.

Island of Kauai

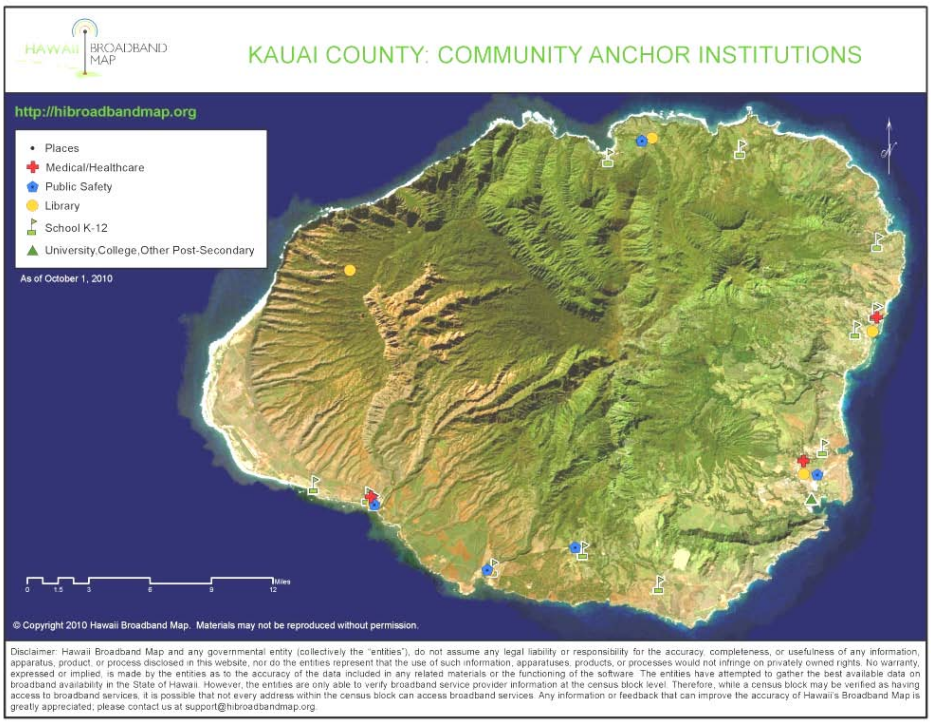

Figure IV.6. Map of Kauai County with CAIs

Kauai County has experienced a 14.8% increase in population between 2000 and 2010. The following table reflects the resident population for the county and by district, and the percentage change between 2000 and 2010.[184]

County and district	April 1, 2010	Percent Change 2000 to 2010
State total	1,360,301	12.3
Kauai County	67,091	14.8
Hanalei	7,828	23.3
Kawaihau	20,992	13.3
Lihue	14,683	22.1
Koloa	14,086	9.7
Waimea	9,502	8.9

As of the Census 2010 data, the country's population demographic is composed of 9% Native Hawaiian and Pacific Islander, 33% White, 31.3% Asian and 26.7% Other. The age demographic is composed of 22.7% under the age of 18 and 14.9% over the age of 65, with 62.7% of the population between the ages of 18 and 65. Approximately 8.8% of the population lies beneath the poverty level.

Island of Niihau

The County of Kauai also includes the privately owned island of Niihau, which has a population of 130 persons. At 18 miles long and 3 to 6 miles wide (70 square miles), it is the smallest of the populated Hawaiian Islands. The highest point on the island is 1,280 feet. Niihau has no paved roads, indoor plumbing, cars, stores, restaurants, or health or public safety officials.[185] The State Department of Education (DOE) supports Niihau School, which is located near the village of Puuwai. Although electrical power is available at the school from a photovoltaic system, the DOE 2011 school report notes that: "As of this date, no internet or email system is available to Ni'ihau School."[186]

[184] *Id*. Table 1.12.

[185] Ni'ihau Cultural Heritage Foundation, http://www.niihauheritage.org/niihau_today.htm.

[186] Niihau School: School Status and Improvement Report – School Year 2010-2011, *available at* http://arch.k12.hi.us/PDFs/ssir/2011/Kauai/SSIR461-7.pdf.

V.
Strategic Goals and Actions

The Hawaii Broadband Task Force established the following vision for the State:

> *Hawai`i understands that advanced broadband services are essential infrastructure for an innovation economy and a knowledge society in the 21st century. As a result of proactive policy initiatives, Hawai`i residents and businesses throughout the State have access to advanced broadband services of the caliber and at the pricing available in the leading developed nations of the world.*

Although steps have been taken towards making this vision a reality, the State must continue to encourage a more consolidated, committed and focused effort by all state and county agencies, providers, and other stakeholders in order to ensure ubiquitous high-speed broadband availability and to best position Hawaii for global competitiveness. The HBI represents the next step along these lines with the ambitious goal of ubiquitous access to 1 Gbps broadband service at affordable rates throughout Hawaii by 2018.

From a strategic standpoint, the successful deployment of advanced broadband services in Hawaii rests upon three factors: Availability, Adoption, and Application. The following section proposes goals and objectives for each of these areas. However, specific timelines or milestones are purposely not addressed because these will be included as part of DCCA's Broadband Capacity Building and Broadband Technical Assistance Projects, which are scheduled to commence at the beginning of 2013.

Availability- Physical Infrastructure

To provide ubiquitous access to affordable high-speed broadband service statewide, the State must advance policies, programs and initiatives to increase investment in broadband infrastructure, to support a competitive market, and to drive broadband usage. Providers, and other private stakeholders participating in the BAAC and its workgroups, have specifically identified the following deployment related issues that must be addressed:

- The high capital costs for infrastructure needed to provide ubiquitous service in areas of low population density, and the lack of sufficient demand in those areas to allow providers to recover those costs
- The need for a more competitive marketplace for transpacific and interisland cable connectivity
- The need to replace existing infrastructure, such as utility poles, because of poor condition or the need to upgrade the poles for the desired usage
- The lack of alternative paths (routes) for providers' infrastructure

- The high costs caused by delays in State and county permitting and other approvals

To address these basic infrastructure issues as well as the need to provide more capacity and higher speeds, this Plan recommends the following goals and actions to: (1) bridge the broadband infrastructure gaps; (2) lower costs of deployment by streamlining government approval processes and using government partnerships or resources; (3) increase transpacific connectivity; and (4) drive broadband usage through government applications.

GOAL 1: Ensure Availability Of Broadband To All Hawaii Residents At Affordable Prices

Objective 1.1
Create A Roadmap To Bridge Broadband Infrastructure Gaps to Unserved And Underserved Areas

- Utilize alternative methods to more specifically identify gaps in service by collecting, verifying, and mapping data on broadband availability with more granularity, including working with county government and community groups on each island.
- Work with providers and county agencies and stakeholders to develop plan to close physical infrastructure gaps, which may include use of alternate technologies such as microwave and other wireless technology, to provide broadband access for remote and difficult to reach areas in the State. Set benchmarks for speeds.
- Develop process to obtain real-time data from providers to monitor progress.
- Align and leverage State and county broadband infrastructure related projects and activities.

Objective 1.2
Lower Costs to Deploy Broadband Infrastructure by Streamlining Government Processes

- Develop and implement a modern regulatory framework and permitting environment through cooperative efforts between government agencies and stakeholders that accelerates the deployment of broadband infrastructure. This should include streamlining State and county permitting and other approval processes.
- Work with providers and stakeholders in efforts to consolidate relevant regulatory and permitting responsibilities in a broadband advancement authority that promotes the State's policy objectives and provides advocacy at all levels of government.

- Create model agreements to expedite use of government assets, such as a uniform contract to place wireless infrastructure on government property and buildings.

Objective 1.3
Utilize Government Resources/Partnerships To Deploy Government Broadband Infrastructure And To Lower Costs To Expand And Upgrade Private Networks

- Seek State commitment to recognize broadband as critical infrastructure with accompanying commitment to invest in infrastructure through policies, incentives and investment in shared open-access infrastructure to provide access to broadband services at speeds and prices comparable to those of the leading economies in the world.

- Efficiently allocate and manage government assets, through policies designed to encourage sharing of government infrastructure and processes to expedite use of that infrastructure to facilitate network upgrades and competitive entry. For example, make available at consistent and reasonable cost, and in a competitively neutral manner: (i) access to fiber corridors along state highways and roads, and (ii) access to other state owned assets useful in deployment of network equipment.

- Monitor and actively participate in relevant FCC proceedings to pursue universal service support, in particular high cost support for remote and insular areas, for deployment of broadband infrastructure in Hawaii's remote areas. Monitor other relevant government programs to identify potential funding for State broadband-related activities. Champion the State's interests and work with federal and county agencies and officials and private organizations to utilize available federal funds to speed and advance broadband access.

- Utilize State regulatory functions, such as DCCA's award of cable franchises, to seek investment in infrastructure (specific fiber links to educational and government facilities) to strengthen and expand the State's I-NET. Develop management system with INET Partners (CIO, UH, DOE, DAGS/ ICSD) to best utilize negotiated INET benefits for the State and counties, and to ensure equitable distribution of benefits between the State and individual counties.

- Encourage coordination at the state and local level to leverage projects for efficiency. Identify opportunities and timing for development of new fiber facilities and other critical broadband infrastructure in conjunction with planned State and local capital improvement projects.

- Ensure completion of gigabit service to all public K-12 schools, higher education, and libraries using existing ARRA funds by 2013.

- Plan for and potentially create fully redundant and survivable fiber optic infrastructure on each island. Seek partnerships and leverage existing systems and programs to create full fiber rings around each island.

- Provide a framework for a local emergency and metropolitan communications network with broadband as a primary or secondary system.

- Investigate establishment of a federal/state/county partnership to deploy world-class broadband similar to that entered into under the Hawaii Clean Energy Initiative.

- Work with providers and stakeholders to address pole attachments issues.

- Support BAAC activities to facilitate deployment, such as creating a centralized joint pole database to expedite review of pole attachment requests, identify poles in need of repair, upgrade, and assist providers in determining routing of their networks.

- Monitor issues related to access to existing interisland cables, costs of connection, and meeting future interisland connectivity needs.

- Develop and implement and in a competitively neutral manner provider and consumer incentives to foster development or expansion of fiber optic and wireless networks. This may include: (i) tax credit or deduction to offset investment in network equipment; (ii) direct State investment into Broadband Improvement Zones; (iii) tax deduction or credit to consumers who upgrade service to 100/50 or higher; (iv) grants to medical providers to offset cost of installing fiber (or equivalent wireless technology) to hospitals, community health centers, and other medical practices.

- Encourage provider efforts to best utilize resources to advance and expedite deployment of faster broadband speeds.

Objective 1.4
Drive Use of Broadband Through Government Programs and Applications

The Hawaii Broadband Task Force recommended proactive initiatives by the State to stimulate demand for broadband, such as through the active development and deployment of public services by agencies in their areas of responsibility and education of the public. To drive demand for increased network performance, the State should make a substantial commitment and investment in broadband programs and applications in sectors that government operates or influences: energy, education, public safety, health care, government services, and civic engagement. These broadband based services and applications should be targeted to increase the State's efficiency and ability to deliver an enhanced level of services to Hawaii residents. In conjunction with these efforts, the State must promote widespread awareness within Hawaii's population of broadband's value to the individual, households, and businesses.

The State and many individual State agencies have already begun instituting many programs and applications that allow residents to access government services through the Internet, improving efficiency and saving money for businesses and consumers. For example, DCCA's Business Registration Division has repeatedly won awards for online innovation, most recently a top international award for its suite of mobile business applications. These mobile apps are the first of their kind worldwide, and the first mobile apps launched by the State. The apps are modified versions of services available on the Business Registration Division's website.

- Education

  - Ensure equitable access to education throughout all islands, from K12 through higher education, by leveraging advanced broadband applications for e-learning and distance education. Ensure that all of Hawaii's public school children have use of a lap-top or tablet-like device as an integral part of their learning environment.

  - The ability of Hawaii's children to access digital content effectively and ethically is an important 21st century skill. By 2014, all of Hawaii's K-12 public schools, libraries, and university campuses will be connected to a fiber optic network capable of transmitting data at 1 Gbps, utilizing existing AARA funds. To make best use of this resource, the Hawaii DOE will develop and implement a comprehensive technology plan to upgrade back office functions, improve on campus electrical and information technology infrastructure, and appropriately integrate high speed broadband applications into the teaching and learning environment.

  - Ensure integration of technology into instruction from K12 through higher education, establish training programs for teachers, and establish curriculum to fully leverage this capability.

- Public Safety

  - Work with FirstNet to develop a statewide, wireless, interoperable public safety network built to public safety specifications with multiple backup and redundancy capability to ensure operation 24/7 with advanced data capability using 4G LTE technology. Voice communication shall have priority but new data capabilities such as streaming video (surveillance, remote monitoring), digital imaging, automatic vehicle location, computer aided dispatching, email, mapping/GIS, remote database access, report management system access, text messaging, telemetry/remote diagnostics will become available for use as appropriate by the public safety community.

  - Support deployment of the Next Generation 9-1-1/e911 (NG9-1-1) nationwide emergency services system, which will operate on a secure Internet protocol-based network and allow emergency communications via text, email, pictures and video from any communications device.

- Health Care

  - Develop and deploy e-health applications to support health information exchange and provide advanced diagnosis, consultation and treatment for Hawaii residents.

  - By 2018, all of Hawaii's citizens will be able to participate in the secure exchange of electronic health records, as well as efficient and affordable access to state of the art tele-health services. Health information technology (health IT) makes it possible for health care providers to better manage patient care through secure use and sharing of health information. Health IT includes the use of electronic health records (EHRs) instead of paper medical records to maintain people's health information. With the help of health IT, health care providers will have: (i) accurate and complete information about a patient's health profile including medical history and current and past conditions; (ii) the ability to coordinate the care they give; (iii) a way to securely share information with patients and their family caregivers over the Internet; information to help doctors diagnose health problems sooner, reduce medical errors, and provide safer care at lower costs. The State will invest funds through a state match to support the Hawaii Health Information Exchange. The State will deploy Medicare and Medicaid Electronic Health Record incentive, identify and map all medical providers; extend INET to HHSC and DOH requested sites (27 sites); provide incentives to medical providers to upgrade health IT services and broadband access; map of medical providers statewide.

- Government Services

  - Expand the use of networked information technologies to improve the efficiency and convenience of all levels and types of government services.

  - Access to State records and permits should be available electronically. The public should have a single entry point into government and be able to quickly retrieve information on the use of government resources, obtain a permit, or receive a service. To accomplish this, a strategic plan should be implemented to overhaul state IT services. The State should invest in a cross-cutting enterprise solution for: (i) a new fiscal accounting, budgeting, and program performance system (a new FAMIS); (ii) procurement; (iii) managing federal funds; and (iv) document tracking and management.

- Civic Engagement

  - Provide more access to government records and open meetings online to allow the public greater opportunity to participate in government.

  - Increase methods to use social media and the Internet to communicate with citizens and to allow their participation in government.

- Telework

  - Promote and encourage use of telework alternatives for public and private employees, including appropriate policy and legislative initiatives.

  - Advise and assist state agencies, and county agencies upon request, in planning, developing, and administering programs, projects, plans, policies, and other activities to promote telecommuting by employees of state and county agencies.

- Other

  - Promote and encourage policies, programs, and applications in other areas such as hospitality, travel, and tourism.

Objective 1.5
Increase Supply of Transpacific Submarine Fiber Connectivity

To reduce Hawaii's barriers to global participation and to create a competitive marketplace, the State should promote greater transpacific fiber connectivity and ensure equitable access for all islands. The Hawaii Broadband Task Force recommended that Hawaii welcome transpacific submarine fiber by reducing "barriers to landing new fiber in Hawaii through a shared-use, open-access, fiber-ready, international submarine cable landing station on O`ahu that is made available to all projects on a fair and equitable basis."[187] The State is continuing its efforts with respect to potential landing site projects as well as other methods to increase transpacific connectivity.

- Aggressively promote and create incentives for the landing of transpacific submarine fiber optic cables.

- Reduce the barriers to landing new fiber in Hawaii by creating shared access fiber-ready international cable landing stations on each of the major islands to induce additional submarine fiber cable projects to the State. The stations should be privately managed with users sharing in the cost. The State may provide land, underwrite the cost of permits, and make on-shore improvements to connect the cable hubs to existing or new fiber rings.

- Monitor proposed transpacific undersea cable projects; develop strategies to facilitate landing sites in Hawaii such as shared access landing sites and cable stations; and work with relevant state and county agencies, including the Department

[187] Hawaii Broadband Task Force Final Report at 10.

of Defense, and other parties to take advantage of opportunities to participate in such projects.

- Create incentives for existing transpacific cable owners who are repairing or upgrading their systems that will allow the State to upgrade its existing broadband network. In addition to incentives, review applicable Hawaii regulatory framework for opportunities to streamline landing site permitting and approvals.

- Seek partnerships to support a fiber optic cable from Maui to the west coast and between the islands.

- Create a true international peering point in the State to become a true data crossroad for Asia/Australia/Pacific Nations traffic and the West Coast to: 1) significantly lower internet bandwidth costs to the State and its businesses and residents; 2) significantly increase Hawaii businesses' ability to service businesses from Asia/Australia/Pacific Nations resulting in the creation of or movement to Hawaii of higher-paying "Green" information technology jobs, and 3) elimination of barriers to create and retain high-tech companies in Hawaii reliant on competitive internet bandwidth rates and to encourage mainland companies to move to Hawaii.

Adoption: Digital Literacy And Internet Use

To ensure that all residents have access to high-speed broadband services and everything it affords, the State must create policies, programs and initiatives to enable its residents to access and utilize broadband services that are made available. High speed broadband enables use of a host of IP based services currently available in the areas of healthcare, education, public safety, government efficiency, and civic engagement, as well as those to come.

Barriers to adoption include awareness, digital literacy, computer ownership, and Internet subscription. As discussed under Section II.C.2, existing data and studies support a correlation between low broadband adoption rates and socio-economic factors, such as lower income, lower education levels, higher population over 55 years of age, and higher non-white or Asian population.[188] Hawaii has a high number of communities where those factors are present in both rural and suburban areas, and growth in these areas has been significant over the last decade.[189] Community Anchor Institutions (CAIs) must be utilized to provide additional computer

[188] U.S. Department of Commerce: NTIA, *Digital Nation: Expanding Internet Usage: NTIA Research Preview* (Feb. 2011), *available at* http://www.ntia.doc.gov/report/2011/digital-nation-expanding-internet-usage-ntia-research-preview.

[189] *See* DOH State of Hawaii Primary Care Needs Assessment Data Book 2009.

and Internet access for unserved and underserved communities to help increase broadband access and adoption levels. As noted above UH, 693 new public access broadband-connected computers have been provided through ARRA funding in over 60 public facilities, including every public library and community college and their remote education centers. Additional programs must be developed to support and supplement ongoing public and private programs.

GOAL 2: Eliminate The Digital Divide And Promote Broadband Adoption

Objective 2.1
Remove Barriers to Access Through Digital Literacy and Access Programs

- Identify barriers to adoption of broadband and information technology services through collection of data, including outreach survey activities.
- Develop and support programs and strategies to increase digital literacy and access to computers and other devices, utilizing gigabit service at public schools, higher education facilities, libraries, and other community anchor institutions for Hawaii's children, seniors, and other citizens who may not access to these services at home.
- Develop and support other media literacy programs that help our citizens benefit from broadband services personally and that invest in the technology skills of Hawaii's workforce.
- Provide free high-speed Internet services in public areas in and around all state buildings, public libraries and schools.
- Invest in programs that will provide students with digital content via tablets, laptops and other mobile devices.
- Develop and implement provider and consumer incentives accordingly for last mile installation or service subscription to encourage adoption and foster provision of affordable services in strategic areas.
- Ensure equitable access to education throughout all islands, from K12 through higher education, by leveraging advanced broadband applications for e-learning and distance education.

Objective 2.2
Ensure Public Awareness of the Benefits of Broadband to Increase Adoption and Improve Quality of Life

- Develop programs and strategies to educate the public on the existence and use of broadband applications, and their value to the individual and household, including quality-of-life applications such as broadband-delivered education, health, emergency services, and communication services.

Applications: Broadband Applied For Economic Growth

To fuel and accelerate the economic growth and diversification that broadband can provide, the State will support and promote initiatives that promote industries and applications that increase demand for, delivery and use of ultra high-speed broadband capability. The resulting increase in demand for broadband services will propel greater investment in broadband infrastructure.

GOAL 3: Promote Broadband Industries And Applications For Economic Development

Objective 3.1
Support Ultra High Speed Broadband Access Sites And Areas On Each Island To Foster A Creativity And Innovation Economy.

- Create ultra high-speed broadband demonstration sites at public places statewide.
- Make 10 gigabit symmetric services available on each island at designated research centers and at technology development and commercialization centers to foster economic diversification and high quality job creation.
- Identify and prioritize key broadband development locations. Create county-designated broadband improvement zones on each island with access to ultra high speed broadband services. Coordinate infrastructure projects between the State and counties to create areas for deployment of ultra high-speed broadband zones for businesses.
- Provide infrastructure/incentives for Cloud applications to be hosted in Hawaii.

Objective 3.2
Promote And Support Use Of Information Technology And Innovation To Foster Economic Diversification And High Quality Job Creation.

- Expand the use of information technology and innovation in education to provide enhanced learning opportunities for students on all islands through interactive Internet technologies, and to create world class educational and research facilities at the UH.
- Create a plan to identify investment requirements for smart grid based on 2030 energy goals.
- Facilitate innovation and technology transfer among government agencies.
- Create an economic development and diversification plan to leverage ultra high-speed broadband capability, to develop new businesses or industries, and to establish Hawaii as a highly conducive location for new technology innovation and other technology related companies.
- Work with providers to create financial incentives to attract investment.
- Promote, develop and demonstrate applications that utilize the high-speed connections.
- Support efforts to establish Hawaii within the Pacific region as a highly accessible, highly reliable, highly secure, strategic communications partner.

APPENDICES

Appendix A
Plan Review Participants

The following government and private stakeholders were given copies of this Plan for review and may have provided feedback incorporated into the final version:

BAAC Member and Participant Entities

Hawaii State Senate
Hawaii State House of Representatives
Office of U.S. Senator Daniel Inouye
University of Hawaii
City and County of Honolulu
County of Hawaii
AT&T
Oceanic Time Warner Cable
Hawaiian Telcom
Hawaiian Electric Company
tw telecom
Office of Information Management and Technology
Department of Business, Economic Development & Tourism/High Technology Development Corporation
Oceanit
Verizon Wireless

Other Stakeholder Entities

Division of Consumer Advocacy
Public Utilities Commission
County of Maui
County of Kauai
Department of Land and Natural Resources
Department of Transportation
Akakū: Maui Community Television

Appendix B
Transpacific Cable Systems

(available at http://www.iscpc.org/)

Southern Cross Cable Network (RFS: November 2000)
Cable Length: 30,500 km
Owners: Telecom New Zealand, SingTel Optus, Verizon Business
URL: http://www.southerncrosscables.com
Landing Points: Alexandria, Australia - Brookvale, Australia - Hillsboro, Oregon, United States - **Kahe Point, Hawaii, United States** - Morro Bay, California, United States - **Spencer Beach, Hawaii, United States** - Suva, Fiji - Takapuna, New Zealand - Whenuapai, New Zealand

The Southern Cross cable system includes the following segments that land in Hawaii:

Segment C: Takapuna, Auckland, New Zealand to Spencer Beach, Hawaii
Segment D: Spencer Beach, Hawaii to Morro Bay, California, US Mainland
Segment F1: Nedonna Beach, Oregon, US Mainland to Kahe Point, Oahu
Segment G1: Kahe Point, Oahu to Suva, Fiji
Segment I: Spencer Beach, Hawaii to Kahe Point, Oahu (In-Service: Feb 2001)
Segments B, E, F2 and H are land based segments using terrestrial transmission technologies, remainder are submerged plant segments using submarine cable WDM technology. Segments A, C, G1, G2 and I operate at 40 Gbit/s per fibre pair on 2 fibre pairs. Segments D and F1 operate at 40 Gbit/s per fibre pair on 3 fibre pairs. One additional fibre pair on Segments A, C, D, F1, G1 and G2 was upgraded to 160Gbit/s operation in 2002.

Capacity on the segments is divided into 3 SDH rings comprising:

a) A North-South ring of Segments A, B, C, D, E, F2, F1, G1, G2 and H.
b) A northern ring of Segments D, E, F2, F1 and I.
c) A southern ring of Segments A, B, C, I, G1, G2 and H.

Total cumulative length of the segments is approximately 30,500km. Id. (Updated 25 Oct. 2005 - SCCL). http://www.southerncrosscables.com/public/Network/default.cfm?PageID=62 (2008)

Asia-America Gateway (AAG) Cable System (RFS: November 2009)
Cable Length: 20,000 km
Owners: Telekom Malaysia, AT&T, Starhub, PLDT, Communications Authority of Thailand, Authority for Info-communications Technology Industry of Brunei Darussalam (AiTi), airtel (Bharti), Telstra, Telkom Indonesia, BT, Eastern Telecom, PT Indonesia Satellite Corp., Telecom New Zealand, Viettel Corporation, Saigon Postal Corporation, Vietnam Telecom International, BayanTel (BTI)

URL: http://www.asia-america-gateway.com
Landing Points: Changi, Singapore - Currimao, Philippines - **Keawaula, Hawaii, United States** - Lantau Island, Hong Kong - Mersing, Malaysia - San Luis Obispo, California, United States - - Sri Racha, Thailand - Tanguisson Point, Guam - Tungku, Brunei - Vung Tau, Vietnam

Japan-U.S. Cable Network (JUS) (RFS: September 2001)
Cable Length: 22,682 km
Owners: Verizon Business, REACH, AT&T, BT, Sprint, CenturyLink, KDDI, NTT, Cable & Wireless Worldwide, Chunghwa, Tata Communications, SingTel, Telekom Malaysia, Softbank Telecom, France Telecom, Level 3, AboveNet, SK Broadband, KT, China Telecom, China Unicom, LG Uplus, New World Telecom, Starhub, PCCW, Telstra
URL: n.a.
Landing Points: Kitaibaraki, Japan - **Makaha, Hawaii, United States** - Manchester, California, United States - Maruyama, Japan - Morro Bay, California, United States - Shima, Japan

"The Japan-U.S. Cable Network consists of 9 segments connecting 3 landing points in the United States and 3 landing points in Japan with approximately 21,000km of 8 fiber submarine cable in a 100% self-healing ring configuration. The Network uses state-of-the-art SDH technology to provide an ultimate capacity better than 160Gbits/s per fiber pair for a minimum design capacity of 640Gbits/s." http://www.iscpc.org/cabledb/Eastern_Pacific_Cable_db.htm (Updated 23 May 2002 - AT&T).

Telstra Endeavour (RFS: September 2008)
Cable Length: 9,125 km
Owners: Telstra
URL: http://www.telstrawholesale.com
Landing Points: **Keawaula, Hawaii, United States** - Paddington, Australia

Honotua (RFS: September 2010)
Cable Length: 4,500 km
Owners: OPT French Polynesia
URL: http://www.opt.pf
Landing Points: **Kawaihae, Hawaii, United States** - Papenoo, French Polynesia

American Samoa-Hawaii (ASH) (RFS: May 2009)
Cable Length: 4,250 km
Owners: American Samoa Government, Elandia
URL: n.a.
Landing Points: **Keawaula, Hawaii, United States** - Pago Pago, American Samoa

Appendix C
Hawaii Speed Test Data

Tests taken between 01/25/12 - 05/25/12 (120 days)

State

STATIC Speed Test Data			
County	**Tests Taken**	**Ave Dn Mbps**	**Ave Up Mbps**
Kauai	682	5.14	0.97
Honolulu	14,965	6.26	1.04
Maui	2,242	4.00	0.92
Hawaii	2,239	4.33	1.10
Kalawao	0	0.00	0.00
Statewide Statistics			
Statewide	**20,128**	**3.95**	**0.81**
Mean		**4.85**	**1.33**
Minimum		0.00	0.02
Maximum		339.71	28.10
Std. Deviation		4.98	2.03
Speed Analysis			
Download Speed		**Count**	**% Tests Taken**
< 768 Kbps		1,470	7.30%
≥ 768 Kbps	< 1.5 Mbps	2,844	14.13%
≥ 1.5 Mbps	< 3.0 Mbps	3,901	19.38%
≥ 3.0 Mbps	< 5.0 Mbps	3,583	17.80%
≥ 5.0 Mbps	< 7.0 Mbps	4,190	20.82%
≥ 7.0 Mbps	< 10.0 Mbps	2,764	13.73%
≥ 10.0 Mbps		1,376	6.84%
≥ 15.0 Mbps		660	3.28%
≥ 25.0 Mbps		191	0.95%
≥ 50.0 Mbps		1	0.00%
≥ 100.0 Mbps		1	0.00%
≥ 1.5 Mbps		15,814	78.57%
≥ 3.0 Mbps		11,913	59.19%
≥ 5.0 Mbps		8,330	41.39%
≥ 7.0 Mbps		4,140	20.57%
≥ 10.0 Mbps		1,376	6.84%
≥ 15.0 Mbps		660	3.28%
≥ 25.0 Mbps		191	0.95%
≥ 50.0 Mbps		1	0.00%
≥ 100.0 Mbps		1	0.00%

City & County of Honolulu

Location	Tests_Taken	Ave_Dn_Mbps	Ave_Up_Mbps
Aiea	542	5.44	1.02
Aina Haina Baptist Church	2	8.60	0.99
Aloha Towers	1	6.12	0.99
Bhansok Korean Baptist Church	1	7.52	0.91
Calvary Lutheran Church	1	1.02	0.48
Camp Kokokahi	8	8.66	0.86
Cartwright Field	1	4.12	0.94
Christ United Methodist Church	2	4.38	0.94
Dillingham Transportation Building	2	7.50	0.79
Dole Middle School	31	5.08	0.79
Ewa Beach	1,444	6.75	1.07
Ewa Beach Elementary School	1	1.53	0.85
Gateway House	1	4.16	0.92
Haleiwa	8	2.02	0.85
Hauula	38	7.08	1.10
Hawaii Kai Recreation Center	8	1.75	0.62
Hawaii Kai Shopping Center	4	6.47	0.93
Honolulu	8,651	4.33	1.52
Honolulu Fire Department Station 30 Moanalua	1	3.39	0.70
Honolulu Fire Department Station 35 Makakilo	2	13.66	2.60
Honolulu Fire Department Station 38 Waiau	1	1.32	1.01
Honolulu Fire Department Station 41 Mililani Mauka	1	6.65	0.94
Immaculate Conception Church	2	18.00	0.93
Jarrett Middle School	4	2.85	0.91
Kaaawa	2	5.24	0.92
Kailua	519	5.10	0.93
KAIM-FM (Honolulu)	1	6.09	0.78
Kaiulani Elementary School	1	7.51	0.93
Kaneohe	818	5.98	1.16
Kapolei	195	7.07	1.12
Kawainui Canal	3	7.20	0.94
King Kalakaua Plaza Shopping Center	2	6.45	0.91
King Kamehameha Statue	2	3.46	0.69
KLEI-AM (Kailua)	4	6.56	0.95
Koa Playground	1	30.13	1.30
Kuapa Pond	2	7.65	0.91
Kuli'ou'ou Homesteads	1	9.83	0.95
Laie	47	5.23	1.85
Lower Village	3	3.62	0.94
Luluku Stream	2	3.01	0.66
M C B H Kaneohe Bay	6	5.92	0.95
Makalena Golf Course	2	5.30	0.93
Manoa Palolo Drainage Canal	3	5.14	0.81

Location	Tests_Taken	Ave_Dn_Mbps	Ave_Up_Mbps
Mililani	1,182	6.97	2.66
Moanalua High School	4	5.62	0.95
Our Lady of Good Counsel Church	1	8.16	4.00
Papakolea Park	4	6.53	0.89
Pearl City	383	4.09	2.24
Pearl City Highlands Elementary School	4	6.52	0.94
Pearl Harbor	12	5.28	1.15
Pelekane	4	6.54	0.90
Pu'ukapu	1	9.49	0.97
Puuloa Playground	1	8.58	0.93
Saint Augustine Parish Convent (historical)	1	5.02	0.90
Saint Clements School	3	6.60	0.85
Saint Stephens Church	3	0.75	0.42
Schofield Barracks	7	12.17	1.85
Shriners Hospitals for Children Honolulu	3	6.62	0.98
Smyth Auditorium	1	1.51	0.19
The Cabana at Waikiki, a Gay Resort	4	9.30	0.93
Wahiawa	267	6.72	1.04
Wai'alae Iki	3	7.93	0.93
Waialae Iki Playground	3	5.83	0.93
Waialua	6	3.90	0.47
Waianae	168	5.20	1.09
Waikiki Beach Condominiums	2	3.64	0.70
Waimanalo	4	4.93	0.70
Waipahu	510	6.19	0.96
Waipi'o	7	8.68	0.92
Ward Warehouse Shopping Center	5	0.39	1.03
Wilhelmina Rise	1	6.30	0.93
Honolulu County	**14,965**	**6.26**	**1.04**

Kauai County

Location	Tests_Taken	Ave_Dn_Mbps	Ave_Up_Mbps
Anahola	22	3.19	0.66
Birthstone Heiau	1	5.22	0.94
Eleele	45	5.96	0.89
Hanapepe	26	4.40	0.73
Kalaheo	43	3.73	0.71
Kalena Gulch	3	6.73	0.96
Kapaa	171	6.52	2.09
Kekaha	2	7.55	0.95
Kilauea	195	4.81	0.89

Koloa	44	5.04	0.86
Lawai	5	4.42	1.03
Lihue	89	4.37	0.97
Princeville	36	4.89	1.00
Kauai County	**682**	**5.14**	**0.97**

Maui County

Location	Tests_Taken	Ave_Dn_Mbps	Ave_Up_Mbps	Island
Aapueo	2	4.86	0.85	Maui
American Medical Response Station Medic 6 Hana	1	0.63	0.37	Maui
Haiku	83	3.81	0.74	Maui
Hana	360	1.88	0.37	Maui
Hawaiian-Spanish Village	1	6.47	0.97	Maui
Hoolehua	267	2.07	0.39	Molokai
Kahului	99	4.64	0.95	Maui
Kaunakakai	114	2.74	0.34	Molokai
Kihei	315	5.73	1.29	Maui
Kula	70	4.05	0.94	Maui
Lahaina	114	5.52	0.87	Maui
Lanai City	23	6.95	4.01	Lanai
Makawao	419	3.77	0.77	Maui
Maunaloa	2	4.04	0.36	Molokai
Paia	11	2.62	1.49	Maui
Palms At Wailea Resort	2	4.67	0.15	Maui
Papa'a'eanui	13	0.69	0.41	Maui
Pukalani	8	8.92	1.69	Maui
Puunene	8	1.73	0.94	Maui
Tenrikyo Maui Kyokai Church	17	2.86	0.63	Maui
Wailea Fire Station	9	5.29	0.94	Maui
Wailuku	300	3.50	0.78	Maui
Wells Street Professional Center	4	4.61	0.88	Maui
Maui County	**2,242**	**4.00**	**0.92**	
Maui	1,836	4.01	0.84	
Molokai	383	2.95	0.36	
Lanai	23	6.95	4.01	

Hawaii County

Location	Tests_Taken	Ave_Dn_Mbps	Ave_Up_Mbps
Camp Four	2	5.02	0.94
Captain Cook	22	4.18	0.76
Hakalau	1	4.01	0.39
Hawaii County Fire Department Station 2 Waiakea	1	2.80	0.70
Hilo	902	4.79	0.93
Holualoa	7	3.16	0.93
Honokaa	35	3.53	0.68
Honomakau	4	0.63	0.41
Kailua	126	4.38	0.99
Kailua Kona	470	5.33	1.00
Kamuela	100	3.40	1.55
Kapaau	81	1.46	0.57
Keaau	140	3.62	1.19
Kealakehe Homesteads	14	5.07	4.65
Kurtistown	1	0.02	0.32
Makaukiu Point	5	1.85	0.46
Mountain View	1	3.36	0.90
Naalehu	18	6.44	1.07
Ocean View	96	1.90	0.51
Paauilo	4	1.71	0.58
Pahoa	141	1.97	0.55
Papaikou	5	1.71	0.62
Pepeekeo	13	9.61	0.93
Prince Kuhio Plaza Shopping Center	1	4.49	0.87
Twelvemile School (historical)	1	4.99	4.30
Volcano	3	2.47	0.47
Waiakea	3	28.29	3.72
Waikahekahe Nui	1	4.88	0.95
Waikoloa	31	4.10	0.86
Waipahoehoe Stream	10	0.57	0.16
Hawaii County	**2,239**	**4.33**	**1.10**

Appendix D
Service Areas Socio-Economic Risk Ranking

Ranking of Service Areas by County		
Service Area	**Risk Rank**	**Risk Score**
Honolulu County	*(highest)*	
Waiʻanae	1	9.4
West Honolulu	2	2.8
Wahiawā	3	-0.3
Waialua	4	-1.0
Koʻolauloa	5	-2.2
East Honolulu	6	-2.3
ʻEwa	7	-4.5
Koʻolaupoko	8	-5.1
	(lowest)	
Hawaiʻi County	*(highest)*	
Kaʻū	1	9.6
Puna	2	7.4
Hilo	3	3.6
Hāmakuā	4	2.0
South Kona	5	-0.6
North Kohala	6	-1.6
North Kona	7	-3.5
South Kohala	8	-5.0
	(lowest)	
Maui County	*(highest)*	
Molokaʻi	1	7.1
Lānaʻi	2	1.1
Hāna	3	-0.9
Wailuku	4	-1.3
Lāhainā	5	-4.3
Makawao	6	-5.0
	(lowest)	
Kauaʻi County	*(highest)*	
Waimea	1	2.6
Līhuʻe	2	-0.5
Kōloa	3	-1.6
Kapaʻa	4	-1.7
Hanalei	5	-4.0
	(lowest)	

State-Wide Ranking of Service Areas		
Service Area	**Risk Rank**	**Risk Score**
State of Hawaiʻi	*(highest)*	
Kaʻū	1	9.6
Waiʻanae	2	9.4
Puna	3	7.4
Molokaʻi	4	7.1
Hilo	5	3.6
West Honolulu	6	2.8
Waimea	7	2.6
Hāmakuā	8	2.0
Lānaʻi	9	1.1
Wahiawā	10	-0.3
Līhuʻe	11	-0.5
South Kona	12	-0.6
Hāna	13	-0.9
Waialua	14	-1.0
Wailuku	15	-1.3
North Kohala	16	-1.6
Kōloa	17	-1.6
Kapaʻa	18	-1.7
Koʻolauloa	19	-2.2
East Honolulu	20	-2.3
North Kona	21	-3.5
Hanalei	22	-4.0
Lāhainā	23	-4.3
ʻEwa	24	-4.5
South Kohala	25	-5.0
Makawao	26	-5.0
Koʻolaupoko	27	-5.1
	(lowest)	

Appendix E
Glossary

3G – Third generation of loosely defined mobile standards and wireless technologies which enables network operators to offer users a wider range of more advanced services including wide-area wireless voice telephony, video calls, and broadband wireless data.

4G – Fourth generation of mobile wireless standards and technology which enables network operators to provide a comprehensive IP solution where voice, data and streamed multimedia can be delivered users on a stationary or mobile basis, and at higher data rates than previous generations. The ITU (International Telecommunications Union) designates ITM-Advanced (4G) target transmission rates, for research purposes, at 100 Mbps when in a high mobility environment (e.g., in a moving vehicle) and 1 Gbps when stationary.

Bandwidth – In this document the word refers to channel capacity or data throughput in terms of bit rate.

Broadband Access or Broadband Service – An "always-on" service. that includes but is not limited to computer processing capabilities, information provision, and computing interactivity with data transport, enabling end users to access the Internet and use a variety of applications at established minimum speeds.

Census Block – The smallest geographic area for which census data is collected by the Bureau of the Census. No socio-economic data is reported for census blocks.[190]

Census Tract – A census track is an aggregation of census blocks groups (which, in turn, is an aggregation of census blocks). The population of a tract ranges from 1200 to 8000 people. The geographic size of census tract varies depending on population density. It is the smallest geographic area for which socio-economic data is made available.[191]

Coaxial or Coax Cable – A wire surrounded by insulating material which is then surrounded by a grounded shield of thin metal and/or braided wire usually protected by an outer plastic or rubber sheath. This type of cabling is normally used to carry high frequency signals such as those used for video and data services.

Community Anchor Institutions - Schools, libraries, medical and healthcare providers, public safety entities, community colleges and other institutions of higher education, and other

[190] Census Blocks and Block Groups, *available at* http://www.census.gov/geo/www/GARM/Ch11GARM.pdf.

[191] 2010 Census Summary File 1, *available at* http://www.census.gov/prod/cen2010/doc/sf1.pdf#page=474.

community support organizations and entities that can provide additional computer and Internet access.

Digital Divide – The division between people who have and those who do not have access to the Internet, and also referring to the limitations of accessing information and services by those who do not have Internet access.

DOCSIS – Data Over Cable Service Interface Specification is an international standard developed by CableLabs that defines the communications and operation support interface requirements for a data over existing cable TV wiring systems. The latest version, DOCSISS 3.0, is capable of providing a theoretical maximum of 160 Mbps downstream speeds.

Downstream or Downlink – Refers to the flow of data from a remote source to a local computer from the end-user's perspective.

DSL – Digital Subscriber Line is a family of technologies that provides digital data transmission over the copper wires of a local telephone network. This technology is used by the telephone companies to provide Internet services.

FTTH or FTTP – Fiber-to-the-Home or Fiber-to-the-Premise is a form of fiber-optic communication delivery in which an optical fiber is run directly onto the customers' homes or premises to deliver very high speed broadband service and other services such as cable television.

Gbps – Gigabit per second or billions of bits per second is a unit of data transfer rate equal to a billion bits per second.

GIS – Geographic Information System is an information system that captures, stores, analyzes, manages, and presents data that refers to or is linked to physical locations.

IP – An abbreviation for Internet Protocol as described in DARPA RFC791. It is the protocol used for sending, receiving, addressing, and routing data across a packet-switched network.

kbps – Kilobits per second is a unit of data transfer rate equal to 1,000 bits per second.

Last Mile – The phrase describes the infrastructure segment that provides the final connection from a provider's central distribution point (e.g., neighborhood nodes or CO facility) to the subscriber's premises. The distance this "last mile" covers may be less than 100 feet in urban areas, while in rural and remote areas it may actually represent many miles.

LTE – An abbreviation for "Long Term Evolution". It is a wireless data technology with theoretical speeds of up to 170Mbps upstream and 300Mbps downstream. It is currently used by AT&T and Verizon. Sprint and T-Mobile plan to deploy LTE in the near future.

Mbps – Megabits per second is a unit of data transfer rate equal to 1,000,000 bits per second.

MHz – One million hertz. A hertz is a frequency unit defined in cycles per second.

Microwave – Radio Frequency waves, roughly starting at 1GHz in the radio spectrum, commonly used for point-to-point communications systems.

Middle Mile – The interconnection of core networks (backbone) to local network plants such as central offices, headends, and mobile switching centers.

POTS – An acronym for Plain Old Telephone Service.

Upstream or Uplink- Refers to the flow of data from a local computer to a remote destination from the end-user's perspective.

WDM and DWDM –Abbreviations for Wave Division Multiplexing and Dense Wave Division Multiplexing. These technologies combines outputs from multiple optical sources and combines them to allow transmission into a single fiber optic strand. This allows a single fiber cable to carry multiple independent sources of data simultaneously.

WiFi – A popular wireless telecommunications technology based on the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards that provides for the wireless transmission of data over a short range network, utilizing unlicensed radio spectrum to provide access to a network. Speeds usually range from 11Mbps to 100Mbps.


DEPARTMENT OF COMMERCE AND CONSUMER AFFAIRS
STATE OF HAWAII