HAWAII BROADBAND STRATEGIC PLAN

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INTRODUCTION

> *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]

Broadband is the critical infrastructure of the 21st century and as such needs to be a public and private sector priority. The State of Hawaii recognizes robust broadband infrastructure as foundational to Hawaii's economic future and, as importantly, the quality of life of its residents. In 2007, the Hawaii State Legislature formed the Hawaii Broadband Task Force and charged it with removing barriers to broadband access, identifying opportunities for increased broadband development and adoption, and enabling the creation and deployment of new advanced communications technologies in Hawaii." The Task Force issued its final report to the Governor and to the Legislature in December 2008 that recommended strategic actions to meet Hawaii's goals including establishing a forward-looking vision to make Hawaii globally competitive, welcoming trans-Pacific submarine fiber to Hawaii, ensuring access to broadband for all its citizens.

Legislation followed in 2010 that charged the Department of Commerce and Consumer Affairs (DCCA) with promoting broadband development; created the Broadband Assistance and Advisory Council (BAAC) under DCCA which would convene and gather stakeholder perspectives into the strategic process; and established a full-time chief information officer and an information technology steering committee.

In August of 2011, the Hawaii Broadband Initiative (HBI) was launched 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 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. 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 2012, the State Broadband Strategic Plan was developed 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 supported grant-seeking 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 as well as input from county officials and multiple state agencies.

Since the establishment of the Hawaii Broadband Initiative the focus has been on establishing key strategic digital infrastructure including a carrier neutral cable landing station on Oahu and the neighbor islands to lower the cost barrier for trans-Pacific fiber optic cables to land in Hawaii, to create a robust broadband network in Hawaii, to extend gigabit broadband to the entire state and to create an environment in Hawaii for the global digital economy to thrive.

Currently, most of the trans-Pacific fiber projects are bypassing Hawaii. These cables are crucial in enabling broadband service in Hawaii and keeping Hawaii connected and competitive in the global marketplace.

Hawaii Broadband Initiative priorities include planning, designing, and construction of a trans-Pacific fiber optic cable landing station using a public-private partnership model.

Taking a holistic approach to the HBI, it is widely recognized that broadband touches the community by providing the foundation for innovation, economic development, healthcare, education, public safety, entertainment, etc. through the entire continuum of broadband connectivity including:

1. Transpacific fiber optic cable and carrier neutral fiber landing station
2. Terrestrial backhaul to connect subsea cables to data centers and aggregation points on-island
3. Wireless broadband deployment including 5G small cells
4. Inter-island fiber optic connectivity between the Hawaiian Islands
5. Rural broadband, last mile/first mile and community networks
6. Broadband application drivers: telehealth, big data, smart city, smart grid, machine learning, artificial intelligence, autonomous vehicles, augmented reality, eSports, etc.

In March 2020, cases of COVID-19 virus were detected in our state, upending all that residents knew as normal. Governor Ige was joined by Mayors in mandating restrictions and policies on operations, travel between islands, and working from home policies. The drastic and sudden change required leaders and managers in government, business, education, and nonprofits to expeditiously solve functions and communications to achieve their objectives in a virtual mode.

With thousands forced to function from residences, workers relied on the quality of their Internet connections for Zoom communications. Public and private education scrambled to set up distance learning procedures and soon discovered that pockets of students needed tailored solutions for access to hardware and to Wi-Fi. Health care providers had a new reliance on connectivity to bridge isolated patients through telehealth. Businesses who could remain open or tried to remain open looked to Internet sales to shore up lost revenue. Nonprofits adjusted annual plans to effectively serve their target populations virtually. Government relied on social media and websites to keep constituents informed on the latest developments and procedures.

The common thread was broadband. The resulting solutions adopted underscored our ongoing dependence on our broadband infrastructure. Previously considered an amenity and not prioritized, broadband's efficacy in every aspect of our lives could not be ignored.

DCCA and its BAAC members responded with an array of initiatives to aid those stranded by inadequate or lack of Internet service. A Wi-Fi pilot evaluates the feasibility and cost of providing residents with free internet access at government locations.

Another designated 100 sites. Another tool to allows residents to report their home wireline internet speeds to create a crowd-sourced map. To supplement federal and other maps underserved or unserved areas, a map tool enables residents to pinpoint locations of no Internet service.

The State's Broadband Strategy Officer in collaboration with the nonprofit organizations Transform Hawaii Government and the Economic Development Alliance of Hawaii began gathering an informal Hawaii Broadband Hui. Its initial focus centered on broadband-related initiatives that would enable Hawaii to weather the impacts of the pandemic, such as offers from providers to ease connectivity to students and homes. The premise drew participation from more than 200 empowered leaders from businesses including the carriers and providers; federal, state, and county levels of government; public and private education; and nonprofits with community initiatives. Themes that emerged from the discussions led to focus groups to delve deeper into overcoming specific barriers to solutions. The Hui is also clarifying where community investment is most needed to address digital equity among the residents of Hawaii.

Against this backdrop, the Hawaii Broadband Strategic Plan builds on the collaborative energy and spirit of Hawaii's social capital to position Hawaii's economy for a stronger, more resilient future.

Strategic Goals and Actions

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.

Vision Statement
Hawaii Broadband Task Force
2008

Our ability to access, to connect our families to the world, to create jobs, to educate our people, that's what's going to restore us. We can't do this if we are not connected. This is about the survival of Hawaii.

Jack Wong
CEO
Kamehameha Schools
Hawaii Broadband Hui meeting, August 19, 2020

It isn't usually until crisis or dramatic changes in society occur that risk and opportunity lock steps. In the past decade there have been numerous attempts to lift the opportunities and inequities of Internet access as a tool for new industry and foundational infrastructure in modern economics for all of Hawaii. The advantages, barriers, and opportunities have been documented and reported to hopefully inspire the investments of capital, policies, and programing necessary to provide equity and more in this high-speed communication world.

It would be good to recognize who can take advantage of high-speed access. The answer is simple: Anyone and everyone who has access, the necessary tools, and computer literacy. With open network protections, tool has no bias for the user. What might the advancing of Hawaii's Broadband Initiative mean to a community that has overall a higher tolerance and acceptance of differences in people? What might it mean to a community that has lenses of creativity and innovation because of our

limited natural resources and geographic isolation? What might it mean to a community which is much more relational than transactional in culture? What might it mean for a community that is risking boldly on a sustainability future and in so doing inviting innovation? It opens, inspires, and elevates the brilliance within the people of Hawaii.

The closing of pineapple production on Lanai in 1992—after 40 years of operation—was devastating to a community whose entire economy was based on agriculture. The pivot that was easiest and natural was to align with Hawaii's largest industry. It was imperative that products or services to import dollars were needed to replace pineapple for the people of Lanai and tourism was the chosen venture. For a community who worked through four generations in pineapple it must have been a difficult transition but, without any real options for their own economic sovereignty, they shifted.

Like Lanai in 1992 we find ourselves at a crossroads of change. This time the risk can be our own, the investments of ourselves can be leveraged to inspire others to join us and instead of being a laboratory for others we can be a resource for other laboratories. Broadband is our link to a future of greater resiliency and promise for Hawaii's future.

The following goals, objectives, and strategies are a path for strengthening and expanding broadband in Hawaii. It is timely for us to embrace the risk and tackle the opportunity to support all the islands and residents of Hawaii.

GOAL 1 :: Ensure Robust Broadband Infrastructure to All Hawaii Residents

Hawaii's unique island geography requires a wide range of infrastructure and technologies to provide broadband connectivity both across the State and with the rest of the world. With approximately 70% of Hawaii's residents living on Oahu, it is a challenge for providers to create an economically viable market in the much less densely populated areas of the islands outside of Oahu. Most of the areas of the State without broadband service or service fall below the Federal Communications Commission's definition of broadband and are on the islands outside of Oahu, i.e., Hawaii, Lanai, Molokai, Kauai, and Maui.

In addition to emphasizing broadband as fundamental to life and business today and to Hawai`i's future, the COVID-19 crisis also reiterated the digital divide by highlighting disadvantages posed to those without Internet access. The transition to remote work, virtual learning, and telehealth underscored the importance of ensuring statewide access to affordable Internet and exposed significant gaps in connectivity.

OBJECTIVE 1

Advance policies, programs and initiatives to public and/or private investment in broadband infrastructure

- Identify and map specific infrastructure of rural communities across the State to determine a more accurate understanding of need
- Reduce the costs and delays associated with permitting, regulatory, and acquisition processes
- Create incentives and leverage public assets including rights of way, antenna siting, easements, and joint pole agreements to attract infrastructure development for new technology operations and applications

OBJECTIVE 2

Foster public/private partnerships to develop broadband infrastructure

- Identify opportunities and timing for joint development of new fiber facilities and other critical broadband infrastructure
- Seek federal and other opportunities for funding of broadband infrastructure
- Continue to work with the First Responder Network Authority and its contractor to efficiently utilize the Nationwide Public Safety Broadband Network for use by local first responders and public safety agencies
- Leverage utility infrastructure for extending connectivity to underserved or unserved areas
- Leverage cable franchise obligations for I-Net, especially dedicated fiber to public facilities

OBJECTIVE 3

Increase transpacific submarine fiber connectivity

- Aggressively promote and create incentives for the landing of transpacific submarine fiber optic cables
- Create carrier neutral, shared access, fiber-ready submarine cable landing stations on each of the major islands to induce additional submarine fiber cable projects to the State

OBJECTIVE 4

Secure broadband access sites on each island

- Make 10 gigabit symmetric services available on each island at designated research centers and at technology development and commercialization centers
- Create broadband improvement zones on each island with access to broadband services
- Coordinate infrastructure projects between the public and private sector to create areas for deployment of broadband zones for businesses
- Attract open access landing stations to support bringing the capacity ashore
- Leverage existing State network assets especially Research and Education Networks and public safety for all community anchors
- Foster inter-island connectivity to support the in-state distribution of capacity, including resilience in this layer
- Create fully redundant and resilient fiber optic infrastructure and fiber rings on each island
- Plan and develop dedicated network connections for every public facility and community anchor institution that could serve as a disaster response or recovery facility

GOAL 2 :: Expand Digital Inclusion and Adoption to Achieve Digital Equity

The National Digital Inclusion Alliance defines inclusion as the activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to and use of information and communication technologies.
Accurate estimates of statewide broadband inclusion and adoption rates in Hawaii in general and home broadband adoption rates in particular are difficult 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 70-80%, with home broadband adoption falling within the middle of that range. During COVID however, significant gaps emerged especially as schools scrambled to erect distance learning channels, businesses worked to implement work-from-home practices, and social services attempted to meet the demands of clients remotely.

Hawaii is challenged by several barriers to broadband inclusion and adoption. Insufficient data on the availability and coverage of broadband especially in remote areas. The business case for providing broadband is not sufficient to justify infrastructure investment, unless supplemented by federal or other grants. Cost or affordability of services and the lack of financial resources to purchase a service plan or a desktop, laptop or other devices underscore the challenge of the digital divide. Even if costs and coverage barriers are addressed, digital illiteracy prevents maximum benefit from broadband access to those unserved or underserved.

OBJECTIVE 1

Identify and remove barriers to access and adoption to unserved and underserved

- Continue to convene the Hawaii Broadband Hui to regularly identify barriers to broadband access statewide and develop solutions to overcome them
- Enable community access to connectivity 24/7/365 at public schools and colleges, libraries, fire stations, and other community anchor institutions
- Ensure connectivity and devices to all students and teachers to bridge digital divide
- Support public, private and community training programs that promote digital literacy, including teachers and families
- Leverage community anchor networks between each public/community facility

- Leverage the cable franchise I-Net obligation to underserved areas
- Secure and maintain relevant demographic data on target populations

OBJECTIVE 2

Address affordability for income-limited households

- Identify all Lifeline eligible residents and develop consumer information to enlist more low-income residents in those programs
- Develop and implement provider and consumer incentives to address last mile installation and/or service plans
- Enlist employers to help identify and meet affordability needs of their employees to support a telework environment
- Support recycling, refurbishment, and reuse of computers and other devices

OBJECTIVE 3

Conduct public awareness and outreach of broadband as a basic need

- Emphasize broadband as a basic need for community and economic wellbeing including education, health care, governance, and communications to policy makers
- Enlist the Hawaii Broadband Hui and other community-based groups to communicate broadband as a basic need
- Tailor public awareness and outreach to least served populations and geography with consideration for linguistic, cultural, generational, and literacy challenges
- Collaborate with state libraries to augment public awareness initiatives to underserved and unserved
- Incorporate value of connectivity as means to stay connected with culture and to protect the environment

OBJECTIVE 4

Secure resources to sustain digital inclusion solutions

- Leverage public, private, nonprofit, and community collaborations to provide funding and in-kind support for digital inclusion

- Emphasize digital equity and inclusion through digital literacy messaging to address e.g. accessibility, linguistic, cultural, generational, and literacy challenges in seeking resources

GOAL 3 :: Enable Hawaii to Thrive through a Digital Economy

Broadband is fundamental to life and business today. It is the retail operation instantly transmitting sales to its bank account. It is a visitor reserving a hotel stay. It is the orthopedic surgeon accessing a patient's X-ray instantly from the diagnostic lab. It is the telescope operator of a defense contractor capturing images of objects in space. It is the utility precisely balancing energy demands of residential and commercial customers. It is a researcher uncovering a technology breakthrough through visualization.

Seemingly overnight, the coronavirus upended how we functioned. The effects were devastating on the state's economy. Jobs transitioned from in situ to teleworking from home, classrooms pivoted to virtual learning, and telehealth replaced in-office visits. COVID-19 brought into sharp focus Hawaii's broadband capability—or lack of it—as the state and the counties sought effective responses to the prolonged economic challenge.

We cannot survive without continuing to invest in broadband. Our island economy and all of its sectors can only recover and then thrive by enhancing, expanding, and building on our broadband infrastructure. The World Economic Forum Global Future Council estimates that "70% of new value created in the economy over the next decade will be based on digitally enabled platform business models" and reinforces the role of broadband to create new opportunities that improve the economic and social well-being of Hawaii's residents.

OBJECTIVE 1

Empower DBEDT's Broadband and Digital Equity Office to achieve economic development goals in broadband

- Create a Broadband and Digital Equity Office in the Department of Business Economic Development and Tourism to pursue the economic objectives and realize

the opportunities of broadband

- Collaborate across state departments and agencies to advance broadband objectives
- Coordinate with the Hawaii Broadband Hui on addressing economic development challenges and opportunities for broadband
- Publicize Hawaii's broadband capabilities and related assets to attract development, projects, and investment
- Secure demonstration projects that build on Hawaii's broadband infrastructure
- Assist broadband projects with navigating through the process of starting up or expanding in Hawaii
- Annually survey small businesses statewide to assess their current practices and needs re connectivity
- Develop a Broadband Dashboard to track progress and gaps that will inform decision making in business development
- Leverage local media production and distribution assets to capitalize on digital media as a broadband demand driver

OBJECTIVE 2

Leverage and bolster the ecosystem of broadband resources to diversify and create job opportunities

- Tap accelerator programs and venture capitalists to target start up activities related to broadband
- Expand workforce development preparation related to broadband careers
- Augment emerging technologies to ensure Hawaii's competitiveness in the foreseeable future, such as artificial intelligence, machine learning, autonomous vehicles, smart cities, big data analytics, augmented reality and e-Sports
- Plan for broadband infrastructure to support smart grid development that will support Hawaii's 2045 renewable energy goals
- Foster collaboration among public, private, and nonprofit organizations in support

of broadband expansion, including community networks

- Track and strengthen capability to secure federal opportunities for funding economic development opportunities related to broadband in the state
- Develop policies to ensure open secure networks that protect net neutrality and consumer/worker privacy
- Address displaced workers through expanded telework opportunities

OBJECTIVE 3

Improve delivery of government services through robust broadband capabilities

- Facilitate innovation and technology transfer culture among government agencies
- Upgrade back-office functions and information technology infrastructure
- Expand broadband applications into the communications, teaching, learning, and work environments
- Enable local first responders and public safety agencies to utilize the Nationwide Public Safety Broadband Network through the First Responder Network Authority
- Support deployment of the Next Generation 9-1-1/e911 (NG9-1-1) nationwide emergency services system
- Develop and deploy tele-health applications to support health information exchange, advanced diagnosis, consultation and treatment for residents
- Increase electronic access to all government records, services, and proceedings
- Increase use of social media and the Internet to communicate with citizens and increase their participation in government

GOAL 4 :: Strengthen Community Resiliency through Broadband

As defined by the RAND Corporation, community resilience is the sustained ability of a community to use available resources (energy, communication, transportation, food, etc.) to respond to, withstand, and recover from adverse situations (e.g. economic collapse to global catastrophic risks. This can only happen if systems are in place or are created in times of peril and crises to connect individuals and groups and allow

them to coalesce to meet collective needs. Broadband is essential to enabling that interconnection.

The Hawaii Broadband Hui provides a model that has enabled and empowered disparate individuals and groups to convene around the shared goal of finding solutions to the devastation wrought by COVID. The weekly forum initially attended by 20 people has attracted more than 200 individuals, representing the private sector, nonprofits, wireline and wireless carriers, and federal, state and county administrative and legislative officials. Participants initiated projects and have found in-kind and funding opportunities from forum colleagues. Subgroups have organically formed to more efficiently dive into strategic solutions.

OBJECTIVE 1

Interconnect the functions and operations of public, private and community networks

- Establish and annually convene island-based collaborative planning teams of public, private, and nonprofit stakeholders to address broadband resilience framework
- Annually assess current geographically specific conditions and risks and update strategies that relate to broadband infrastructure including communications, carrier/provider capabilities, recovery priorities
- Create community resilience plans and checklists for broadband for each island to include components such as public awareness, training, hotspots, devices, and partners

OBJECTIVE 2

Maximize open access and ensure timely connectivity to critical network infrastructure during crises

- Leverage broadband capabilities to aid first responders, to coalesce community networks, and to mobilize volunteer engagement
- Prioritize staffing and connectivity at community anchor institutions such as libraries, community centers, schools, etc.
- Restore and maintain connectivity to business to protect the viability of businesses and the livelihoods of residents

Hawaii's Broadband Landscape

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. More specifically, broadband is defined as a data transmission service that enables end users (government, business, schools, residents) 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).

This section provides a snapshot of the current broadband landscape across the State including an overview of the State's existing telecommunications systems, a technical overview of the distinct segments of physical infrastructure required, the types of technology used to provide broadband connectivity in our island state, and the current transpacific and interisland broadband infrastructure.

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, 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, presents a more

formidable challenge than that faced by most states on the U.S. continent. 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 describes the broadband systems used to provide most consumer Internet access in the State, 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 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. Although this Strategic 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.

Broadband Systems Overview

Several 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).

Wireline Technologies

- Coaxial/DOCSIS. A cable broadband system operates utilizing cable television infrastructure. In Hawaii, cable system serves almost 400,000 cable television subscribers statewide. A limitation of this system is that it carries less bandwidth than fiber. However, evolving technologies to address bandwidth limitations continue to allow cable operators to deploy higher data speeds over existing cable networks.

- xDSL System. A Digital Subscriber Line (DSL) system operates using wireline copper

cable infrastructure. The primary advantage of this system is that it can provide broadband service utilizing much of a provider's existing and widespread telephone infrastructure. A limitation of this system is that it carries less bandwidth than fiber and is distance sensitive. However, similar to improved cable system technologies that allow for greater speeds, evolving technologies continue to increase DSL speeds.

- 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. In addition, all of the wireless carriers in Hawaii have the majority of towers and antennas connected by fiber systems for traffic "backhaul" and are in the process of upgrading a majority of these sites to fiber.

Wireless Technologies

- 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, 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.

- Satellite Systems. Satellite systems use communications satellites for broadband transmissions. The primary advantage to satellite technology is that it may reach 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 may be blocked by mountains and structures. Also, the distance signals must travel to and from the satellite creates inherent delays in the delivery of the signals. This latency may often result in data loss during transmission; the inability to establish a secure connection, such as a Virtual Private Network (VPN); or the inability to maintain a connection. Because of these current limitations, satellite is not a viable option to provide widespread, affordable, secure, reliable, high-speed broadband service in Hawaii at this time. For this reason, this Plan excludes further discussion of satellite technology.

- 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

  Most of the major wireless providers provide 4G LTE technology to deliver faster data speeds, although coverage is poor or nonexistent in various rural areas. Higher speeds may be possible in the future such as 5G is developed and deployed based upon demand but is not expected to be prevalent in rural areas.

- Wide Area Wi-Fi 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.

Infrastructure Segments

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

- 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. While transpacific telecommunications cables once needed to land in Hawaii as a technological necessity, making Hawaii a crossroad for transpacific telecommunications, advancements in submarine fiber optic technology now allow transpacific crossings to bypass Hawaii and connect Asia and North America directly 2009. 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.

- New cables with landings in Hawaii are SEA-US (2017) and Hawaiki (2018). This new capacity will be sufficient to serve Hawaii in the near future.

  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. Because current technology allows new transpacific fibers to bypass Hawaii.

- 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.

There are currently three interisland cables connecting all of the major islands. The largest risks with interisland fiber connectivity are in three main areas:

- Common cable landing locations for interisland cables (terminating in the same or adjacent beach manholes)
- The age of the existing interisland cables (all but 1 were deployed in the 1990s) and are approaching their useful service life
- Extremely high costs and permitting requirements in Hawaii to deploy new cable landing

- On-Island Connectivity. Almost all of the telecommunications systems utilize fiber optic cabling for their on-island backbone infrastructure to connect services between electronics.

- "Last Mile" Connectivity. The term "last mile," also referred to as "first mile" from a rural and indigenous community perspective, 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 and population densities do not provide a sufficient market to support the deployment.

Broadband Availability

The 2012 Legislature required providers to report 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 helps the State in its efforts to more accurately determine the status of broadband access in the State.

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.

Unserved and Underserved Areas

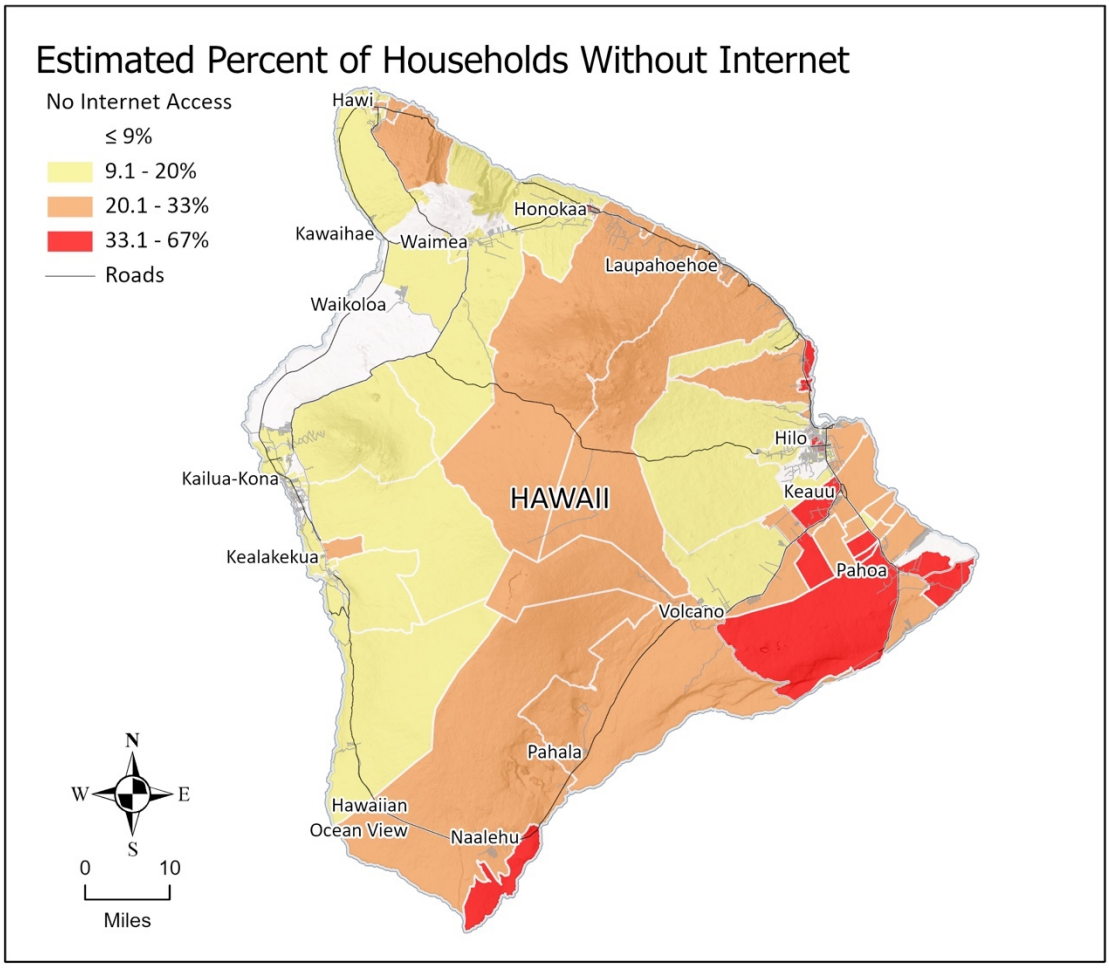
Efforts are being made to accurately map unserved areas of the State, as well as underserved Identification of unserved and underserved areas are the most complicated to identify and normally the costliest to service.

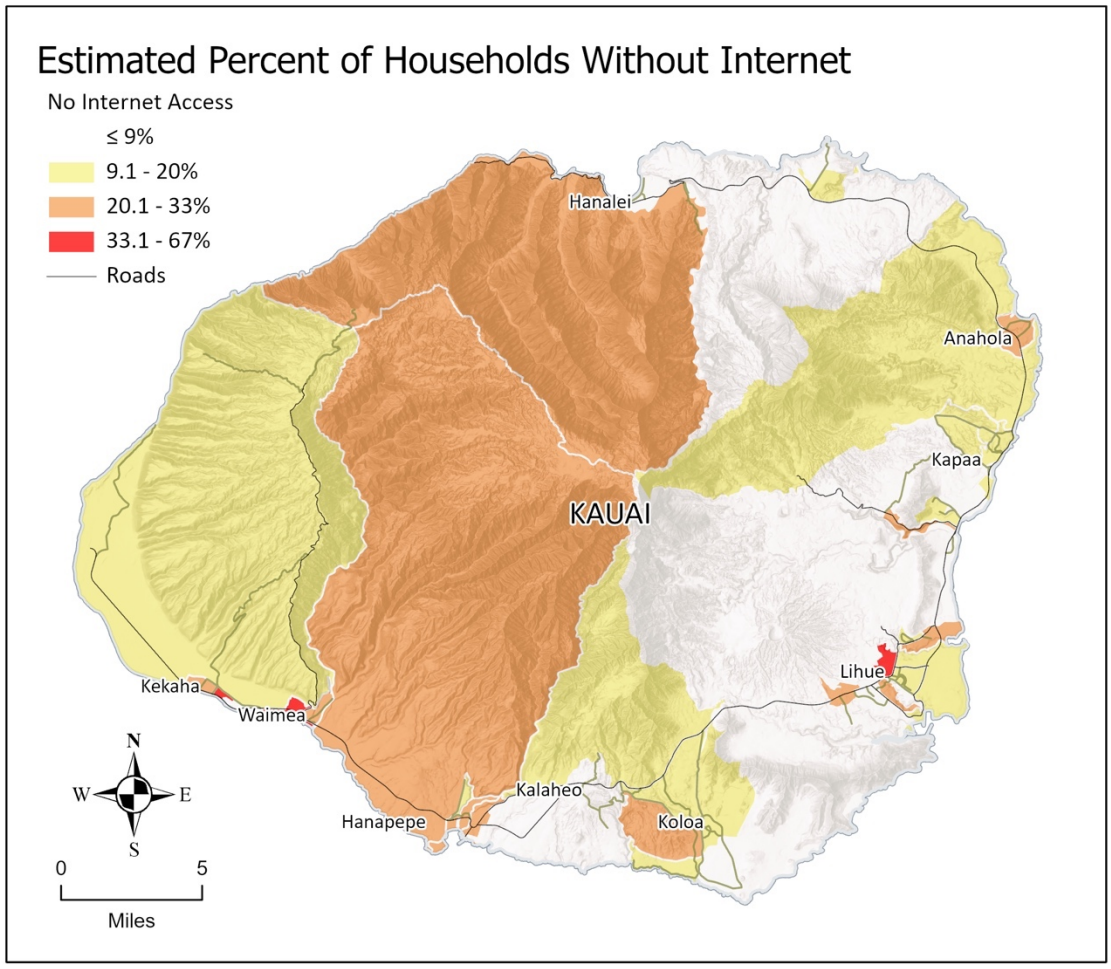
For unserved areas, identification of the exact locations and potential subscribers pose several challenges. Current subscribers of non-broadband services, such as voice or cable are easily identifiable by their respective service providers. However, not every current subscriber has a valid living address. In many cases, there is no postal delivery service nor do some of the counties provide an address unless specifically requested by the owner. There is also a proliferation of building structures in residential areas erected without a building permit, which also makes identification through public records unreliable. Determining the potential serving area and population density therefore is understated and subsequently lessens the potential of service providers to invest in an area.

Federal (FCC and USDA) identification of unserved and underserved areas only go down to the census block level. Although this is an easy method for calculating funding and potential locations in a given area nationwide, there are significant variances at a local level which in some cases completely bypass areas needing of investment. As an example, the federal government will not provide grant funding for any census block where at least one location is determined to be serviced by broadband. In an area of multiple square miles and several tens of unserved locations, they will be completely bypassed because of a single customer.

The majority of locations in Hawaiian Homelands who are in unserved and underserved areas are not eligible for any federal funding as the incumbent service provider is no longer an Eligible Telecommunications Carrier. The following maps illustrate the

disparity of access to Internet across communities of the state:





HAWAII STATEWIDE GIS PROGRAM
HAWAII STATE OFFICE OF PLANNING

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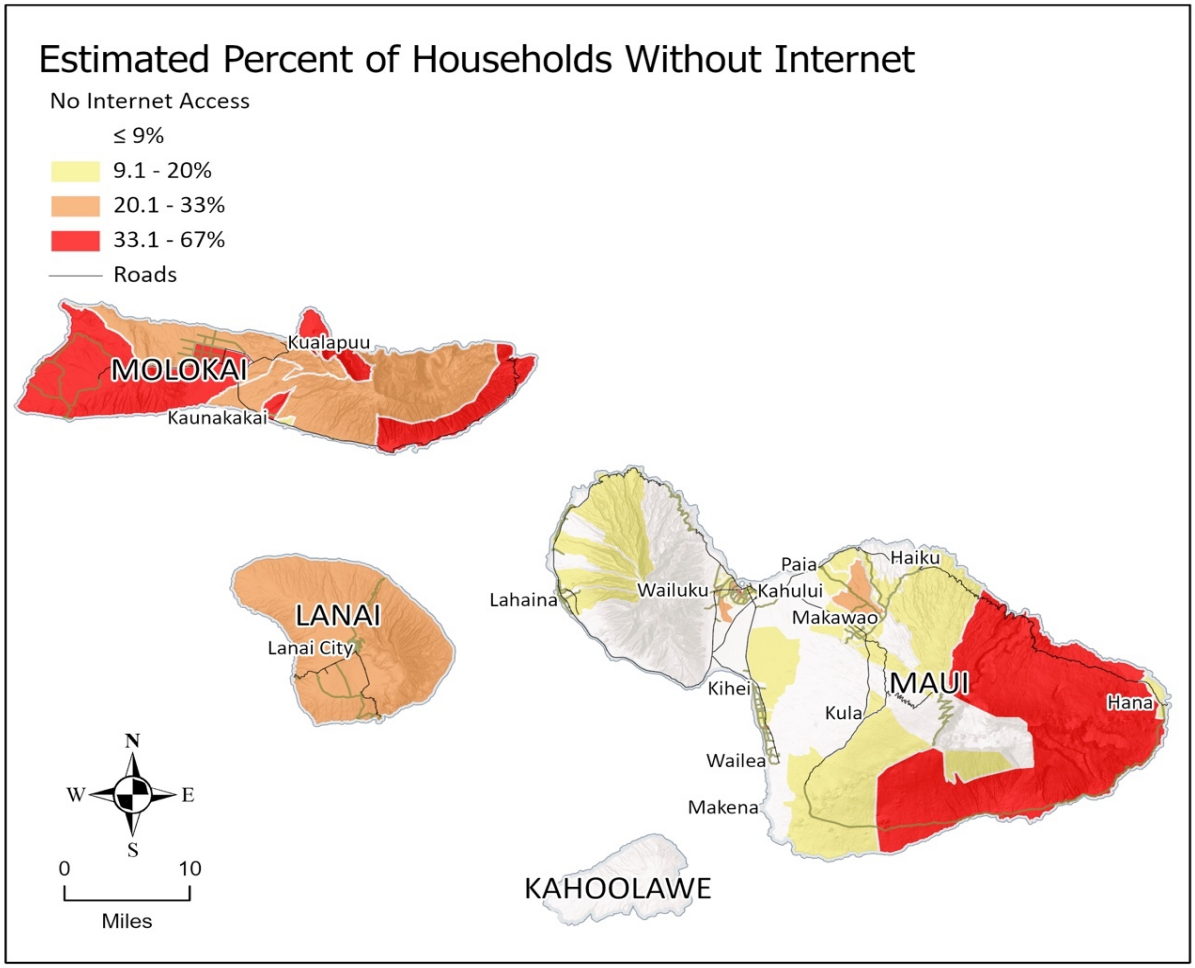
Map No: 20201019-CC
Map Date: 10/19/2020
Sources: U.S. Census 2014-2018



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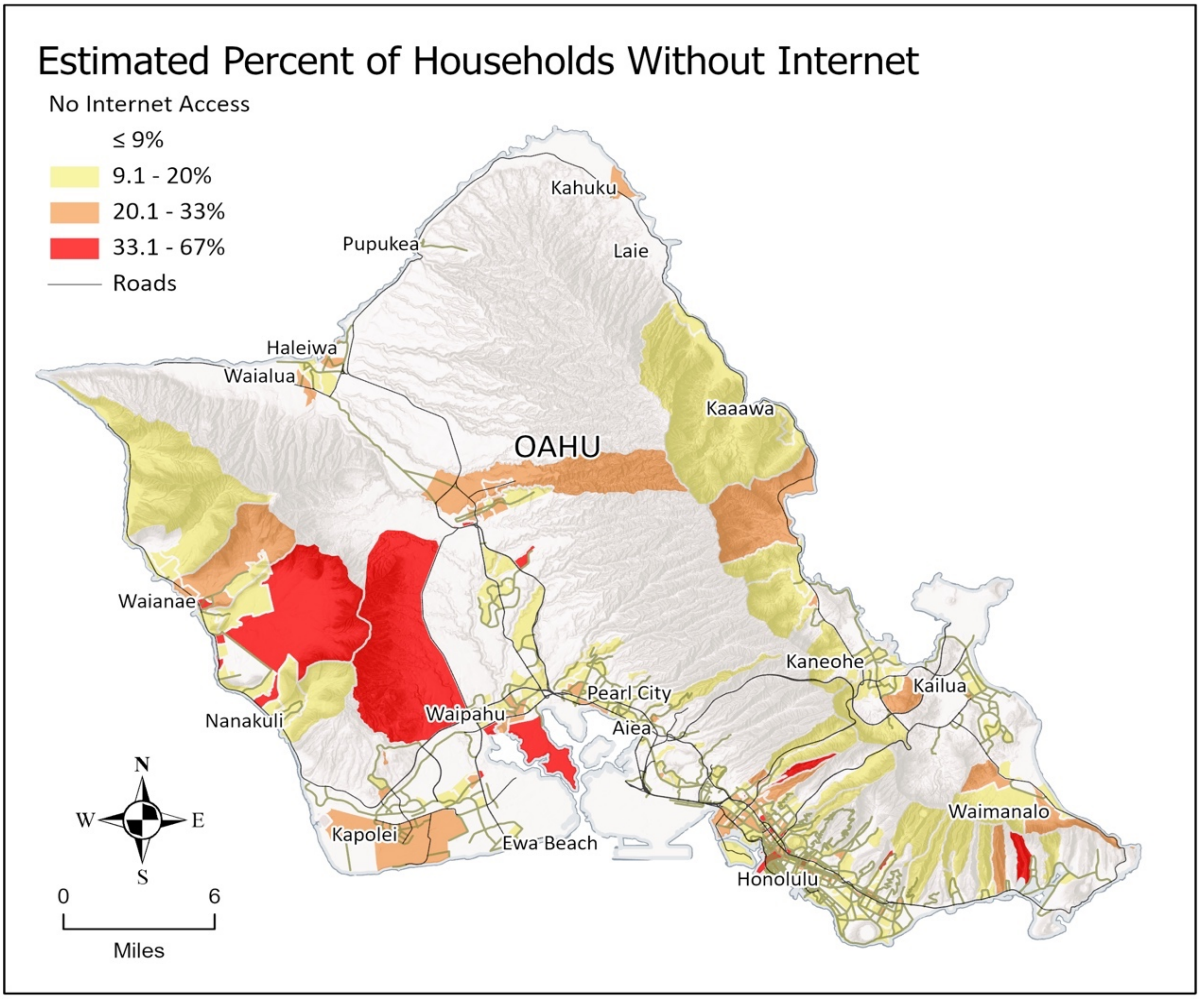
Map No: 20201019-CC
Map Date: 10/19/2020
Sources: U.S. Census 2014-2018



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Map No: 20201019-CC
Map Date: 10/19/2020
Sources: U.S. Census 2014-2018

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.

Geography and Environment

Hawaii's unique geography and environment create unique and difficult challenges for the deployment and maintenance of broadband infrastructure. 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. Located in the middle of the Pacific Ocean, it is the most isolated population center on Earth.

Distances from Hawaii

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. 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, 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.

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. In some rural and remote areas of the islands, providers must also overcome the lack of commercial electricity.

Even the rainwater, 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, 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."

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 Iwa passed through the islands of Niihau, Kauai, and Oahu with wind gusts of over 100 mph in 1982. Ten years later, Hurricane Iniki, 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. 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. Saltwater 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.

Population Demographics

Between 2014 and 2018, Hawaii's average population was 1,422,029. This population was highly concentrated on the island of Oahu, where approximately 70% of the population resided. The remaining 30% of the population was 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 2018 Hawaii had an average of 240,341 visitors present in the State per day, and 9,761,448 visitors in 2018 who stayed overnight or longer. The State's four counties are roughly designated by island:

- County of Kauai (the islands of Kauai and Niihau)
- City and County of Honolulu (the island of Oahu)
- County of Maui (the islands of Maui, Molokai, Lanai)
- County Hawaii (the island of Hawaii)

The 2014-2018 average population density by county and by island is as follows:

Resident population and population density by county and island, 2014-2018 average

County and Island	Resident Population	Land Area (sq miles)	Population Density (per sq mile)
State Total	1,422,029	6,422.63	221.4
County			
Honolulu	987,638	600.74	1,644.0
Hawaii	197,658	4,028.42	49.1
Maui 1/	165,356	1,173.51	140.9
Kauai	71,377	619.96	115.1
Island			
Oahu	987,638	597.64	1,652.6
Hawaii	197,658	4,028.42	49.1
Maui	155,707	771.99	201.7
Lanai	2,826	141.07	20.0
Molokai	6,823	260.46	26.2
Kauai	71,377	552.35	129.2
Niihau	2/	67.60	2/

1/ Includes Kalawao County, whose 2014-2018 average population was 75.
2/ No population estimates are available for the 2014-2018 time period. The 2010 decennial census population was 170, with a population density of 2.5.

For the period between the years 2000 and 2010, the County of Hawaii experienced the largest annual average growth followed by the County of Maui. That pattern held between 2010 and 2018:

Average annual growth for the State of Hawaii and its counties

Period	State Total	City and County of Honolulu	Hawaii County	Kauai County	Maui County 1/
1990-2000	0.9	0.4	2.1	1.3	2.4
2000-2010	1.2	0.9	2.2	1.4	1.9
2010-2018	0.5	0.3	1.0	0.9	1.0

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.

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

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

Hawaii has a very multi-ethnic and multiracial population, which reflects a large immigrant population from Asia and the South Pacific. Between 2014-2018, the racial makeup was as follows:

Race alone from 2014-2018
American Community Survey

10.1%	Native Hawaiian and Other Pacific Islander
25.0%	White
37.8%	Asian
24.0%	Two or more races
3.1%	Some other race

Race alone or in combination with other races from 2014-2018 American Community Survey

43.1%	White or part-White
56.5%	Asian or part-Asian
26.2%	Native Hawaiian and Other Pacific Islander, part-Hawaiian or part-Pacific Islander
8.4%	Some other race or races

State's Role in Cable TV, 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: cable TV, land use regulation, and education. Land use in Hawaii is the most regulated of all the fifty states. Providers seeking to deploy broadband infrastructure must contend with layers of permitting and approvals at both the State and county levels. According to many providers, the State and county permitting and approval processes for infrastructure deployment can take years, even for upgrades to existing infrastructure. 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 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.

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:

- Spectrum, the incumbent cable television provider, with approximately 288,000 subscribers and
- Hawaiian Telcom, the State's primary Incumbent Local Exchange Carrier (ILEC), 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 that own and operate a wireless metro Oahu broadband network providing both middle mile and last mile connectivity. Many smaller companies 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.

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.

Characteristics Specific to Each County

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 about 70% of the State's total population. 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. Between 2014-2018, 91% of households had a computer and 85.3% had a broadband Internet subscription.

The following table reflects the resident population for the county and by district, and the percentage change between 2005-2009 and 2014-2018.

Resident Population and Population Change
for 2005-2009 and 2014-2018, Honolulu County

District	2005-2009 population	2014-2018 Population	Percent Change
State total	1,280,241	1,422,029	11.1
Honolulu County	**902,564**	**987,638**	**9.4**
Honolulu	374,567	401,549	7.2
Koolaupoko	113,230	112,189	-0.9
Koolauloa	18,923	20,738	9.6
Waialua	13,812	13,442	-2.7
Wahiawa	35,327	44,706	26.5
Waianae	42,771	50,127	17.2
Ewa	303,934	344,887	13.5

Between 2014-2018, the county's racial makeup was as follows:

Race alone from 2014-2018
American Community Survey

9.5%	Native Hawaiian and Other Pacific Islander
21.0%	White
42.5%	Asian
23.5%	Two or more races
3.5%	Some other race

Race alone or in combination with other races from 2014-2018
American Community Survey

38.5%	White or part-White
61.2%	Asian or part-Asian
24.9%	Native Hawaiian and Other Pacific Islander, part-Hawaiian or part-Pacific Islander
8.9%	Some other race or races

The median age was 37.6 years old. Children under 18 made up 21.4% of the population, and 16.9% of the population was 65 years and older. About 34% of the population aged 25 years and older had a Bachelor's degree or higher. The percentage of people in poverty was 8.7%.

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 about 12% of the State's total population. Between 2014-2018, 90% of households had a computer and 83% had a broadband Internet subscription.

During the period between 2005-2009 and 2014-2018, Maui County's population increased around 16%, with Wailuku and Lahaina experiencing the largest population gains and Hana experiencing the largest population losses.

Resident Population and Population Change for 2005-2009 and 2014-2018, Maui County

District	2005-2009 population	2014-2018 population	Percent change
State total	1,280,241	1,422,029	11.1
Maui County	**142,274**	**165,356**	**16.2**
Hana	2,267	1,642	-27.6
Makawao	41,316	43,846	6.1
Wailuku	69,034	86,986	26.0
Lahaina	19,367	23,233	20.0
Lanai	2,868	2,826	-1.5
Molokai	7,344	6,748	-8.1
Kalawao	78	75	-3.8

Maui County includes Kalawao County

Between 2014-2018, the county's racial makeup was as follows:

Race alone from 2014-2018 American Community Survey

11.1%	Native Hawaiian and Other Pacific Islander
35.5%	White
29.2%	Asian
22.2%	Two or more races
2.1%	Some other race

Race alone or in combination with other races from 2014-2018 American Community Survey

52.9%	White or part-White
46.6%	Asian or part-Asian
25.9%	Native Hawaiian and Other Pacific Islander, part-Hawaiian or part-Pacific Islander
6.3%	Some other race or races

The median age was 41.1 years old. Children under 18 made up 22% of the population, and 17% of the population was 65 years and older. Of the population aged 25 years and older, 26.5% had a Bachelor's degree or higher. The percentage of people in poverty was 9.7%.

Island of Maui. Maui is the third most populated island and 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.

Island of Molokai. Molokai, the fifth largest of the Hawaiian Islands, is sparsely populated with less than 7,000 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 under 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.

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. Between 2014-2018, 86% of households had a computer and about 75% had a broadband Internet subscription. 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 89 earthquakes with a magnitude of 5.0 or greater between 1974 and 2019.

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. 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.

Hawaii County participated in a federal pilot project that provided wireless broadband based on 4G LTE technology for research and public safety applications. During the period between 2005-2009 and 2014-2018, Hawaii County's population increased around 11%, with Puna experiencing the greatest population gains and Hilo experiencing the greatest population losses.

Resident Population and Population Change
for 2005-2009 and 2014-2018, Hawaii County

District	2005-2009 population	2014-2018 population	Percent change
State total	1,280,241	1,422,029	11.1
Hawaii County	**172,370**	**197,658**	**14.7**
Puna	33,975	46,768	37.7
South Hilo	55,437	52,936	-4.5
North Hilo	1,755	1,510	-14.0
Hamakua	6,431	6,672	3.7
North Kohala	5,161	6,045	17.1
South Kohala	16,693	19,855	18.9
North Kona	37,703	43,631	15.7
South Kona	8,565	10,768	25.7
Kau	6,650	9,473	42.5

Between 2014-2018, the county's racial makeup was as follows:

Race alone from 2014-2018
American Community Survey

12.4%	Native Hawaiian and Other Pacific Islander
33.5%	White
22.5%	Asian
28.7%	Two or more races
2.9%	Some other race

Race alone or in combination with other races from 2014-2018
American Community Survey

55.4%	White or part-White
43.3%	Asian or part-Asian
33.4%	Native Hawaiian and Other Pacific Islander, part-Hawaiian or part-Pacific Islander
8.2%	Some other race or races

The median age was 42.3 years old. Children under 18 made up 21.9% of the

population, and 19.3% of the population was 65 years and older. Of the population 25 years and older, 29.5% had a Bachelor's degree or higher. The percentage of people in poverty was 16.6%.

County of Kauai

The County of Kauai consists of the oldest islands of Kauai and Niihau. It has approximately 619.96 square miles of land area and is home to 5% of the State's population. Between 2014-2018, about 89% of households had a computer and around 81% of households had a broadband Internet subscription.

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.

During the period between 2005-2009 and 2014-2018, Kauai County's population increased around 11%, with Lihue experiencing the largest population gain and Hanalei experiencing the largest population loss.

Resident Population and Population Change
for 2005-2009 and 2014-2018, Kauai County

District	2005-2009 population	2014-2018 population	Percent change
State total	1,280,241	1,422,029	11.1
Kauai County	**63,033**	**71,377**	**13.2**
Hanalei	6,684	6,232	-6.8
Kawaihau	19,890	21,480	8.0
Lihue	14,551	18,272	25.6
Koloa	13,702	15,820	15.5
Waimea	8,206	9,573	16.7

Between 2014-2018, the county's racial makeup was as follows:

Race alone from 2014-2018
American Community Survey

9.0%	Native Hawaiian and Other Pacific Islander
32.5%	White
34.0%	Asian
22.6%	Two or more races
1.8%	Some other race

Race alone or in combination with other races from 2014-2018
American Community Survey

49.4%	White or part-White
51.3%	Asian or part-Asian
24.8%	Native Hawaiian and Other Pacific Islander, part-Hawaiian or part-Pacific Islander
5.4%	Some other race or races

The median age was 42.4 years old. Children under 18 made up 22% of the population, and about 19% of the population was 65 years and older. About 30% of the population 25 years and older had a Bachelor's degree or higher. The percentage of people in poverty was 8.8%.

Island of Niihau. The County of Kauai also includes the privately-owned island of Niihau, which had a population of 170 in the 2010 decennial census. 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. 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, no Internet or email system is available to Niihau School.