“BROADBAND-IN-A-BOX” for TRIBAL LAST MILE

Broadband Plan for SWAMC Economic Development District

A “SHOVEL READY” BROADBAND PLANNING GUIDE TO HELP ALASKA NATIVE TRIBES APPLY FOR FEDERAL FUNDING TO DEPLOY BROADBAND INFRASTRUCTURE & IMPROVE BROADBAND SERVICES IN SOUTHWEST ALASKA COMMUNITIES.

- **“BROADBAND-IN-A-BOX” PLAN FOR DEPLOYMENT OF THE POWERFUL TRIBAL OWNED 2.5 GHZ SPECTRUM AWARDED BY THE FCC.**
- **USES 2.5 GHZ SPECTRUM TO DELIVER HIGH-CAPACITY BROADBAND SERVICE VIA A FIXED WIRELESS BROADBAND ARCHITECTURE.**
- **STANDARDIZED PLAN ADAPTABLE TO ANY RURAL VILLAGE.**

Prepared for

Southwest Alaska Municipal Conference

by Alaska Tribal Broadband LLC

August 24, 2021

Alaska Tribal Broadband

Our Mission

To empower tribes with access to and ownership of affordable high-speed broadband

About us

Alaska Tribal Broadband is a 100% native owned company based in Anchorage, Alaska whose focus is on delivering affordable high-speed broadband into rural Alaska communities. Our solution connects unserved and underserved Alaskans to the worldwide web at speeds previously unattainable and/or unaffordable. Our objective is to empower your community with a solution that you can own and control. We support tribal ownership & tribal self-determination.

Our Team

Harold Johnston is Alaska Tribal Broadband's Founder & President. Harold is native Hawaiian raised on traditional native Hawaiian homelands. He has run domestic and international operations for AT&T and Verizon, and a rural native-owned telephone company. He is a graduate of the U.S. Naval Academy and holds an MBA from San Jose State University. Harold recently moved to Alaska to be closer to some of his long-time Alaska family members.

Craig Fleener, ATBs' CEO, is a Gwichyaa Zhee Gwich'in Tribal member from Fort Yukon. He has extensive experience in Alaska state and tribal government including experience in wildlife management, tribal governance, and Arctic policy. He is a 35-year US Marine Corps and US Air Force veteran. He has a BSc in Natural Resources Management from the University of Alaska Fairbanks and an MA in Intelligence Studies from American Public University.

Both Johnston and Fleener have served in tribal leadership roles and as military officers and combat veterans. Johnston was a Marine infantry company commander in Viet Nam. Fleener served as an intelligence officer in Afghanistan. He was a U.S. Marine and is now a Lt. Col. in the Alaska Air National Guard. These 2 leaders lead a team of experienced telecommunications professionals committed to improving tribal broadband.

What We Do

Alaska Tribal Broadband plans, designs, engineers, builds and manages broadband solutions in cooperation with a focus on rural communities across Alaska.

Contact

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How We Can Help

Alaska Tribal Broadband is working in partnership with Alaska Village Initiatives and with tribes across Alaska to apply for broadband funding from the National Telecommunication and Information Administration to provide high speed and affordable broadband to every household in their communities. If you need support or would like to join our coalition of tribes, please contact us. Either a letter of support or resolution must be provided before September 1st. In addition to grant writing support AVI/ATB will provide ongoing support to your tribe as you build out your broadband capability. If you need help with setup, installation, engineering, operations, and management, please contact us, we are here to help.

LAST MILE TRIBAL BROADBAND PLAN

SECTION 1: INTRODUCTION to 2.5 GHz SPECTRUM & TRIBAL LAST MILE PLAN

INTRODUCTION

In November 2020, the Southwest Alaska Municipal Conference (SWAMC) commissioned native-owned Alaska Tribal Broadband LLC (ATB) to develop a Broadband Plan (Plan) that would accelerate improvement of broadband service throughout the extensive SWAMC region. This project followed findings of SWAMC's 2018 Southwest Alaska Broadband Study, which underscored that southwest Alaska was at the very bottom of the "digital divide" when it comes to broadband capacity in Alaska. This is a high priority of the past and current long term SWAMC Comprehensive Economic Development Strategy (CEDS).

ATB began the Plan development 2 months after the September 3, 2020 closing of the Federal Communications Commission's (FCC) "Tribal Priority Window", which allowed federally recognized tribes across the country to apply for a license for the 2.5 GHz frequency spectrum. The 2.5 GHz frequency is considered a prime spectrum for the emerging "5G" wireless technology and has excellent broadband capability in terms of speed and data-handling capacity. ATB had been heavily involved in advising tribes on the value of the spectrum and assisting them in applying for the FCC license. Two hundred and fourteen of Alaska's 229 federally recognized tribes applied for the license and have either received or will receive the license shortly. ATB and SWAMC agree that, while it would not solve all the issues, the quickest and most cost-effective way to improve broadband is to deploy the 2.5 GHz throughout Alaska. This Plan focuses on deployment of the 2.5 GHz spectrum asset to the 54 tribes in the SWAMC district covering Bristol Bay, the Alaskan Peninsula, the Aleutian/Pribilof Islands, and the Kodiak Island Archipelago.

PLAN OBJECTIVE, OVERVIEW, AND BENEFITS

The Plan's primary objective is to get tribes "shovel ready" to apply for any funding from state, federal, or private sources that would enable deployment. "Shovel ready" translates to demonstrating to the funding source that you've done your homework and know what you want, how much you need and most importantly, that you have a comprehensive implementation plan upon funding award.

COVID-19 underscored just how bad off Alaska's rural areas are with inferior Internet access compared to urban areas where online access for education, healthcare, commerce, and staying connected with family and friends mitigated some of the pandemic's negative impact. Congress has responded with unprecedented broadband funding with significant set-asides for tribal entities. Available now is the $1 billion Tribal Broadband Connectivity Program (TBCP) grant, with Alaska Tribes expected to get at least $400 million as they represent 40% of the nation's federally recognized tribes. The National Telecommunications and Information Administration (NTIA) grant will be discussed later in this Plan document.

"BROADBAND-IN-A-BOX"

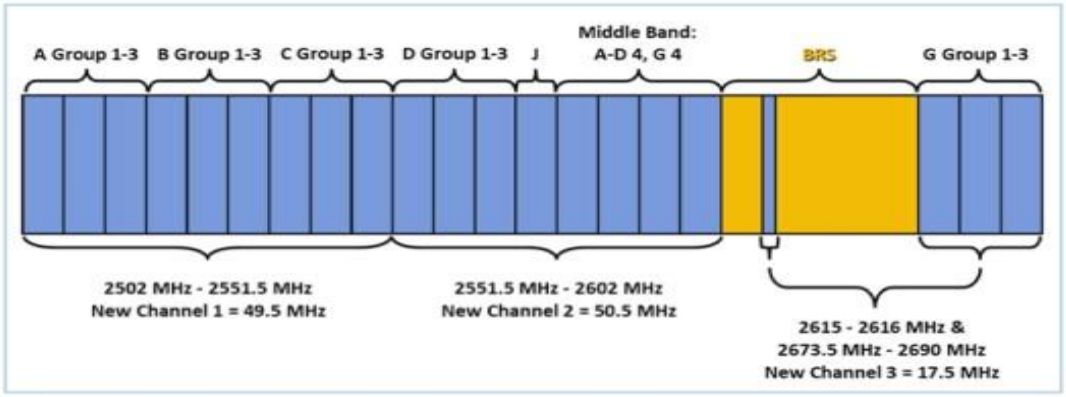
The term, "broadband-in-a-box", is an oversimplification, but it represents the intention to develop a standardized broadband solution that will fit deployment of the tribal owned 2.5 GHz spectrum asset for any Alaska Native Village. While the Broadband-in-a-Box solution requires modification to fit the topology and demographics of each village, the 2.5 GHz portion of the broadband network is standardized. The Plan identifies the equipment, infrastructure, and other cost elements as construction, installation, and shipping that each tribe needs to incorporate into its own comprehensive broadband plan. It provides a benchmark budget by village size to help determine the "what" and "how much" to ask for in applying for a federal fund like NTIA'S TBCP grant. Help is available from ATB and others to support a tribe when "fine tuning" its broadband plan and grant application.

ATB got a head start in planning 2.5 GHz networks by developing comprehensive broadband plans for Alaska Native tribes that it had helped to receive BIA broadband planning grants, as well as the SWAMC contract. A real-time planning boost is coming from ATB's current involvement in planning and implementing Alaska's first tribal owned 2.5 GHz network for the Native Village of Akiak. Akiak received an American Rescue Plan grant to fully deploy a 2.5 GHz capability to deliver a minimum of 25/3 Mbps (download/upload) broadband service – about 10 times faster than the average rural Alaska Native village is currently receiving. This deployment is already yielding new requirements information that will benefit all tribes as they plan and implement their own networks.

2.5 GHZ SPECTRUM LICENSE VALUE

Frequency Spectrum and Ownership: An FCC licensed frequency is no different than a radio station's license frequency – like Bethel's KYUK radio station at 640 megahertz (MHz) "on the dial". No other station can operate at that frequency within the Bethel coverage area. The 2.5 gigahertz (GHz), or 2500 MHz, spectrum is a wide band of frequencies ranging from 2494 – 2690 MHz of *bandwidth*, represented by the blue bars called "channels" in the chart below. The 2.5 GHz license for Alaska tribes will include the entire 117.5 spectrum bandwidth. This is a unique and unprecedented situation. In the Lower 48 and Hawaii, many of those channels are already in use, and tribes in other states will only receive a license for the channels not already licensed to another party. Alaska tribes will own the rights to all 2.5 GHz for their licensed areas, and no one else can use any of the channel frequency within the licensed territory. Licenses are granted for a 10-year period and are renewed every 10 years by a simple notification request form submitted to the FCC. The license asset is also valuable in that it can be handed down to future generations.

2.5 GHz Spectrum –2494-2690 Megahertz of Bandwidth
117.5 MHz (Blue) avail to Tribes vs. Carriers own orange band)*



* Not all BRS channels shown

2.5 GHz Broadband and Monetary Value: The significance of the wide band of frequencies licensed to Alaska tribes is that the wider the spectrum band, the more Internet capacity it has to carry data and video transmission. In comparison, the frequency bands used by cell service carriers typically cover only 10-15 MHz of bandwidth. A tribe should only need about a third of the spectrum band to meet the broadband needs of its own village. The excess 2.5 GHz channels can be leased to other parties (cell phone carriers, government, or private entities) to generate revenue for the tribes. The history of the 2.5 GHz tribal spectrum, which was previously assigned to educational institutions across the country, was that it was primarily used as a revenue generator under long term leases of 10-30 years. The spectrum's monetary lease value in low-density rural Alaska is yet to be determined. Wireless frequency licenses are normally granted by the FCC via auctions for specific geographic areas. Frequency licenses typically represent 30-35% of a cell phone carrier's asset value. This frequency has exceptional value because of its 5G-technology capability. When auctioned by the FCC in other parts of the country, the same frequency that Alaska tribes receive from the FCC at no cost would typically yield billions of dollars.

Cautionary Advisory: ATB advises tribes to be careful not to give away or lease access for long time periods at low costs. Please, fully evaluate your own needs before entering a long-term lease or other arrangement for excess 2.5 GHz frequencies. Tribes should also ensure that they have adequately evaluated the options for spare frequencies and have adequate contractual agreements protecting their rights to this long-term asset should they decide to lease out any portion of the spectrum.

SECTION 2: 2.5 GHz SPECTRUM LICENSE VALUE & BROADBAND NETWORKS

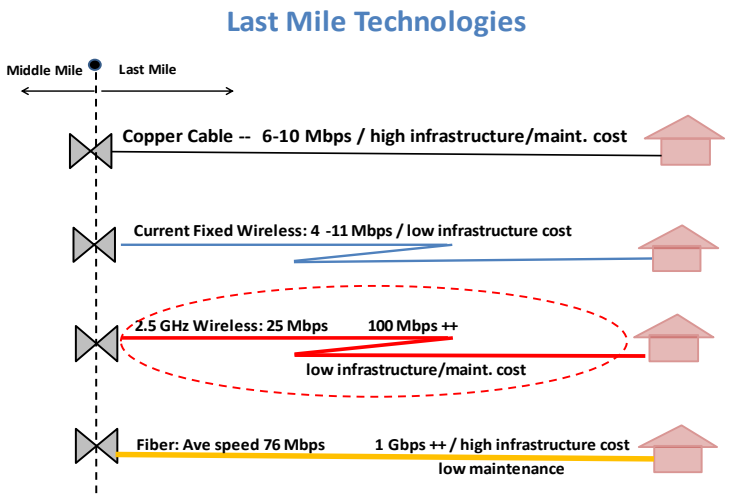
USING 2.5 GHz SPECTRUM TO IMPROVE BROADBAND

Tribal-Owned Fixed Wireless "Last Mile" Network: The immediate benefit of the 2.5 GHz license owned by tribes is to deploy a community-based fixed wireless network that, in broadband terms, is referred to as the "Last Mile". ATB estimates that the tribe will only need a portion the 2.5 GHz frequencies – about a third of the wide bandwidth assigned. The remainder can be leased out to generate revenue for the tribes.

The last mile network connects each home or commercial/government facility to the Internet via a copper or fiber cable, or a wireless medium. In rural tribal communities, most of the Last Mile connections are made by copper cable or low-capacity unlicensed wireless frequencies. In many cases, the community Last Mile infrastructure does not exist. A few tribal households have had access to satellite services, but that capacity has generally been exhausted for several years. Only a few rural tribal communities are connected to the Internet by fiber networks, referred to as Fiber to the Home (FTTH).

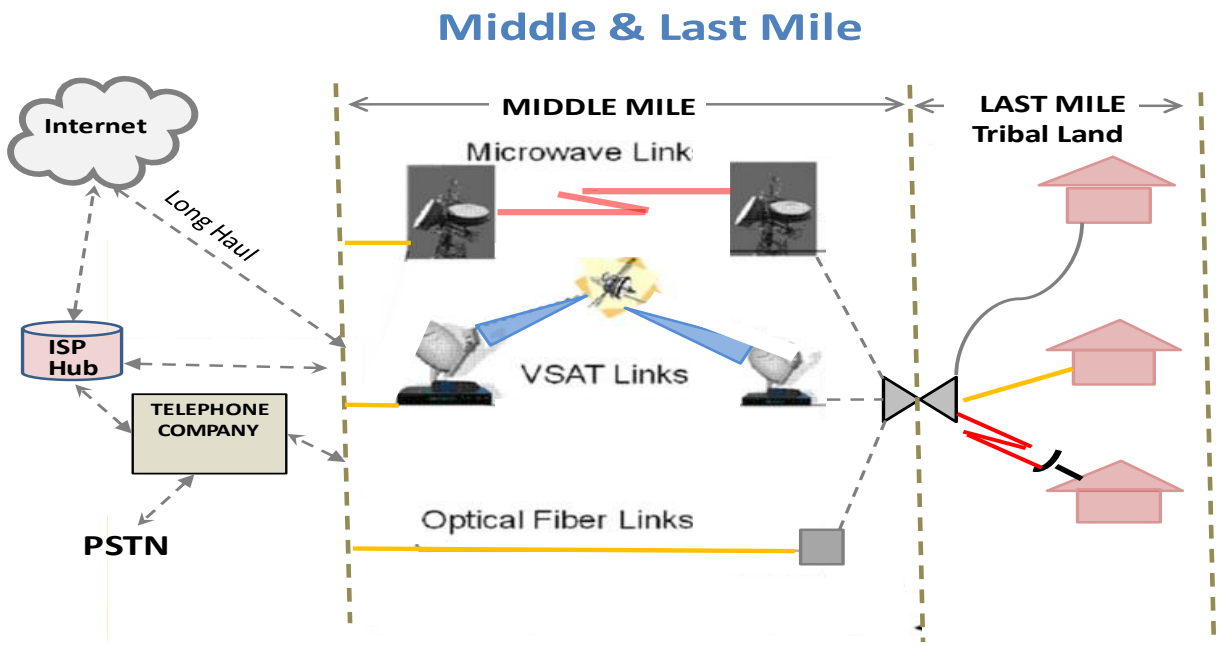
2.5 GHz Fixed Wireless vs Other Last Mile Mediums

The diagram below shows a comparison of the licensed 2.5 GHz fixed wireless last mile network to the other last mile infrastructure mediums. The FCC defines the minimum download speed to qualify as acceptable broadbands as 25 Mbps. Only the bottom 2 last mile mediums, Fixed Wireless 2.5 GHz and FTTH, meet and exceed the standard. Fiber, of course, is the gold standard, having many more times the data and video carrying capability than any other medium. The 2.5 GHz fixed wireless network is fully capable of meeting and exceeding the FCC's broadband speed requirement. It is a quick and low-cost last mile deployment, in comparison to fiber, which is not available to most rural communities. Fiber infrastructure is costly to deploy. New fiber infrastructure networks are planned for rural Alaska but will take 2-3 years or more to deploy and are likely to never reach many remote tribal communities. The tribal owned 2.5 GHz networks will be available to serve rural villages by summer of 2022.



The Middle Mile Issue: The tribal 2.5 GHz fixed wireless network provides a low cost, quick deployment (about 6 months from order to service ready) broadband solution. The tribe needs to access the target information sources at the far end of the Internet network. That information-source target is likely located in another state or even another country. To accomplish that, the tribal-owned network needs to connect to a service provider's "middle mile" network with infrastructure that interconnects the tribal last mile network with a "long haul" network interconnected to the distant information source. The following diagram shows the network positioning of the tribe's last mile network infrastructure serving the homes, and then interconnected to the "middle mile". The middle mile then interconnects to the final long-haul network reaching the target information source and allowing data, video, or even voice communications traffic to flow between that distant information source and a tribal household.

Examples of the middle mile infrastructure includes microwave radio hops, satellite uplinks and downlinks, or fiber optics. Fiber is the "gold standard" and can carry hundreds or thousands of times more data and video traffic that than the other mediums. Fiber middle mile is only available to a small percentage of rural Alaska villages. An extensive microwave radio network infrastructure was deployed by GCI, but remaining broadband capacity is limited and generally reserved for educational, village health clinics, and critical village government services. Over 70% of Alaska rural villages are served only by satellite. Current satellite capacity is generally tapped out. A limited number of tribes have access to Quintillion's marine fiber network serving the northwest and arctic slope portions of the state, and GCI's and Matanuska Telephone Cooperative.



SECTION 3: FIXED WIRELESS PLAN FOR ALASKA NATIVE VILLAGES

Plan Purpose

ATB developed this broadband plan to help Alaska's tribes receiving the FCC 2.5 GHz license get "shovel ready" to apply for current and expected new federal broadband grant funding programs available to the nation's federally recognized tribes. By having a "shovel ready" plan in place, a tribe applying will satisfy the requirements of the federal agency administering the grant program that the tribe knows what it is applying for, the amount of funding required, how the grant will be used to provide benefits, and has a comprehensive plan in place to successfully implement the involved program upon grant award.

The current grant available to the nation's 500-plus tribes is the $1 billion Tribal Broadband Connectivity Program (TBCP) grant administered by the National Telecommunications and Information Administration (NTIA) under the Department of Commerce. NTIA was months late in satisfying the Congressional mandate to get the TBCP grant NOFA ready by the end of March 2021. NTIA issued its NOFA (Notice of Funding Authorization) on June 1 with a grant application deadline of September 1, 2021. While the remaining time is tight, tribes should apply for this grant, as the NOFA sets aside a minimum of $500,000 for each tribe applying. This shovel ready "Broadband-in-a-box" plan will help the SWAMC area and other tribes in their grant application.

Standardized 2.5 GHz Fixed Wireless Plan

The Plan focuses on using the tribes' 2.5 GHz spectrum license. The Plan's design uses the 2.5 GHz spectrum license as the core broadband asset in a fixed wireless architecture as the tribal owned last mile portion of the broadband network that was explained in Section 2. ATB has developed this plan as the result of focused broadband planning over the past year, for SWAMC, and other broadband planning projects under BIA planning grants that it helped Alaska tribes receive. The Plan is applicable to most villages, with modifications for the number of network equipment elements or heights of towers due to the varying demographics or size and topography among villages.

The 2.5 GHz Fixed Wireless Last Mile deployment was selected as the core architecture for this Plan for the following reasons:

- The 2.5 GHz spectrum license is the only broadband asset owned and controlled by Alaska tribes.
- Fixed Wireless deployment is a low cost and fast way to improve broadband service in Alaska Villages.
    - If funding is provided within 3-4 months following grant submission as expected, tribes should be able to have improved broadband service at greatly reduced rates prior to the end of 2022.
- The 2.5 GHz Fixed Wireless Last Mile Network is "agnostic" relative to the last mile medium it uses.

    - That means is can take advantage of the highest capacity middle mile medium -- fiber, microwave radio, or satellite --that is available and has adequate capacity at the most affordable rates.
- The quick deployment 2.5 last mile networks will be ready to deliver greatly improved broadband service as adequate middle mile is available.

ATB in the Process of Deploying Alaska's First Tribal Owned 2.5 GHz Last Mile Network

The Native Village of Akiak in the Yukon Delta was awarded a broadband infrastructure and services grant by the Treasury Department under the America Rescue Plan. Akiak's 8a subsidiary, Akiak Technology, prepared the grant application and is the project manager for the tribal owned 2.5 GHz fixed wireless network. Akiak Technology has awarded a contract to ATB to engineer and build the network, and to be the broadband service provider. ATB is using the same plan presented here to deploy Alaska's first tribal owned network. ATB has already shipped equipment to the village and will be providing 25/3 Mbps service to the village by November of this year via the new 2.5 GHz last mile network and access to the new polar orbit of One Web's low earth orbit (LEO) satellite system on station over Alaska and going through its final testing.

This early deployment is providing valuable lessons that should benefit all future tribal 2.5 GHz deployments in Alaska. Early experiences, such as long shipping times and increased costs due to unique circumstances of basic infrastructure, terrain, and environmental conditions as flood zones in certain Alaska villages have resulted in ATB adding contingency and increased engineering costs to tribal broadband deployment budgets. Safety and Security concerns have added the costs of fencing material and installation to the deployment budget.

"Broadband-in-a-box" Plan – What's Included?

The following pages cover last mile network design and what's included to show "shovel readiness" in the grant application:

2.5 GHz Last Mile Implementation

- **2.5 GHz Last Mile Network Design**
  - Engineering path/coverage analysis of specific village 2.5 GHz network design
  - Equipment required – number of 2.5 GHz network radios, antennas, and base stations
  - Number and heights of towers
  - Cabling and power requirements
- **Middle Mile to be Used**
  - Last Mile and Middle Mile network integration, equipment, cabling, and coordination
- **Subscriber Equipment**
  - Subscriber modules (residential and business external radio antennas)
  - Cabling
  - Subscriber routers
- **Power Requirements**
  - Commercial power requirements
    - Extension of existing or upgraded commercial power to network equipment
  - Equipment DC power requirements
  - Standby generator system and backup batteries
- **Equipment Shelter**
  - Existing or new
  - HVAC system
- **Infrastructure and Site Considerations**
  - Location of tower(s), building, equipment, and power source.
  - Structure base pads
  - Civil engineering and permit requirements
    - Soil conditions, modifications to address flood zones
  - Fencing, surveillance, and other security/safety requirements
- **Engineering, Installation, and Construction Requirements**
  - 2.5 GHz network equipment
  - Towers and equipment shelters, construction equipment required
  - Cabling
  - Subscriber modules
  - Travel, lodging, and per diem for site visits and on-site work crews
- **VoIP (Voice over Internet) Voice services**
  - Local VoIP servers
  - Subscriber VoIP devices
  - Host voice switching source
- **Installed Cost Budget**

Operations & Maintenance

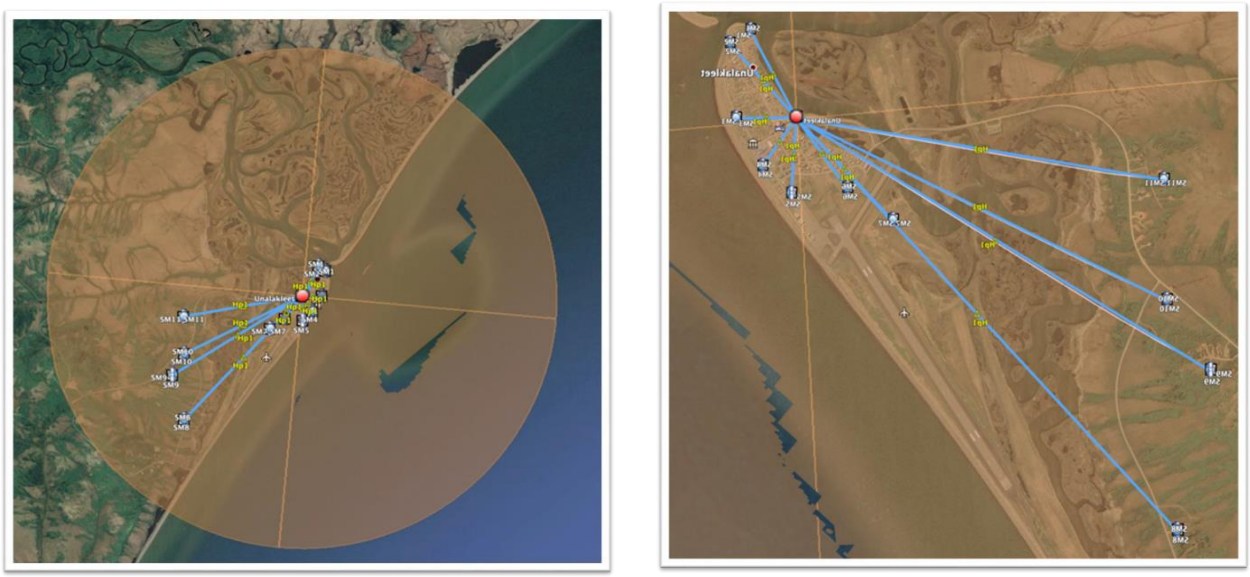
Note: Tribe decides if operations and maintenance performed internally or outsourced to service provider.

- Network Management Systems
- Critical network element alarming and services performance monitoring (Network Operations Center)
- Local operations and maintenance technicians: staffing, training, equipment requirements
    - Development of Operations Practices and Procedures and inter-function workflow
- Customer Service
- Billing and Collection

2.5 GHz Last Mile Network Design

The 2.5 GHz network design follows an assessment of broadband needs, extent and physical layout of area to be covered, and a mandatory site visit. As a result of the pandemic and the time constraints of NTIA's current TBCP grant deadline, site visits are generally not practical. Instead, ATB has completed its design based on desktop studies, backed by experience in actual site surveys of typical villages environments in Alaska's different regions. The 2.5 GHz radio equipment vendor planning tools, used in conjunction with village facilities and topographical maps, have been used to develop path and coverage studies. The desktop studies have provided sufficient data points to support an engineered design for typical villages by size of household and geographic area covered.

The engineering desktop study network design defining the number of network elements and height of tower(s), tempered by conservative design parameters, should be adequate for the TBCP grant application. An actual site visit, as completed for the Akiak project under implementation, is mandatory to finalize the engineering design and infrastructure requirements prior to ordering of equipment. An allowance for the cost of a physical site survey and final engineering based on that survey should be included in the cost budget for each village. The 2 images below represent a typical path and coverage analysis for deployment of the 2.5 GHz last mile network. These were done for Native Village of Unalakleet under a BIA grant award that ATB help Unalakleet receive. They show that a 360° coverage of approximately 2 miles from the tower is required.



Path and coverage analysis depiction

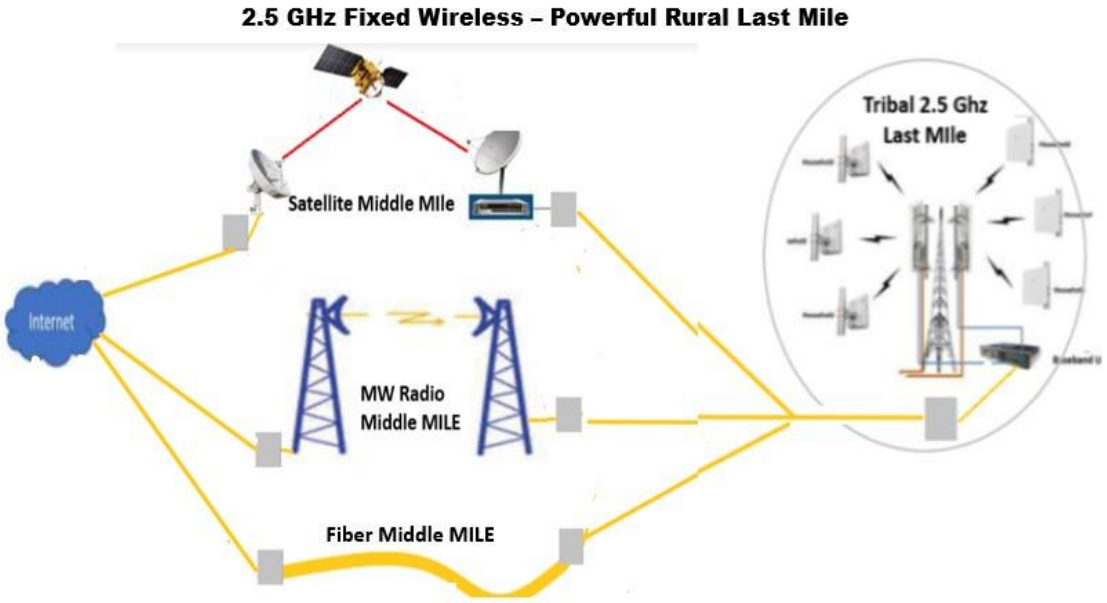
2.5 GHz Last Mile – How Does It Work & How Fast Is It's Broadband?

The 2.5 GHz fixed wireless system is not complex and is designed for low cost, quick deployment. The diagram below shows the major network elements of the tribal last mile network using the 2.5 GHz frequency. The encircled "Tribal 2.5 GHz Last Mile" area on the right shows a tower with radio-mounted radios and antennas sending and receiving 2.5 GHz radio signals to subscriber modules at each household. The diagram shows that the tribal last mile can be connected to any of 3 middle mile medium options: satellite, fiber, or microwave radio (to get to the fiber).

The Broadband Plan targets delivery of 25/3 Mbps or better to each household and commercial subscriber in the community. That is the minimum standard to meet the FCC's definition of broadband. Most rural Alaskans receive nowhere near that speed. Internet speeds of 6/1 Mbps are generally the highest speeds offered to rural Alaska by service providers. Most tribal households do not even get that much because they cannot afford the $250 to over $300 price tag that comes with the "high speed Internet" that some service providers advertise. The tribal owned 2.5 GHz last mile can deliver much higher speeds. It can deliver over 100 Mbps to each household and more. National carrier T-Mobile, which uses the 2.5 GHz spectrum, has testified before the FCC that it expects to deliver 300-400 Mbps to each household within the next 2-3 years using the spectrum. The 25/3 Mbps target of this plan is a practical objective limited not by the 2.5 GHz frequencies, but by the high middle mile cost.

ATB recommends that the tribal last mile be connected to fiber middle mile because of its broadband capacity wherever it is accessible by a tribal last mile network, provided that the cost of the fiber middle mile is reasonable. If fiber is not available or if its cost is prohibitive, then ATB recommends utilizing the new satellites that will be available later this year and in early 2022. The satellite middle mile cost is also high but is currently priced at a rate that is at least half of

the cost of available fiber middle mile systems. The 2.5 GHz last mile is capable of delivering over 100 Mbps via any middle mile platform but, again, the middle mile cost is the limitation.



The Components of the Tribal 2.5 GHz Last Mile Network

The following information describes the major equipment of the 2.5 GHz network that the tribes will deploy. With adequate funding expected from NTIA's current TBCP grant program, tribes will own this equipment and all the 2.5 GHz last mile network.

Following are the major network elements required:

- **2.5 GHz Last Mile Equipment**
  - Tower-mounted radios and antennas that deliver and receive broadband traffic between the subscriber home/business (the "customer premise" or "CPE)
  - A subscriber module about the size of a laptop computer mounted externally at the customer premise.
  - A base station that powers the 2.5 radios and the electronic equipment, manages the local 2.5 network, and provides the interconnection to the middle mile that connects village subscribers to the rest of the world.
  - The number of radios, each covering a 90°-degree sector, will be determined by the coverage/path analysis.
- Lattice Tower
  - The height and placement of the tower is also determined by the coverage/path analysis.
  - Depending on the terrain and distance that needs to be covered.
  - Except for small villages with 50 or under households ATB has used an 80-foot free-standing lattice tower in the broadband plan.
  - A tribe can use a tower with less height, but should consider its future needs, such as mobility requirements.
  - For smaller villages under 50 households with flat terrain, an inexpensive solution is a 30-foot pole that is mounted to the equipment shelter that ATB is recommending.
- An equipment shelter, which houses the electronics for the 2.5 GHz radio systems, network management and security systems, and the integration with the middle mile network.
- Backup batteries and a standby generator in the event of power failure.
- Power and equipment interconnection cabling in accordance with the detailed engineering done as a result of network element locations determined by detailed engineering resulting from the site survey.
- Customer premise routers.

That's generally it. The 2.5 GHz last mile is a fairly simple network architecture with the advantage of low cost and quick deployment. The majority of costs, particularly in remote communities, comes from support infrastructure, construction and installation labor, and shipping and site delivery. The equipment listed above will account for only about 30-40% of the total deployment costs. A total installed cost budget model is provided later in this Broadband Plan document.

Voice Services

While the tribal 2.5 GHz last mile network is designed primarily for Internet and other broadband usage, it is also fully capable of supporting voice services via the VoIP (Voice over Internet Protocol) technology. This is a standard offering by Internet service providers. Basically, the subscriber uses an Internet-capable phone to make voice calls via the Internet to a distant voice switching system that is connected to the Internet.

Most rural Alaska households currently use frequently "spotty" cell phone service for their voice calls. ATB believes that the VoIP service will provide rural tribal households and businesses with more reliable voice calling than is currently available. It should also offer the advantage of low cost or even "free" long distance calling.

ATB will be including VoIP service in the NTIA grant applications of Alaska tribes that it is supporting. VoIP is an optional service that is up to each tribe, but it is included in the cost budgets of this Broadband Plan.

Equipment Recommendations

- **The Current 4G-LTE vs 5G Platform Dilemma**

  ATB has spent the past 2-years evaluating a number of manufacturers of 2.5 GHz radio equipment. An exceptional feature value of the 2.5 GHz spectrum is that it is designated as a prime "5G" technology spectrum. 5G is the latest wireless technology standard adopted by the wireless telecommunications industry. It is referred to as the Internet of Things (IoT) in that it has magnitudes more data-handling capacity, allowing computers to "talk" to multiple computers. Because of its data handling capacity, it enables simultaneous broadband interactions among multiple remote computers and "smart devices" in a true real time session. It is expected to provide new feature benefits in education, healthcare, public safety (embedded GPS in clothing), transportation (driverless "smart cars"), agriculture (food-safety logistics tracking), and manufacturing processes for all industries.

  While 5G is expected to replace the current 4G-LTE standard for mobile and fixed wireless communications and manufacturers are developing roadmaps for future conversion from 4G-LTE to the 5G standard, it is not ready for "prime time" deployment. ATB found only one manufacturer – the Swedish company Ericsson, considered the global leader in developing the 5G standards – that has already incorporated 5G capability into its fixed wireless radio systems. Chinese manufacturer Huawei also has this capability, but its products are banned in the United States. All other manufacturers will continue with the 4G LTE standard for the near future and will do what the service provider industry calls a "forklift", replace 4G-LTE radios with 5G-standard standard at future time.

  ATB spent considerable time evaluating Ericsson's 2.5 GHz product line with its US technical team. Ericsson's 2.5 GHz fixed wireless product line is impressive, and ATB considers Ericsson's 2.5 GHz system the "gold standard" among all products evaluated. ATB, however, expanded the 2.5 GHz candidate list to include 4G-LTE products for the following reasons. Because of complex network management requirements and initial and annual software licensing fees, Ericsson was considered costly. A major concern was that Ericsson, as well as some of the 4G-

LTE systems, required that every user broadband session maintain a connection to a remote "core" session-management-control server in order for the user to continue a broadband communications event. With primarily a single-thread satellite middle mile system, ATB considers products requiring a "remote core" connectivity to maintain a broadband session presents a service quality exposure in the remote Alaska environment. That is ATB's own opinion as a company that expects to be operating and maintaining tribal 2.5 GHz networks and being responsible for service quality. Others have different opinions and believe that the remote "e-Core" management system in our single-thread primarily satellite service rural environment is not an issue. All systems evaluated have pros and cons and will deliver broadband at 100 Mbps and more.

This lengthy discussion is intended to advise tribes that the 2.5 GHz product they select, whether one recommended by ATB or not, will likely be a 4G-LTE technology system and eventually must be replaced when 5G features are further along in development and are a tribal critical necessity. The good news is that 4G-LTE will support solid broadband over the 2.5 GHz wireless frequency and will be around for a number of years. Additionally, the radios themselves are a relatively small portion of the cost of 2.5 GHz last mile network. The majority of cost is comprised of towers, shelters, power systems, middle mile interface, and other infrastructure.

Broadband Plan Budget Based on "Cambium Networks" 2.5 GHz Product

In addition to Ericsson, ATB evaluated four manufacturers using an LTE platform. The LTE manufacturers are Airspan (Israel), Baicells (China manufacturer with USA HQ), Cambium Networks (USA), and Redline Communications. Any of these manufacturers can deliver good broadband to Alaska Tribal communities, and the decision for product selection will be up to the tribe. Because of cost and operational efficiencies, ATB recommends that the product selection be a standardized solution for a regional or broader consortium entity, or across multiple consortium entities. ATB recommends Cambium Networks for the following reasons:

- Does not need connection to remote server for broadband communications.
- Excellent track record for solid performance and rural technical support.
- Breadth of product line – manufactures its own subscriber modules, has short-haul microwave, and Wi-Fi mesh coverage solutions.
- U.S. based 2nd tiers support readily available directly by U.S. based technical teams.
    - ATB has not found this same level of support available from other manufacturers.
- Low initial cost and no annual licensing fees.

Except for the different prices of the 2.5 GHz radios among manufacturers, this Broadband Plan is valid no matter what radio manufacturer is selected by the tribe(s).

- **Pre-Packaged 8x10 Shelter Equipped with Standby Generator & Smart Power Management**
  The Alaska climate requires that electronic equipment be enclosed in an Arctic conditioned shelter, with a suitable HVAC system, and with Heating, of course, being the most important. Additionally, due to limitations of village power systems, adequate standby power consisting of battery backup, standby generator with automatic switch transfer and an adequate fuel supply is necessary to prevent minimum disruptions to telephone and broadband services. Because of the importance of backup power in the rural environment, a smart power management system is desired to minimize standby generator activation and to properly balance loads to prolong battery life.

  Very few villages have adequate shelter space for telecommunications equipment with the suitable support environment mentioned above.

  ATB has evaluated a number of vendors of pre-packaged shelters with standby generators and is recommending that tribes utilize the shelters manufactured by HCI Energy of Lenexa, Kansas. ATB conducted a site visit at HCI's Lenexa facility and believes that it is the ideal solution for Alaska's rural tribal environment. ATB further recommends that the HCI shelter, equipped with power backup and a smart power management system as described above, be procured as a standardized part of each tribal broadband system deployed. The HCI power system uses lightweight lithium batteries with longer life that traditional lead acid batteries. The shelter comes with a secured 100-gallon steel fuel tank, avoiding the need for installing an external fuel tank.

  The HCI shelters are equipped with an automated HVAC and power monitoring system, which can be accessed remotely, as well as providing shelter intrusion alarming and notification to multiple remote monitoring centers. The shelter is also prefabricated with equipment relay racks for mounting of telecom equipment (ATB specifies one rack) and cabling access portals, as well as ventilation exhaust when the generator is running. Further information on the equipped shelter is provided on the next page.

  Besides providing protection for equipment, the HCI shelter also provides a refuge for technicians working and maintaining the equipment. It also serves as the demarcation of the tribe's last mile network and a "meet point" for integration with the middle mile service provider's network. The shelter also visually represents the tribe's ownership of its last mile broadband network.

  The shelters can be supplied with a pole extension which provide a height of either 30-ft or 50-ft, with a wind-endurance rating of 170 Mph. This provides a suitable alternative for mounting of 2.5 GHz radios for some of the coastal or flat terrain villages. This is a low-cost easy solution for some villages. The use of such a ready-made pole attachment should be evaluated against planned expected needs of a village for mounting equipment, such as a microwave radio system, which may require a higher or different type of structure. ATB would be supportive of an HCI pole extension of up to 30-ft but would recommend a lattice tower for higher tower requirements.

SOLUTION OVERVIEW

Prepared for: Alaska Tribal Broadband LLC

8x10 shelter (no solar – no wind turbine)
Smart power management system
Alarms (temperature, water, power, & door security)
HVAC (heat most important)
6KW generator set
100 Amp load center
Surge protection
1 equipment rack

10' HYBRID CUBE™

The Hybrid Cube™ is a prepackaged, turnkey, industrial power solution designed for telecom, public safety, rail, resource extraction, construction and military applications. Whether providing power where it is unavailable or redundant power where it is most critical, the Hybrid Cube includes HCI Energy's state of the art ZPM™. Wind, solar, battery energy storage and a generator can be controlled, monitored and analyzed both locally and remotely. The long service life, ease of install, and low maintenance expense of the Hybrid Cube makes it a better solution to traditional power needs.

ZPM™

The ZPM™ (Zero-glitch Power Module) is a state-of-the-art managed power solution designed for public safety and telecom. Through intelligent controls it leverages smart batteries to deliver the most reliable power. When compared to lead-acid solutions it is half the size and a fourth of the weight. This smaller and lighter package also delivers a longer serviceable life than lead-acid solutions.

Benefits:
Small footprint eases retrofit
Long serviceable life
Truly maintenance free
No ATS eliminates momentary power loss

Key Features:
N+1 or N+2 redundancy
UL and NEBS compliant components
Remote monitoring and control
Local generation and renewable can be added seamlessly

WE ARE IN **CHARGE** OF YOUR **RELIABLE POWER**

ATB Equipment Recommendations (Continued)

- **Towers**
  Tower experts in Alaska recommend a lattice tower as opposed to a monopole for mounting radio and cellular equipment. Lattice towers are easier to climb during winter conditions and can be free standing for heights of over 200-ft. Free-standing means being secured to a prefabricated concreted pad, sized at the base of the tower. For the Broadband Plan, an 80-ft. tower was used as the average tower height.

  Tower planning should address a tribe's planned future needs and not just the immediate requirements of the 2.5 GHz radios, which weigh roughly 40-lbs each. Future plans for mobile service or village-to-village connectivity should be considered. These types of considerations will determine the tower size and structure planning for the initial tower layout.

- **VoIP Equipment**

  VoIP service delivery will be the responsibility of the tribe's selected service provider. ATB recommends that tribes acquire a local VoIP sever to enable local intra-village calling without having to be connected to the middle mile connection to the remote host VoIP switch. Since its architecture is built around a local core, Cambium Networks supports intra-village broadband sessions without a middle mile connectivity requirement. This capability can be helpful in an emergency if the single thread middle mile connection to the outside world is disrupted.

- **Site Safety & Security Equipment**
  Safety and security considerations at the site are interrelated. Basic physical equipment as chain link fencing around the perimeter site equipment area to include the shelter, tower, and other visible equipment protects both village members and the network equipment. In addition to shelter security and HVAC alarm systems with a remote monitoring capability, the tribe should also consider visual monitoring of the equipment area.

- **Network Management Equipment – Site and Remote NOC**
  A Network Management System, including a remote Network Operations Center (NOC) will be provisioned by the service provider, but the local tribe owning the village's last mile network is likely to be responsible for the costs of the local network management equipment.

SECTION 4: TRIBAL 2.5 GHz LAST MILE BUDGET

Budget Overview

As a result of its planning work for several Alaska tribes over the past year, ATB has developed a standardized Tribal Fixed Wireless Last Mile design, using the 2.5 GHz frequency. The design is applicable to most villages in the state wanting to deploy a 2.5 GHz fixed wireless, last mile network, modified only for the size and geographic layout of the community. The Tribal Last Mile Budget below is intended to give tribes a benchmark, based on the size and demographics on their communities, for the equipment, infrastructure, and services it will take to put a last mile network in place and about what it would cost.

The equipment components listed in the table are the same that would be deployed anywhere in the Lower 48. The major difference is that the Table reflects the reality of Alaska that generally only satellite is currently available for the majority of rural Alaska tribes. While Alaska tribes may be planning fiber and microwave radio networks, those deployments are likely to take 3 years or longer to implement. For that reason, the table shows the cost associated with a satellite terminal as the tribe's interface into the satellite middle mile. Lower 48 tribes will generally have access to a fiber middle mile. The 2.5 GHz network, however, can interface into either fiber, microwave, or satellite middle mile.

The other difference from Lower-48 deployment is cost. ATB estimates that an Alaska rural tribal last mile deployment costs at least twice as much as in the lower 48. The current Native Village of Akiak deployment is providing real time information on the additional costs most Alaska tribes face due to their isolation and being off the highway grid. Barge costs for not only broadband equipment but loading basic infrastructure support needs as fencing and gravel and concrete for tower base platforms. Heavy equipment and even helicopters need to be considered in construction planning. Alaska's permafrost conditions increase the costs of tower construction, adding $100,000 to $200,000 incremental costs compared to the lower 48 just for the tower base support platform. A site visit by experienced Alaska engineers is an absolute requirement for the necessary logistics and site deployment planning to determine an accurate budget for the specific tribes.

The table below assumes a lattice tower 40-ft high for villages with population under 100 households, and 80-ft high for those with 100 households and more. Site visits will determine that actual heights required.

Tribal Last Mile Estimated Budget by Number of Village Households

Village Households / 2.5 GHz Radios	HH/Radios 25/2	HH/Radios 50/2	HH/Radios 75/3	HH/Radios 100/4	HH/Radios 200/4	HH/Radios 300/4	HH/Radios 500/6	HH/Radios 1,000/ 8
BASELINE TRIBAL LAST MILE DEPLOYMENT BUDGET ($)								
2.5 GHz Radio Netwk	38,000	44,000	50,000	50,000	50,000	50,000	86,000	98,000
Subscriber Equipment	16,000	32,000	47,500	63,000	123,500	184,000	305,000	607,500
Shelter w/Pwr Mgmt	180,000	180,000	180,000	180,000	180,000	180.000	180,000	180,000
Tower	250,000	250,000	250,000	800,000	800,000	800,000	1,600,000	1,600,000
Satellite Terminal	35,000	35,000	35,000	35,000	35,000	35,000	60,000	60,000
Engineering	60,000	60,000	80,000	80,000	92,000	92,000	135,000	175,000
Installation	40,000	45,000	50,000	58,000	75,000	100,000	175,000	300,000
Project Management	78,000	104,000	115,000	187,000	196,000	198,000	356,000	440,000
Power & Cabling	20,000	22,000	25,000	30,000	30.000	35,000	55,000	80,000
VoIP Equipment	19,000	22,000	26,000	30,000	45,000	62,000	85,000	142,000
Netwk Mgmt. System	55,000	55,000	85,000	110,000	110,000	120,000	175,000	175,000
Village Infrastructure	75,000	100,000	150,000	200,000	225,000	250,000	400,000	600,000
Shipping	90,000	150,000	160,000	180,000	200,000	250,000	300,000	400,000
Systems Integration	210,000	250,000	276,000	368,000	432,000	435,000	586,000	726,000
TOTAL	**1,166,000**	**1,349,000**	**1,529,500**	**2,371,000**	**2,593,500**	**2,791,000**	**4,498,000**	**5,583,500**

SECTION 5: OPERATIONS

Current Operational Model

Rural communities, including Alaska tribes, have not been involved in any of the operations regarding the provisioning of their services. A telephone company with certain regulatory certifications applies for and is granted approval and the responsibility by the state public utilities commission to provide telephone service for a certain geographic area. In Alaska, the Regulatory Commission of Alaska (RCA) provides that authority. Rural areas are, of course, much more costly to serve than urban areas. Recognizing that it's not economically viable for private companies to serve high-cost rural area without subsidies, the federal government has historically provided such subsidies to rural service providers through the Federal Communications Commission (FCC). This has been the national policy since the 1930's with the objective that rural America should have the same level of service as the urban areas. Except for Anchorage, Fairbanks, and Juneau, the FCC considers all other areas of the state high-cost rural areas and eligible for federal subsidies under an FCC program called the Universal Service Fund (USF). The USF support helps service providers to offset the high cost of capital investment and operations in serving rural communities. Service providers tend to use the limited USF funds to prioritize deployments and service in more densely populated rural areas qualifying for USF support than for the remote tribal communities.

Tribal Infrastructure Ownership Presents New Options

With the ownership of the 2.5 GHz tribal spectrum and the last mile infrastructure expected to be funded by the pending NTIA and future grants, Alaska tribes have an opportunity for new leverage in working with existing service providers. ATB's experience in supporting tribes in broadband planning is that not many service providers previously showed much interest in supporting tribal fixed wireless networks. With the availability of sizable broadband funding, service providers are becoming much more interested in working with tribes not only to possibly advance last mile solutions or support tribal last miles, but also to work with tribes to utilize the

tribal funding to expand much needed middle mile. ATB sees this as a positive development to improve broadband infrastructure on tribal lands.

The existing service providers certainly have the experience to support tribes in deploying and operating networks. Tribes should keep in mind, however, when negotiating with service providers, that they own the 2.5 GHz spectrum licensed to them, as well as the last mile broadband infrastructure that is expected to be funded by the federal government. It appears that tribal funding under the current NTIA grant, as well as the recently announced $2 billion tribal broadband funding included in the 2021 Infrastructure Bill encourages tribal partnerships with service providers to expand middle mile for tribal areas. ATB suggest that tribes keep in mind that their ownership of wireless spectrum and broadband infrastructure, and access to sizeable tribal broadband funding, gives them leverage in negotiating broadband services and pricing with service providers.

Alternative Service Providers

Tribal ownership of the fixed wireless network presents opportunities for a tribe to seek alternative providers over the current local service provider(s), or even become its own provider of service if it should so choose. Becoming a service provider is not an easy matter and is probably best done at the regional level. ATB always recommends that tribes first attempt to work out a suitable arrangement for support of its tribal-owned network with their existing service providers. If an arrangement that is satisfactory to the involved tribe cannot be worked out with the existing service provider, then the tribe should consider an alternative service provider.

By default, as most service providers have not shown interest in supporting the tribal-owned last mile network, ATB is one of the companies that have surfaced as a Wireless Internet Service Provider to support tribes in engineering, building, and operating tribal-owned networks. ATB will be operating the 2.5 GHz last mile network that it is currently implementing under contract for the Native Village of Akiak. ATB also expects to build and operate tribal last mile networks for 40-50 tribes in 2022. Tribes desiring to become their own service providers may be interested in a contractual arrangement where an experienced telecommunications company provides operations and services for a period of time but provide the technical training and support that enables tribes to assume operations and service at a scheduled future time.