A Broadband Blueprint for Native Nations

Helping you to plan, fund, design, implement, and operate a sustainable broadband network

Table of Contents

Introduction

Broadband connectivity is a powerful tool for Native Nations grappling with the digital divide. It facilitates access to vital services such as education, healthcare, commerce, and entertainment and opens opportunities for social inclusion and economic growth. More importantly, the deployment of high-speed broadband networks offers the chance to unlock the full potential of the rich cultural heritage of these communities, empowering individuals as global citizens while preserving their unique cultural ties.

The availability of federal funding presents an unprecedented opportunity to bridge this digital divide. This support enables the implementation and maintenance of crucial broadband infrastructure within Native Nation communities. This brings immense benefits, including increased access to services and the chance to fully embrace and disseminate their rich cultural heritage.

AtLink partnered with Cisco, a global internet technology leader, and Tarana Wireless, an industry innovator in fixed wireless access, to deliver this blueprint to guide you on the journey to envision, plan, fund, design, implement, and operate a sustainable broadband access network. The blueprint is organized into five sections:

- Broadband access for all – covers key use cases for high-speed broadband in communities and stakeholders with whom you need to connect to plan and achieve effective use of the service;
- How to build a broadband network – outlines key technologies involved and choices to be made;
- How to operate service sustainably – steps to plan, design, implement, and operate the broadband network;
- Funding broadband business – looks at the funding models to ensure that investments and expectations are aligned with commercial needs and long-term sustainable business;
- Digital equity and social sustainability – how building, operating, and owning broadband network will enable learning and job creation for tribal members;

Native Nations can promote economic development, social inclusion, and cultural values by deploying high-speed broadband networks for all tribal members. Broadband today can enable profound positive changes through digitalization in many domains of activity, including education, government, commerce, healthcare, and entertainment.

AtLink, our partners are ready to help you build and sustainably operate broadband services for your communities.

Samual Curtis P.E.
President/CEO; AtLink Services, LLC

AtLink has experience successfully supporting Native American Tribes exercise their unique sovereignty to build and operate successful telecommunications companies.

Our successful projects include Gila River Telecommunications, Inc ("GRTI") and Fort Mojave Telecommunications, Inc. ("FMTI")

Ongoing projects with The Osage Nation, The Muscogee Creek Nation, The Otoe Missouria Tribe, and other Oklahoma Tribal Nations to build and operate successful broadband operations.

About AtLink

Senior management of AtLink has had experience successfully supporting Native American Tribes to exercise their unique sovereignty to build and operate successful telecommunications companies.

Our successful projects include Gila River Telecommunications, Inc ("GRTI", https://gilarivertel.com/) and Fort Mojave Telecommunications, Inc. ("FMTI", https://ftmojave.com/).

Currently, AtLink is working closely with The Osage Nation (https://www.osagenation-nsn.gov/), The Muscogee Creek Nation (https://www.muscogeenation.com/), The Otoe Missouria Tribe (https://www.omtribe.org/), and other Oklahoma Tribal Nations to build and operate successful broadband operations. www.atlinkservices.com

What is AtLink Services?

Formed in 2005, AtLink is an Oklahoma Fixed Wireless Broadband (FWB) provider and the largest such provider in the Midwest:

- Serves over 10,000 residential and business customers across Oklahoma
- Awarded several USDA Broadband Initiatives Program grants to provide internet service to 14+ additional unserved and underserved Oklahoma regions
- Provides end-to-end network solutions with a full range of products and services, including broadband data, voice, video, VPN, municipal and security surveillance services
- 48 Owned Towers, 110 Leased Towers, 63 Micro Towers; and 1,267 Access Points

Proven AtLink Capabilities:

- Onboarding Customers Fast-Efficiently
- Building/Modernizing Wireless and Fiber Networks
- Building/Modernizing Towers and Tower Networks
- Building/Modernizing Tier 1 Data Center
- Successfully Managed $19 Million System Expansion 2010-18 Using a Combination of USDA Grant/Investor Monies.

Broadband access for all

Broadband has quickly become the most transformative technology of the modern era and is as essential as electricity. Moreover, many argue that broadband has become an inalienable right that is needed to create opportunities and strengthen communities.

The opportunities with broadband are limitless, and the best way to think of broadband is as a platform upon which tribal members can create valuable services that are tailored to the specific needs of each Native Nation.

The current Federal funding programs provide Native Nations with an unprecedented opportunity to make high-speed broadband available and affordable to all tribal members, providing the platform for social, cultural, and economic growth.

The key drivers for providing broadband access for all include:

- **Economic Development**: Broadband facilitates economic activity, carving out new job opportunities, invigorating local businesses, and attracting new investment. It allows tribal members to buy goods at lower prices and sell goods to a global marketplace. Overall, broadband catalyzes innovation, improves productivity, and cultivates a spirit of entrepreneurship.

- **Empowering Education**: Broadband plays a pivotal role in democratizing education, providing access to a rich reservoir of educational resources, thus mitigating the digital divide. It paves the way for remote learning and lifelong education, empowering community members with the opportunity for continuous skill development. It allows for tribal stories and customs to be preserved for future generations.

- **Revolutionizing Healthcare**: Broadband brings about a transformative shift in healthcare, particularly in underserved or remote communities. It underpins telehealth and telemedicine services, allowing tribal members to avail healthcare facilities from the comfort of their homes, enhancing patient care, and saving time.

- **Enhancing Public Services**: Broadband holds immense potential in boosting the efficacy and efficiency of public services, ranging from emergency response and environmental control to local governance. Digital platforms powered by broadband can increase transparency, enable equitable access to judicial services, facilitate online transactions, augment citizen engagement, and protect natural resources.

- **Gateway to Information**: Broadband equips community members with the tools to access a broad spectrum of online information and services, from critical government services to local community events and engagements. It also expands and enhances community connectivity, enabling citizens to easily connect with relatives, friends, and professional associates worldwide. It nurtures a sense of community, bolsters collaborative efforts, and enhances social engagements.

- **Future of Work**: With a sturdy and reliable broadband foundation, communities can ensure seamless connectivity for remote workers, creating a virtual workspace that mirrors the efficiency and collaboration of a physical office. From high-definition video conferencing to secure data sharing and collaboration tools, broadband solutions empower workers to stay connected, productive, and engaged, irrespective of location. Remote working also reduces the time and expense of travel.

Broadband development is a cornerstone in forming digitally inclusive societies, providing a spectrum of opportunities spanning education, healthcare, and economic growth. By bridging gaps and connecting people with services, it plays an instrumental role in creating thriving, robust, and inclusive tribal communities. More insight on broadband solutions for governments and industries can be found in the portfolio explorer: https://www.cisco.com/c/m/en_us/solutions/industries/portfolio-explorer.html.

How to build a broadband network

There are some predictable patterns in new broadband builds. After the planning, we typically see a core network being built. This network often connects Tribal Government facilities and other community anchor institutions with high-speed active Ethernet connections. These facilities often provide Wi-Fi services to Tribal members. The core network also provides the backhaul for broadband access technologies that will combine last-mile fiber (likely in limited cases, given the typical low household density on native lands) and next-gen fixed wireless.

The following diagram highlights the typical network build pattern:

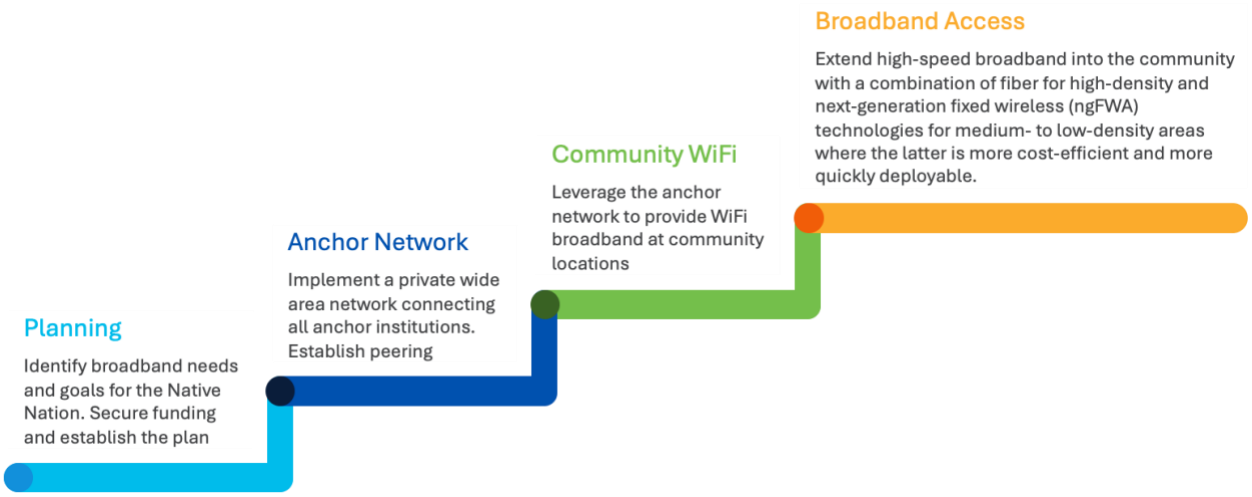


Figure 1 Typical tribal broadband builds

Here are three examples of Tribal broadband builds that followed this predictable pattern. All builds started with federal funding and created a core network connecting anchor institutions before building broadband access with fixed and wireless technologies.

	Coeur d'Alene Tribe Idaho	Nez Perce Tribe Idaho	St. Regis Mohawk Tribe New York
Funding	American Recovery & Reinvestment Act	BTOP and ARRA, expanding with CARES	American Recovery & Reinvestment Act
Anchor Network	Government offices (5Gbps) and schools (10Gbps)	Tribal law enforcement buildings	Government offices
Last Mile Access	FTTH and fixed wireless (licensed and unlicensed)	FTTH and fixed wireless (licensed and unlicensed)	FTTH and fixed wireless (licensed and unlicensed)
Size	1700 households	2300 households	1500 households (+ fixed wireless off nation)

Figure 2 Executing the broadband builds

The St. Regis Mohawk Tribe further developed its network to provide broadband services to other communities outside the Tribal lands and generated additional income.

Broadband business models

As technology and services continue to change, the business models for broadband are also evolving. This includes adapting to the needs of different stakeholders, understanding necessary investments, and securing available funds.

The traditional and vertically integrated telecommunications business model focused on the most profitable customers and couldn't justify the investment to serve the Native Nations. The new business models address the digital divide by splitting the telecoms value chain across assets with different lifetimes and economics. For example, a duct or fiber may have a useful life of 50 years, whereas a server providing voice services may only have a life of 3 years. The inherent differences between the different assets in the telecoms value chain led to a disaggregation of the value chain and introduced multiple entities, from both the public and private sectors, working together to deliver sustainable broadband service.

Figure 3 shows the fragmentation of the telecoms value chain and identifies some of the different business models making broadband more available and affordable.

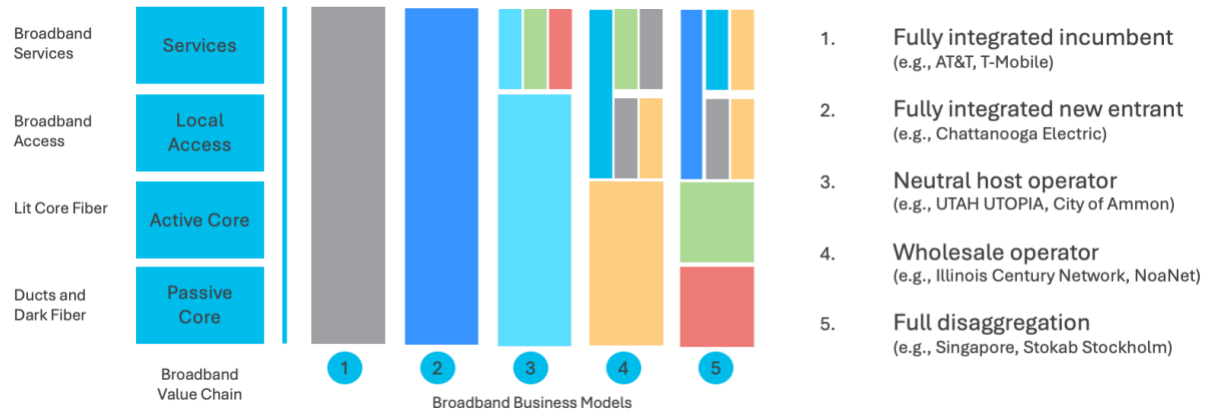


Figure 3 Broadband business models

Models four and five (Figure 3) show the most significant level of disaggregation and create wholesale services between different entities in the broadband value chain. For example, in model four, the Tribe could

provide core wholesale services to a mobile operator who then provides a mobile service across the Nation. The Tribe would also use the core network for other access technologies and broadband services.

Broadband network building blocks

The foundation for broadband is an IP-routed infrastructure. IP, or "Internet Protocol," is the primary connectivity fabric of the Internet, and it is used in every single technical solution proposed in this blueprint. IP routers enable IP routing, which steers data flows to relevant destinations.

There are two main elements to a broadband network: the core network and the access network, as shown in the diagram below:

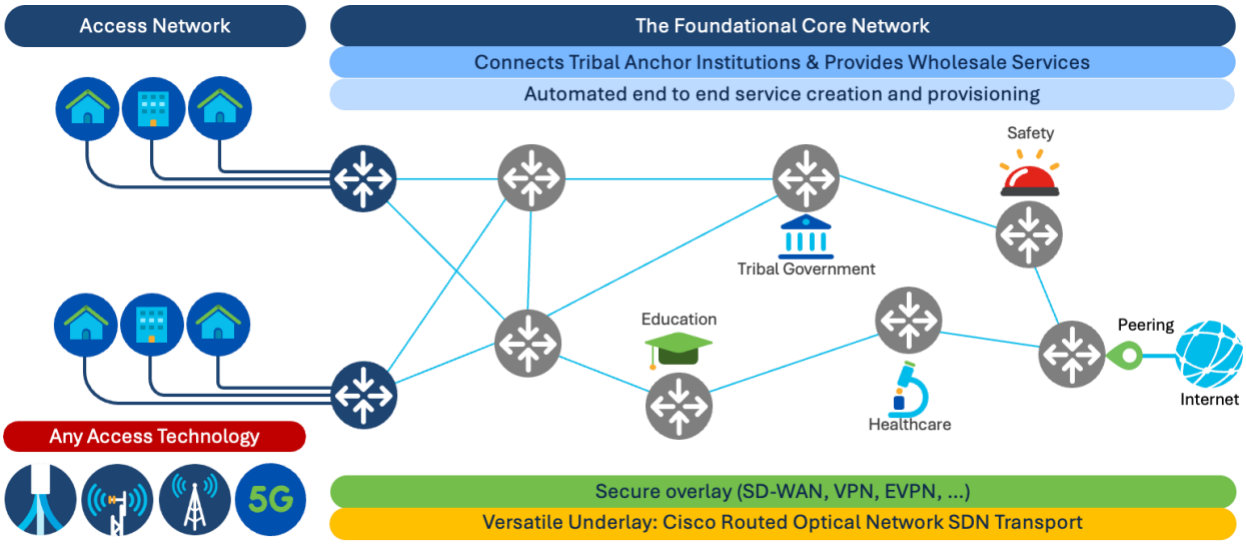


Figure 4 Broadband network infrastructure

The core network aggregates all the broadband access traffic and connects to the global internet. On Tribal lands, the core network often provides direct connectivity to anchor institutions. The core network has passive ducts, fiber strands, optical systems, and high-capacity routers. The network can scale to hundreds of gigabits per second (Gbps).

The access networks connect the core network to homes and businesses. They are built with fixed and wireless technologies.

Other necessary building blocks include subscriber management, automation, and security.

Core network

Historically, core networks have been built with separate and siloed routing and optical layers that require lots of equipment to transmit the traffic between the layers. These layers also have overlapping and redundant resiliency that require separate management systems. This architecture adds complexity and operational cost to the broadband network and hinders its sustainability.

Our blueprint transforms how core networks are built to dramatically lower capital and operational costs. The blueprint is based on Cisco's Routing Optical Networking solution, which simplifies the network by merging the routing and optical layers onto a single IP network where all switching happens at Layer 3. This results in a larger scale and lower cost network design using high-density routers, pluggable coherent optics, simplified optical line systems, and end-to-end automation and security. Cisco's NCS 540 is designed for Tribal deployments and is suitable for core, aggregation, and access networks. It provides flexible port interfaces from 1Gbps to 400Gbps and has a capacity of 1Tbps. The NCS 540 is a hardened device suitable for indoor and outdoor deployments. The router uses Cisco's innovation in Segment Routing for ease of management and embeds security with DDoS Edge Protection.

Cisco Network Convergence System NCS 540

A converged access platform designed to deliver services and applications with cost-effectiveness in mind. The NCS 540 is temperature hardened, and its low power consumption and small form factor makes it suitable for indoor or outdoor use.

NCS 540 is a single platfrom to provide XGS-PON, ngFWA backhaul, and active Ethernet to serve all the needs of the nation.

www.cisco.com/c/en/us/products/routers/network-convergence-system-540-series-routers/index.html

The pluggable optics offload traditional wavelength division multiplexing functionality to the router, eliminate the need for transponders, and enable high bandwidth links at speeds up to 400Gbps. These coherent optics can transmit data up to 70 miles without amplification.

Where transmission of data is needed over longer distances, our blueprint uses Cisco's optical line systems that service long-haul networks by providing a simple DWDM network that scales with ease.

Finally, the blueprint uses Cisco's Crosswork Automation software for low/no-touch operations. It is multi-vendor and multi-domain and spans both on-prem and cloud tooling. The tools encompass a full-service lifecycle, including planning and design, implementation, ongoing operations, and assurance.

ACG Research found that Routed Optical Networking reduces operational costs by 57% and initial capital costs by 35% compared to traditional core network architectures[1]. This translates to more broadband availability and affordability for Tribal members.

Broadband services to communities

We adhere to the notion of "using the right tool for the right job." We recommend deploying fiber wherever economical and fixed wireless access when laying fiber is cost-prohibitive or when time-to-service is of the essence.

AtLink is leveraging Tarana Wireless and Cisco technologies to provide multiple choices to deliver high-speed broadband services.

[1] ACG research "The economic benefits of IP transport at 400G": https://www.cisco.com/c/dam/en/us/solutions/collateral/service-provider/routed-optical-networking/white-paper-sp-acg-400g-ip-transport.pdf

Service offers	Typical service	Best use scenario	Considerations
Passive Optical Network (XGS-PON)	1-10 Gbps	Typical service for residential users and many businesses in high-density areas.	Deploying fiber is slow and expensive at large distances. Cost effective to operate.
Next Generation Fixed Wireless Access (ngFWA)	250-1000 Mbps	Typical service for residential users and many businesses in medium- and low-density areas.	Fast and cost-effective deployment, less exposure to physical network damage.
Active Ethernet	1-400 Gbps	High-speed offer for business customers and premium subscribers	Only available where fiber available, require more fiber strands.

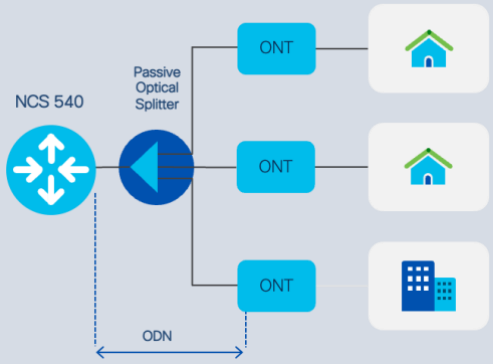
Access service: Passive Optical Network (PON)

Fiber to the home ("FTTH") is one of the most future-proof technologies one can deploy. FTTH uses passive optical network technology, which supports peak symmetric throughputs of up to 10 Gbps in both the downstream and upstream directions ("XGS-PON"). FTTH is suitable and most desirable where fiber construction possibilities exist, and time and cost are not of the essence because some broadband support is already available. Fiber construction is a lengthy, costly process, which becomes the salient issue with this technology. However, when deployed, FTTH offers a future-proof, evolvable platform on which continued broadband growth can be supported. There are no active electronic components requiring power in the outside plant, which means this kind of solution is highly resilient (there are no outside plant electronics that can fail). Deploying fiber "where you can and if you can wait" is always a good idea. FTTH delivered via PON relies on what is known as a "PON Split," wherein a single strand of fiber supports services for up to 64 users, which are "split" from the main fiber. An upstream controller arbitrates access to the fiber, hence reducing port costs.

AtLink delivers a PON solution leveraging Cisco NCS 540 family routers to handle the multi-access capability. The NCS 540 is a family of routers designed for convergence applications. The focus on convergence means it can address PON natively. This single compact solution with the NCS 540 supports a mix of transport interfaces, including active Internet, PON services, FWA, and 5G services.

A single XGS-PON port supports a 1:64 PON split for a fiber distance of 20 km, or a 1:32 PON split for a longer distance.

Cisco NCS 540 with XGS-PON feature



XGS-PON can deliver 10 Gbps symmetric in shared modality to homes and businesses.

The Optical Distribution Network (ODN) - passive optical components, such as optical fibers and passive optical splitters.

Optical Network Termination (ONT) - connects end-user devices (gateway, router, wi-fi access point) into the PON network. Provides the optical to electrical signal conversion.

Access service: Active Ethernet

While XGS-PON is the best solution for consumer-oriented broadband (that is, services offered to homes), Active Ethernet is best for tribal government functions, including law enforcement, education, and healthcare, where a higher number of users and more sophisticated and mission-critical applications require high symmetric internet speeds, typically in the range of 10-100 Gbps. Active Ethernet can provide direct internet access via a dedicated fiber from a router to a tribal entity such as a government or commercial office. Active Ethernet is delivered over fiber and differs from PON because there is no equivalent to a PON

split: the fiber is dedicated to the subscriber and can be used at the highest capacity if the service requires it. For this reason, we recommend its use for critical tribal government functions and businesses resident in tribal lands that require high-quality connection (resorts, hotels, etc.).

The NCS 540 can accommodate conventional Ethernet over fiber plug-ins supporting 10 Gbps bidirectional rates, 25 Gbps, 100 Gbps, and even up to 400 Gbps.

Access service: Next Generation Fixed Wireless Access (ngFWA)

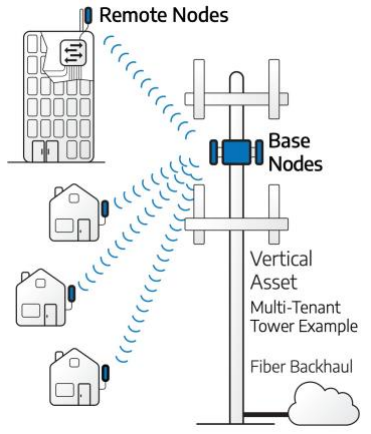
Given the scope, scale, and urgency of the broadband access problem, tribal operators need a better network toolbox that gives them the ability to deploy new or upgrade existing infrastructure to achieve both high capacity and long reach on much shorter timelines, with viable network costs across a wide range of neighborhood conditions. This piece of the broadband puzzle is provided by Tarana.

Tarana's G1 next-gen fixed wireless platform addresses time-to-market requirements and locations where fiber is physically not feasible and/or construction costs of fiber are prohibitive. The Tarana next-gen FWA (ngFWA) platform represents a significant step forward in the FWA category, delivering reliable, high throughput in both directions under the most demanding conditions. Further, it uses license-exempt spectrum, with no spectrum acquisition costs.

G1 is designed from the ground up to support fixed wireless access endpoints. The Tarana system doesn't take on the complexity required to support mobile phones. This is a huge advantage and major differentiator from 5G and LTE mobile systems because by optimizing for coverage and capacity rather than mobility, significant benefits not available for the mobile system can be accomplished. G1 is also different from systems that rely on re-purposed Wi-Fi in that even the basic chipset and RF components in G1 were designed from the ground up on the basic principle that FWA is uniquely different from other use cases and merits a special design.

Central to the feature set of Tarana is that these systems achieve the best possible performance on license-exempt spectrum where there is high potential for interference. Today, G1 operates in 5 and 6 GHz spectrum bands generally used for Wi-Fi. It can also use 80 MHz of adjacent channels in the 3 GHz CBRS spectrum that are assigned for general use, plus any PAL channels (exclusively licensed spectrum) that may be available to the Native Nation, bringing the total available spectrum to 150 MHz. In most cases, there are no spectrum acquisition costs to the Native Nation.

Tarana Wireless ngFWA



Tarana G1 platform meets all ngFWA requirements, delivering fiber-class service with the speed and ease of wireless deployment in unlicensed spectrum.

www.taranawireless.com

In any network, interference from other transmitters operating in the same spectrum is an issue. This is especially important when every tower uses the same spectrum, as does the Tarana system. To accomplish the objective of supporting license-exempt spectrum, the Tarana system must be able to mitigate and suppress interference, which it does through in-silicon advanced digital signal processing. It can mitigate interference from nearby towers, from cellular operators in the same tower using similar frequencies, and from Wi-Fi. In short, Tarana has created a system with a phenomenal ability to block interference, which is typically the scourge of wireless access.

The outcomes that the Tarana system can achieve are simply astounding. 100/20 service is accomplished at distances exceeding ten miles from the tower. Closer to the tower, much higher speeds are achievable. As examples, we show below two G1 sites operated by two leading US wireless Internet service providers

(WISPs) — Wisper Internet in Missouri (Figure 5) and Resound Networks in Texas (Figure 6) — both delivering commercial service in two very different geographies. The key point to take away is that both sites have ~100 subscribers receiving high-performance internet service with mostly obstructed links off one base radio. In fact, the signal strength is high enough to offer >90% of the customers 400 Mbps DL service with a 4.5:1 high-performance upstream[2].

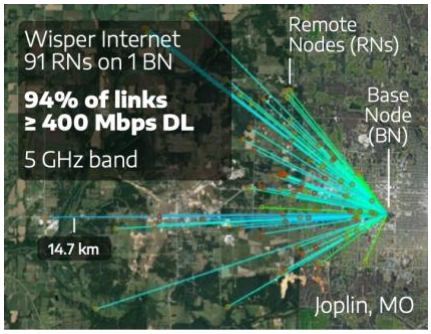


Figure 5 Wisper Internet deployment example.

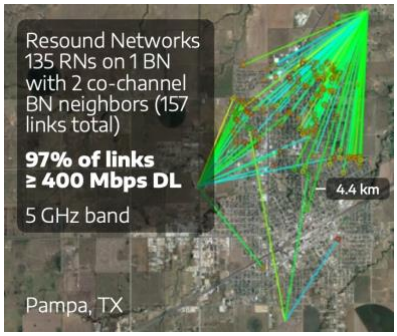
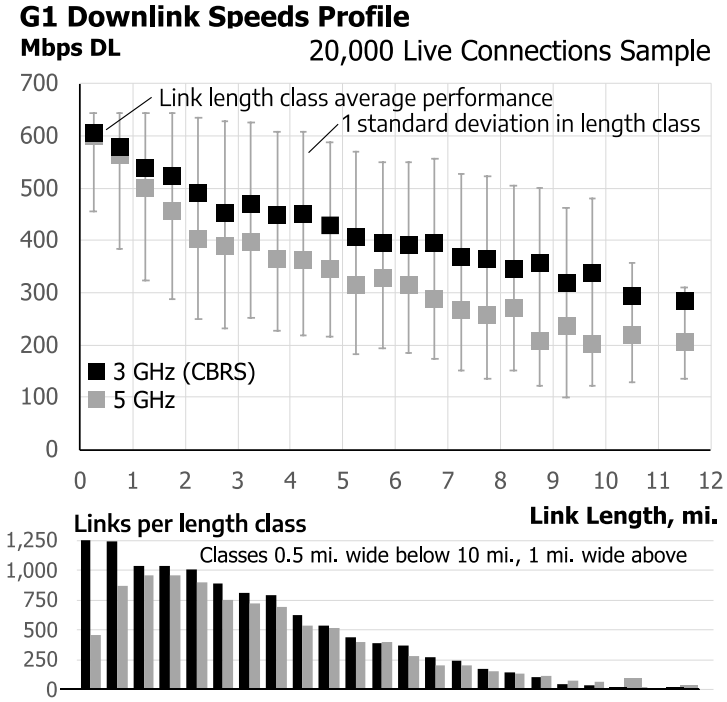


Figure 6 Resound Networks deployment example.

The central question of how service providers can deliver 100s of Mbps cost-effectively to Native Nations, and sooner rather than later, has remained unanswered for years. Tarana has addressed it with a new approach that is increasingly recognized as leading the way to next-generation FWA.

G1's performance is often met with skepticism, given the many sub-par attempts in the industry that have preceded it. But the real-world results across more than 200 ISP networks are helping prove that its fundamental advances in FWA are very real. A recent sample of 20,000 links on Tarana's live customer networks yielded a truly unprecedented set of performance metrics across a wide range of distance and link conditions.



[2] Executive summary: Tarana Has Created the Next Generation of Fixed Wireless Access. https://www.taranawireless.com/wp/wp-content/uploads/2022/05/Tarana-Exec-Summary-2022.05-.pdf

Managed Wi-Fi for public spaces

Wi-Fi has evolved from an emerging technology to a ubiquitous standard, now integral to daily life. It's used by diverse users, from individuals to large businesses, and powers a vast range of devices, including smartphones, laptops, smart home gadgets, and industrial equipment. Its widespread adoption and versatility underscore its transition from novelty to necessity in the digital age.

Public Wi-Fi in tribal communities can facilitate online education, telehealth services, and local business growth. A Wi-Fi broadband service is often the first step in closing the digital divide. It is commonly provided free at anchor institutions such as community centers, schools, libraries, and local businesses, as they are accessible gathering points that can maximize the benefits of connectivity for the entire community.

Cisco Meraki cloud-managed IT is built for the demands of modern local governments, from managing agency and public networks, to streamlining city security and everything in between.

- High performing wireless access points are optimized for government buildings and public Wi-Fi deployments.
- Complete visibility and control over network users, devices, and applications removes the need for dedicated on-site IT staff.
- Self-provisioning, self-optimizing, and self-healing end-to-end solution makes it easy to deploy and manage without specialized training.

Local Government Solution Guide
https://meraki.cisco.com/lib/pdf/meraki_state_and_local_government_solution_guide.pdf
Wi-Fi 6 whitepaper
meraki.cisco.com/product-collateral/meraki-wifi-6-whitepaper

Wi-Fi 6: the new generation
Since the initial Wi-Fi standard was published more than 20 years ago, faster modulation and coding schemes (MCSs), wider channels, additional frequency bands, and technologies such as multiple-input, multiple-output (MIMO) and orthogonal frequency-division multiple access (OFDMA)—to name a few—have addressed the challenges facing Wi-Fi networks: increasing both performance and throughput to support users' growing demands of Wi-Fi networks and devices.

Generation	IEEE Standard	Max. throughput	Radio frequency (GHz)
Wi-Fi 5	802.11ac	6.8 Gbps	5
Wi-Fi 6	802.11ax	10 Gbps	2.4 / 5
Wi-Fi 6E	802.11ax	10 Gbps	6
Wi-Fi 7 (future)	802.11be	46 Gbps	1–7.25 (2.4/5/6)

Mobile technologies

Many Native Nations have acquired a 2.5 GHz spectrum, which can cover large geographic areas. CBRS spectrum at 3.5 GHz can also be used to provide mobile coverage.

For data services, the blueprint includes a Private 5G or LTE solution from Cisco and its radio partners. This solution is ideally positioned for IoT applications such as water management or farming.

For voice services, which include roaming onto national networks, the blueprint recommends working with a national or regional mobile service provider. Various commercial arrangements can be developed with the national carriers as they value the 2.5 GHz spectrum (and T-Mobile has the most experience with this

spectrum). Native Nations will also be able to derive wholesale revenue streams from providing towers and backhaul connectivity.

Network security

As our dependence on internet-connected devices and online services grows, we open ourselves to new possibilities and business opportunities. Yet, this also heightens the need to stay vigilant against cyber threats, a risk posed by those with malicious intent on the internet.

It's not only important for individuals and business owners to comprehend these risks and act wisely, but there's also a significant role for telecommunication providers. They are equipped to provide a host of measures and services to enhance network security and ensure the seamless operation of businesses, playing a vital part in keeping the digital world safe.

DNS protection – the first line of defense

Domain name servers (DNS) are at the heart of connecting every internet request. Securing the DNS layer means blocking malicious domains, IP addresses, and cloud applications before establishing a connection.

Cisco Umbrella uses DNS to stop threats over all ports and protocols. It blocks malware earlier and prevents callbacks to attackers if infected machines connect to your network. Umbrella routes requests to risky domains to a selective proxy for deeper URL and file inspection.

AtLink recommends providing Cisco Umbrella DNS as the default DNS service for all broadband users, with additional content filtering capabilities for organizations and businesses.

More information on DNS protection solutions can be found here: https://umbrella.cisco.com/products/dns-layer-network-security

Software Defined Wide Area Network (SD-WAN)

To address the needs of business customers for secure communications over the internet, AtLink is pleased to propose using Cisco's Software Defined Wide Area Network ("SD-WAN") portfolio.

The basic principle of operation of SD-WAN is that it constitutes an overlay private network defined over high-speed Internet access. The primary features of the Cisco SD-WAN are that it is secure and provides a high degree of isolation from other traffic.

The main advantages of SD-WAN over other wide-area private network solutions are simplicity and affordability. An SD-WAN can be easily configured within minutes compared to other solutions requiring extensive configuration management. The key to this simplicity is that SD-WAN is decoupled from the underlay transport, which is simply the worldwide internet.

SD-WAN solutions today are widely deployed as convenient and low-cost options for private networks. Native Nation use cases include government, law enforcement, access to cloud services, and other use cases requiring high security. AtLink is delighted to work with Native Nations to understand requirements for business solutions on tribal lands.

Duo Mobile - The Best Two-Factor Authentication App

The most important thing you can do to increase your online security, alongside using a password manager, is to enable two-factor authentication everywhere you can. We recommend Duo Mobile, which has the best combination of compatibility, security, usability, and reliability for most people.

The Wirecutter

March 2023

https://www.nytimes.com/wirecutter/reviews/best-two-factor-authentication-app/

More information on SD-WAN solution can be found here:
www.cisco.com/c/en/us/solutions/collateral/enterprise-networks/sd-wan/nb-06-sd-wan-secur-aag-cte-en.html

Protection from distributed denial-of-service (DDOS)

Distributed denial-of-service (DDoS) attacks are sophisticated attacks designed to flood the network with superfluous traffic. A DDoS attack results in either degraded network performance or an outright service outage of critical infrastructure.

DDoS attacks have many motives, ranging from disruption of services to espionage and cyber warfare. While DDoS attacks are a threat to all businesses and all industries, DDoS attacks most often target the following: online gaming and gambling - to win a competitive advantage or financial gain; service providers - to commit data theft, eavesdrop, disrupt essential services, or inflict reputational damage; governments - to steal intellectual property, disrupt operations, eavesdrop, commit espionage, or gain a competitive advantage; financial services - to achieve financial gain, inflict reputational damage, access confidential data, or cause disruption; online retailers - to disrupt operations, gain a competitive advantage, inflict reputational damage, or steal intellectual property.

A DDoS attack attempts to disrupt the regular traffic of a targeted server, service, or network by overwhelming the target or its surrounding infrastructure with a flood of Internet traffic. DDoS attacks typically originate from the end user as the malicious disruption involves hosting BOT viruses on end-user devices. Consumer networks have been plagued with this type of attack. The closer we can tag and clean this traffic to the origination of the DDoS is essential. By deploying the Cisco NCS 540 in the "access" portion of the network, as illustrated in Figure 7, we can clean DDoS traffic closest to the origination and thus save network assets and bandwidth throughout the rest of the network.

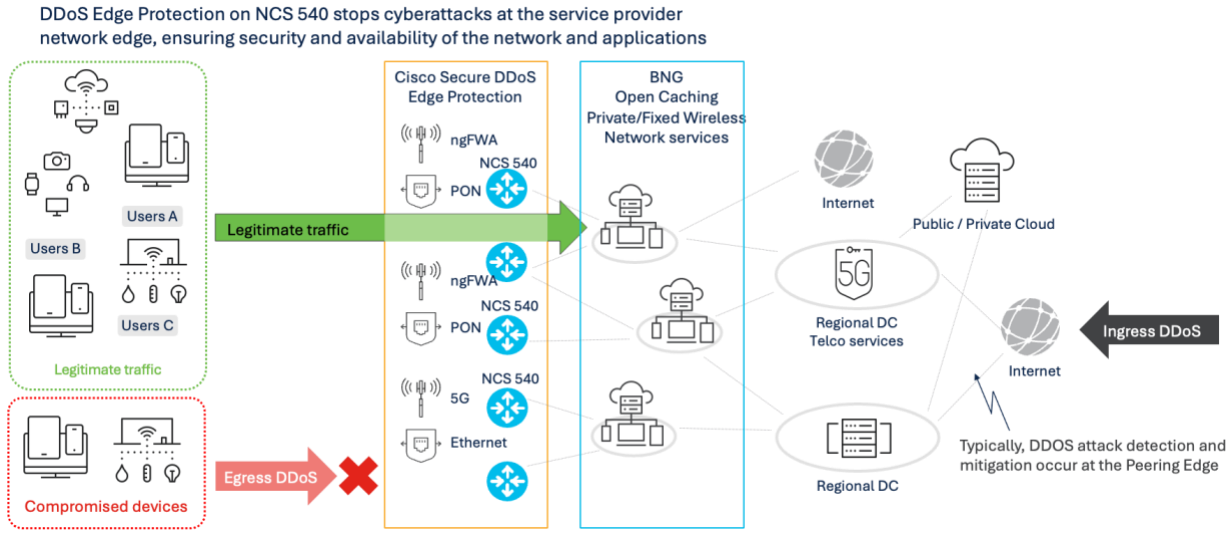


Figure 7 DDoS attack protection at the access network edge

More information on Cisco Secure DDoS Edge Protection solution can be found here:
www.cisco.com/c/en/us/products/collateral/security/secure-ddos-protection/secure-edge-protection-tech-wp.pdf

Subscriber management

An important design element for broadband access is subscriber management. Subscriber management provides the necessary visibility into the subscriber for billing and service definition and compliance with regulatory requirements.

From a technical point of view, it is essential to realize that in broadband access, a subscriber is only apparent to the network at the subscriber management location. Subscriber management is essential to generate a bill or invoice for broadband services. As the FCC/NTIA/USDA deploys broadband grant funds, performance measurement ("PM") testing is now a requirement for all grant recipients. It is essential that PM testing can be performed by the front-line customer service representative ("CSR") and reported to the grant funding agency with ease.

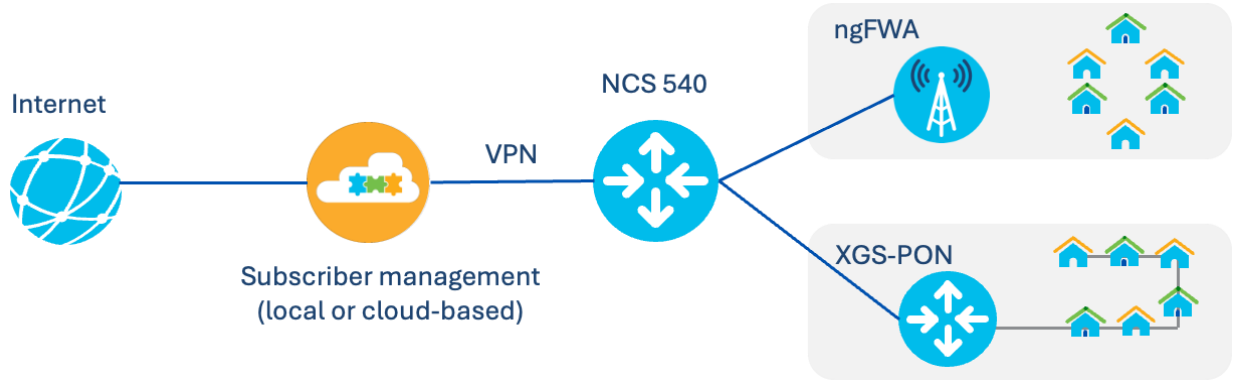


Figure 8 Common subscriber management for FWA and FTTH

FTTH and FWA, in our solution, have a common subscriber management solution. To explain this, we focus on the following simple modification to Figure 4 Broadband network infrastructure as represented in Figure 8 above. Subscriber management is the basis for providing broadband consumer service. A broadband service must support functions such as:

- Generating a monthly bill
- Managing broadband
- Handling trouble tickets

Deploying subscriber management on tribal lands presents a scalability challenge: it must be cost-effective for the expected subscriber base. Existing solutions on the market are designed for large networks and bear high operational costs, which are not cost-efficient for low subscriber counts. A scale of hundreds of thousands of subscribers is necessary to reach reasonable affordability. Therefore, it is imperative to address this issue decisively to ensure sustainable broadband deployment.

Subscriber management solution	**Target number of subscribers**	**Considerations**
no subscriber management	<1,000	Possible if the subscriber count is low and if they can be assumed to be well-behaved. In effect, no subscriber management is equivalent to having all subscribers on the same Local Area Network ("LAN"). This exposes subscribers

		network interface to security vulnerabilities. All subscribers are charged a single flat fee independent of usage and actual "speeds" used. In some cases, this may be a reasonable low-cost solution. Not recommended except in the most exceptional of circumstances.
cloud-based subscriber management	<10,000	Deploy subscriber functions with an outside managed services provider. The managed service provider deploys the BNG and the ancillary software support systems and "powers" the Native Nation service which can maintain branding. The managed service provider will take care of connectivity to the Internet and support IP addressing from its own pool.
local subscriber management	>10,000	Assumes that subscriber functions are deployed within tribal lands and are handled wholly by the tribal telecom service. This option requires deployment of what is known as a Broadband Network Gateway ("BNG") within tribal lands and additionally requires software systems to manage the service and business support systems to manage the subscriber functions.

We address scalability through a subscriber management hub deployed by AtLink that supports, at scale, thousands of customers from many Native Nations. The function of identifying subscribers, defining the service, and creating a monthly bill can be outsourced to AtLink with low cost and simplicity. Should the Native Nation consider it necessary to support a different type of solution, this possibility also exists.

What is Broadband Network Gateway (BNG)?

A BNG attaches an identity to a broadband subscriber. That identity is much more than just an IP address (a network address) because it is attached to a physical/geographic address and an actual paying subscriber. The BNG can define what service in terms of throughput ("bits per second") the subscriber receives. It can shape traffic, and it can monitor the service to see that it is performing well. It is a standard function defined in telecommunications standards (e.g., BBF TR-101) and supported by multiple vendors, including Cisco.

AtLink services addresses the problem of subscriber management scalability by deploying highly scalable BNG solutions which are shared among multiple Native Nations. It will aggregate subscribers therefore and thus ensure a lower price point vs. what would be required if each Native Nation deployed their own BNG. In essence, the large-scale deployment has a much lower per-subscriber cost than dedicated on-prem solutions that lack the scale AtLink can provide. This concept of a managed subscriber service still allows tribal branding of the service, with solid Internet connectivity, but with AtLink powering "under the hood". Note that the concept is completely compatible with the idea of creating tech jobs in tribal lands. This is because many of the functions associated the service remain local and open to tribal residents.

How to operate a profitable and sustainable broadband business

Comedian Steve Martin once joked, *"You want to know how to become a millionaire? First, get a million dollars."* Mr. Martin's joke is funny because he fails to mention the hardest part of becoming a millionaire, namely, how to *earn* that first million dollars!

The answer to the question, "How can our tribe operate a sustainable broadband business ?" is not, "First, get a broadband business." No, the road to sustainability starts much earlier. A great broadband business begins with a great network design supported by an accurate, feasible budget, which in turn is supported by an adequate funding source. Once you have your design, budget, and funding, you build your network, hopefully on time and within budget. Then, you begin operations, hopefully, "sustainably," so that the broadband business can support itself financially, covering expenses for management, maintenance, and modernization of the network for its customers over time.

This section aims to identify and discuss the fundamentals of how to design a broadband network, how to budget for the design and construction of the network, and how to find funding for the network. Then, the real work begins with how to operate the network profitably as a broadband business while delivering service every hour of every day. While this section is not exhaustive as to the ways and means of building and operating a sustainable broadband business, you will find many helpful tips and suggestions about what to do, what to consider, where to find help, and how to get started.

Osage Broadband selected to administer Nation's broadband grants

"AtLink currently serves about 50 customers in Osage County and is poised to expand with coverage in Bowring and Hominy with its operating partnership with Osage Broadband. Ultimately, the system should serve more than 3,000 Native households in the Osage."

December 2022.
https://osagenews.org/osage-broadband-selected-to-administer-nations-broadband-grants/

Why your tribe should want to operate a broadband business

Among other things, the COVID-19 pandemic showed the world just how dependent we've all become on the internet for conducting our lives, our businesses, our schools, our economies, and our governments. Moreover, the sudden heavy reliance on the internet necessitated by having to work, learn, and generally communicate remotely revealed the severe limitations of our broadband networks in early 2020 regarding broadband speeds and access for many communities. Native America quickly learned that many of its communities were not just *underserved* (e.g., slow speeds, unreliability) but often entirely *unserved* in many cases, with many tribal members having no internet access and no experience using it.

In 2019, the standard for "good broadband" in the U.S. was 10 Mbps for downloads and 1 Mbps for uploads. However, by 2023, with the increasing online demands, this standard has dramatically risen to 100 Mbps for both downloads and uploads, showcasing the rapid evolution of digital needs. See unserved/underserved definitions here.

Tribal communities require a robust broadband service, delivering a minimum of 100 Mbps for both uploads and downloads, to ensure seamless access to critical online government and business services. These vital services encompass online education, business transactions, digital banking, e-commerce, employment searches, telehealth consultations, and other essential digital functionalities.

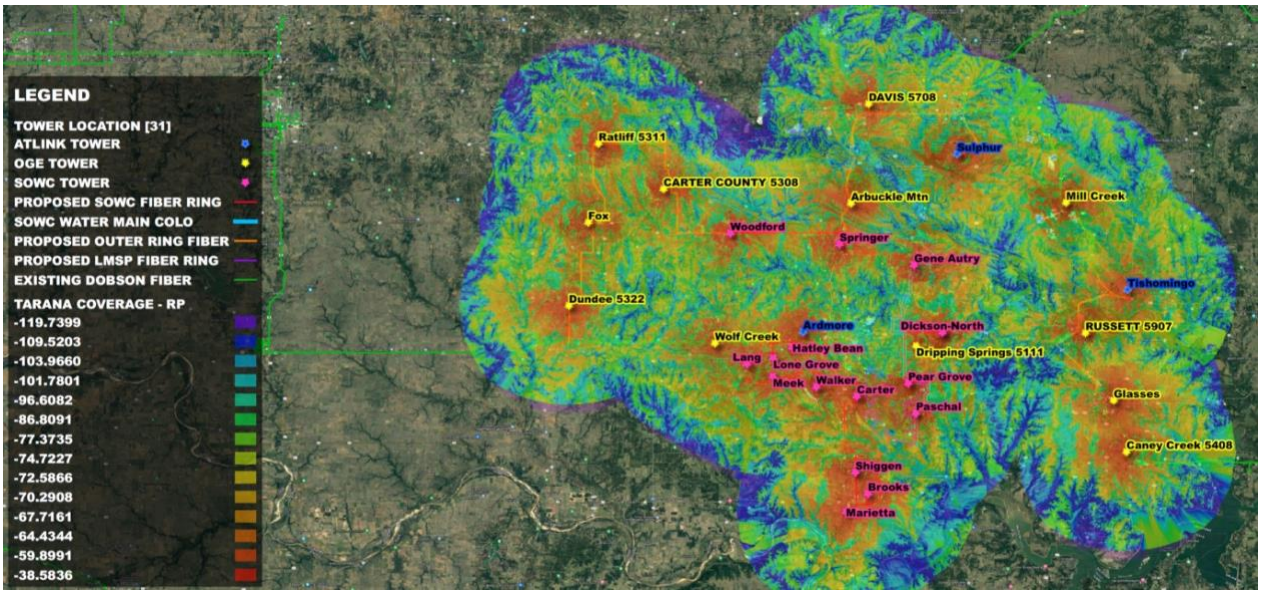
Network design

A superior broadband network begins with a great design, requiring an experienced professional engineering firm to help. If your tribe is embarking on your first broadband network design project, you will likely not have experienced broadband industry engineers on staff. Happily, many engineering firms throughout the US are happy to assist. Make sure you retain one. Here's what an experienced engineer will help you decide:

☐	Where do we want to build our network?
☐	What kind of network do we want, a fiber-to-the-home or business network, or a wireless-to-the-home or business network, or perhaps a hybrid network?
☐	If a hybrid network, where in our target area should we use fiber technology and where should we use wireless technology – and why?
☐	What telecom carriers can provide internet access to our network, redundancy for our network, and where can such carriers tie into our network and how much bandwidth can each company provide to our network?
☐	What are the relative build and maintenance costs of a fiber network vs. a wireless network? (Generally, a fiber network is more expensive to build but less expensive to maintain, while conversely, a wireless network is less expensive to build but more expensive to maintain.)
☐	Is there adequate broadband service or third-party infrastructure already available in the target area and can we simply tie into and extend to our target service area?
☐	How many tribal members, non-tribal members, and locations could we serve in our target area?
☐	What is the competitive landscape of our target area and its market potential (i.e., number of potential subscribers X likely average monthly revenue per subscriber)?
☐	What easements, permits, and possible land acquisitions will we need?
☐	Where will we bury fiber vs. where we can deploy fiber aerially? (N.B. Deploying fiber aerially is usually considerably less expensive.)
☐	For any wireless portion of our network, where must we build towers vs. where we can lease tower space on existing towers?
☐	For any wireless portion of our network, where must we provide a fiber connection from the tower to the internet access point vs. where we could use a licensed or unlicensed frequency for wireless connections for towers?
☐	For any wireless portion of our network, what towers will we use for service and what towers will we use for backhaul (to connect to our core network where we manage our service)?
☐	Where will we site our core network and what telecommunications equipment will we need (make, model, options) to provide the broadband service we must provide?
☐	What telecommunications equipment will we need for a fiber network and/or wireless network in the field and in subscribers' homes, businesses, and offices? What are our make/model options?
☐	What environmental and/or archeological studies must we undertake?

Ultimately, the engineer will consider all these considerations to create a cost-effective design for your network, one that, if built on time and on budget, will provide a solid foundation for a sustainable broadband business. The result will take the form of a comprehensive design document that is full of maps, easement and permit recommendations, suggested construction timelines, construction budgets, and builds of materials for fiber portions of a network and wireless portions of a network, all culminating in a one-to-five-year operations revenue forecast.

Sample engineer-created broadband service coverage map



Construction budgets

Here, as in network design, an experienced engineering firm is essential. The engineers will know what telecommunications equipment costs, how much of each type of equipment you need, where to order the kit, and what lead time for delivery must be considered.

The engineer will know where to tie into telecom carrier networks for internet access and transport, where to site your core network, and at what lease cost, if not at a tribal data center. Your engineer partner will know where you must bury or string fiber, where to build telecommunications towers (if any), and at what cost, where you can lease space on existing towers and utility poles, from whom, and at what monthly cost.

Sample engineer-created summary network build budget.

Id	Description	Unit	Qty	Labor	Material	Unit Cost	Total
SP-L	Splice Location	count	15				
D-125	HDPE SDR11 1.25" Duct (2)	feet	483,469				
F-144-U	Underground Fiber Feeder 144	feet	483,469				
F-BU	Underground Fiber Bore	feet	48,347				
F-RU	Underground Fiber Rock Excavation	feet	12,087				
SL-U	Slack Underground	feet	194				
MP-L	Buried Fiber Marker Post-Locate	count	323				
MP-W	Buried Fiber Marker Post-Warning	count	967				
HH	Handhole	count	194				
FL	Dark Fiber Lease	months	120				
RL	Route length	feet	483,469				
F-COLO	SOWC colocation	feet					
TL	Tower Location	count	15				
FT	10GE Transport	count	4				
FS	10GE service	months	60				
SUB-F	FTTH Subscribers	count					
SUB-W	ngFWA Subscribers	count	4,988				

	SERVICE POTENTIAL SUMMARY	Unit	Count
	Locations within 16km of XXX and Atlink towe	count	25,643
	Served ngFWA 600 Mbps DL	count	19,949
	Served FTTH 1000 Mbps DL	count	-

Contingency	
Engineering	
Grand Total	

Operational revenue forecasts

It is unlikely that your tribal governing council or board will approve your broadband project without a comprehensive financial forecast, one that answers the question, *"If we approve this network construction project and budget, how much operating revenue will it generate over time, and when will it cover its operating expenses such that it can sustain itself without additional tribal capital or investment?"*

Here is where the engineers will seek the assistance of an experienced broadband industry accountant to prepare financial projections. Elements to be considered include market size, likely market penetration, average subscriber revenue per month based on the competitive landscape, likely subscriber growth over time, recurring revenue vs. non-recurring revenue, labor costs, equipment costs, vehicle costs, network maintenance and upgrade costs, marketing and advertising, software licenses, customer resource management costs, and general overhead/G&A costs.

The financial projection should be in Excel format with an easy-to-follow summary sheet supported by several connected detail sheets for various revenue sources and expenses, both capital and operating. A sample financial forecast appears below.

Sample accountant-created operating revenue financial forecast

Year 1 of Operations

	MONTHS												TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	YEAR ONE
Net Customer growth - Fiber	0	0	0	0	0	0	0	100	150	150	150	150	700
Net Customer growth - Tarana	0	0	0	0	0	0	0	0	0	200	200	200	600
Total Customers	0	0	0	0	0	0	0	100	250	600	950	1300	1300
Recurring Revenue	-	-	-	-	-	-	-	8,500	21,250	51,000	80,750	110,500	272,000
Non Recurring Revenue	-	-	-	-	-	-	-	15,000	22,500	52,500	52,500	52,500	195,000
Total Revenue	-	-	-	-	-	-	-	23,500	43,750	103,500	133,250	163,000	467,000
Bad Debt	-	-	-	-	-	-	-	(235)	(438)	(1,035)	(1,333)	(1,630)	(4,670)
Net Revenue	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**23,265**	**43,313**	**102,465**	**131,918**	**161,370**	**471,670**
COGS - Bandwidth, Tower lease, transport	-	-	-	-	-	-	-	2,380	5,950	14,280	22,610	30,940	76,160
Compensation	-	-	-	-	-	-	-	1,700	4,250	10,200	16,150	22,100	54,400
Vehicle Expense	-	-	-	-	-	-	-	425	1,063	2,550	4,038	5,525	13,600
Network & Field Operations	-	-	-	-	-	-	-	255	638	1,530	2,423	3,315	8,160
Marketing and Advertising	-	-	-	-	-	-	-	170	425	1,020	1,615	2,210	5,440
Facilities	-	-	-	-	-	-	-	255	638	1,530	2,423	3,315	8,160
Software & Software licenses	-	-	-	-	-	-	-	255	638	1,530	2,423	3,315	8,160
Professional fees	-	-	-	-	-	-	-	340	850	2,040	3,230	4,420	10,880
Other G&A	-	-	-	-	-	-	-	425	1,063	2,550	4,038	5,525	13,600
Total Expense	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**6,205**	**15,513**	**37,230**	**58,948**	**80,665**	**198,560**
Net Income	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**17,060**	**27,800**	**65,235**	**72,970**	**80,705**	**273,110**
Captial Spend													
Fiber	738,277	33,375	33,375	33,375	33,375	33,375	33,375	33,375	33,375	-	-	-	1,005,275
Tower	-	-	-	-	-	1,264,998	1,264,998	1,264,998	1,264,998	1,264,998	1,264,998	1,264,998	8,854,987
Total Capital	738,277	33,375	33,375	33,375	33,375	1,298,373	1,298,373	1,298,373	1,298,373	1,264,998	1,264,998	1,264,998	9,860,261

Year 2 of Operations

	MONTHS												TOTAL
	13	14	15	16	17	18	19	20	21	22	23	24	YEAR TWO
Net Customer growth - Fiber	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Customer growth - Tarana	250	250	300	300	350	350	400	400	450	450	500	500	4500
Total Customers	1550	1800	2100	2400	2750	3100	3500	3900	4350	4800	5300	5800	5800
Recurring Revenue	131,750	153,000	178,500	204,000	233,750	263,500	297,500	331,500	369,750	408,000	450,500	493,000	3,514,750
Non Recurring Revenue	37,500	37,500	45,000	45,000	52,500	52,500	60,000	60,000	67,500	67,500	75,000	75,000	675,000
Total Revenue	169,250	190,500	223,500	249,000	286,250	316,000	357,500	391,500	437,250	475,500	525,500	568,000	4,189,750
Bad Debt	(1,693)	(1,905)	(2,235)	(2,490)	(2,863)	(3,160)	(3,575)	(3,915)	(4,373)	(4,755)	(5,255)	(5,680)	(41,898)
Net Revenue	**167,558**	**188,595**	**221,265**	**246,510**	**283,388**	**312,840**	**353,925**	**387,585**	**432,878**	**470,745**	**520,245**	**562,320**	**4,231,648**
COGS - Bandwidth, Tower lease, transport	36,890	42,840	49,980	57,120	65,450	73,780	83,300	92,820	103,530	114,240	126,140	138,040	984,130
Compensation	26,350	30,600	35,700	40,800	46,750	52,700	59,500	66,300	73,950	81,600	90,100	98,600	702,950
Vehicle Expense	6,588	7,650	8,925	10,200	11,688	13,175	14,875	16,575	18,488	20,400	22,525	24,650	175,738
Network & Field Operations	3,953	4,590	5,355	6,120	7,013	7,905	8,925	9,945	11,093	12,240	13,515	14,790	105,443
Marketing and Advertising	2,635	3,060	3,570	4,080	4,675	5,270	5,950	6,630	7,395	8,160	9,010	9,860	70,295
Facilities	3,953	4,590	5,355	6,120	7,013	7,905	8,925	9,945	11,093	12,240	13,515	14,790	105,443
Software & Software licenses	3,953	4,590	5,355	6,120	7,013	7,905	8,925	9,945	11,093	12,240	13,515	14,790	105,443
Professional fees	5,270	6,120	7,140	8,160	9,350	10,540	11,900	13,260	14,790	16,320	18,020	19,720	140,590
Other G&A	6,588	7,650	8,925	10,200	11,688	13,175	14,875	16,575	18,488	20,400	22,525	24,650	175,738
Total Expense	**96,178**	**111,690**	**130,305**	**148,920**	**170,638**	**192,355**	**217,175**	**241,995**	**269,918**	**297,840**	**328,865**	**359,890**	**2,565,768**
Net Income	**71,380**	**76,905**	**90,960**	**97,590**	**112,750**	**120,485**	**136,750**	**145,590**	**162,960**	**172,905**	**191,380**	**202,430**	**1,665,880**
Captial Spend													
Fiber	-	-	-	-	-	-	-	-	-	-	-	-	-
Tower	1,264,998	1,264,998	1,264,998	1,264,998	1,264,998	-	-	-	-	-	-	-	6,324,990
Total Capital	1,264,998	1,264,998	1,264,998	1,264,998	1,264,998	-	-	-	-	-	-	-	6,324,990

Funding for construction

Before the COVID-19 pandemic, there were relatively few tribal-directed, tribal-specific broadband development programs at the state or federal level. Before 2020, the Federal Communications Commission and the US Department of Agriculture had several programs designed to fund broadband development. For example, the FCC had its Connect American Fund "reverse auction" program, which offered money to winning and approved parties to develop broadband in underserved/unserved areas. Additionally, the USDA had its Community Connect and ReConnect programs, which offered (and still offer) money to qualified participants to develop broadband in underserved/unserved rural communities. Both of those programs were open to tribal applicants, as well as non-tribal public and private sector businesses and broadband providers.

Since COVID-19 and the recognition of the need for high-speed broadband in tribal communities, the federal government has enacted several programs, each with a particular set-aside for tribal communities and their broadband development needs, including:

☐	The Coronavirus Aid, Relief, and Economic Security Act of 2020 ("CARES Act")
☐	Coronavirus Response and Relief Supplemental Appropriations Act of 2021
☐	The American Rescue Plan Act of 2021 ("ARPA Act")
☐	The Tribal Broadband Connectivity Program of the National Telecommunications and Information Administration (NTIA) of the US Department of Commerce
☐	The Tribal Priority Window Program of the Federal Communications Commission which granted tribes licenses to use unassigned 2.5Ghz Frequency channels on Tribal land)
☐	The Infrastructure, Investment and Jobs Act of 2021
☐	The Consolidated Appropriations Act of 2023
☐	The Affordable Connectivity Program (formerly the Emergency Broadband Benefit program)

The deadlines for participation in many of these programs have passed. However, if all the money allocated to your tribe has not yet been spent, there should still be time to allocate some portion of the remaining funds for broadband development. Also, many states still have ARPA Act funds for tribal broadband development.

Currently open funding programs

1. Round 2 of the NTIA's Tribal Broadband Connectivity Program: The application filing deadline is 11:59 p.m., January 23, 2024; $980 Million set aside for tribal awards. The NTIA will use these funds to make awards directly to applicants. For a complete discussion of this program, go to the Notice of Funding Opportunity at https://ntia.gov/sites/default/files/2023-07/ntia-tbcp-round2-nofo.pdf

2. The Broadband Equity Access and Deployment Program ("BEAD Program"): $42.45 Billion Total Funding for all 50 States, Washington, DC, Puerto Rico, the US Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands. Application deadlines will vary by state and territory; however, each state/territory has until December 28, 2023, to submit to the NTIA initial proposals on how to run its grant program. Presumably, once a state or territory receives NTIA approval and initial funding, each state/territory will set its own application filing deadlines. To see how much your state or territory received in BEAD funding, visit https://internetforall.gov/funding-recipients . For a complete discussion of this program, visit Notice of Funding Opportunity at https://broadbandusa.ntia.doc.gov/funding-programs/broadband-equity-access-and-deployment-bead-program.

Note that these funding programs offer initial grants to cover the expenses of preparing the various parts of the application for the grant itself, i.e., the network design, the construction budget, the revenue forecast, etc. The application processes for these funding programs are pretty similar. Your tribe's filing will include all the work your professional engineering firm and accountant provided and an assessment of how your application satisfies the "scoring criteria" that the program requires. Eligible broadband program funding purposes for underserved/unserved locations include:

☐	Deploying/Upgrading a broadband network to promote education, awareness, training, equipment, and support for tribal communities.
☐	Deploying/Upgrading broadband network facilities or to provide or improve service to tribal anchor institutions such as schools, libraries, medical and healthcare providers, tribal colleges, public housing, workforce facilities, etc.
☐	Data collection, broadband mapping, and planning as needed to facilitate the program goals and deliverables.
☐	Installing internet and WIFI infrastructure or providing reduced-cost and no-cost broadband service to tribal members.
☐	Programs to promote broadband adoption and digital inclusion through providing internet-capable devices and training, including for workforce development, telehealth, online education, and digital skills development.

Unserved/Underserved location definitions for broadband programs:

	Minimum download/upload speeds	Minimum signal latency
Unserved	25 Mbps / 3 Mbps	100 ms
Underserved	100 Mbps / 20 Mbps	100 ms

For more details please read BEAD Program Q&A: https://broadbandusa.ntia.doc.gov/sites/default/files/2022-09/BEAD-Frequently-Asked-Questions-%28FAQs%29_Version-2.0.pdf

FCC Broadband DATA Map: https://broadband477map.fcc.gov/#/

Matching funds

Some funding programs, like BEAD, require applicants to provide matching funds of at least 25 percent of project costs. In that context, securing matching funds is essential to leverage federal grants and expand broadband services across tribal lands. Private investments are pivotal in fulfilling this matching criterion, highlighting the need for strategic collaborations with private sector entities to unlock these funds.

Moreover, in-kind contributions, encompassing non-cash donations like property, goods, and services, waived fees related to rights of way, pole attachments, or even access to existing infrastructure, can significantly complement cash investments.

Embracing private investments and in-kind contributions ensures eligibility for the BEAD program and demonstrates a collective commitment to bridging the digital divide in tribal communities.

Grants application process

As the application process can be lengthy and time-consuming, seeking assistance in preparing and filing the application for entities who require help with the extra lift can be helpful. Fortunately, the NTIA has a "Technical Assistance Hub" as a "one-stop shop for resources and tools" to support grant applicants. See https://broadbandusa.ntia.doc.gov/technical-assistance-hub.

For further guidance, many private and public service companies offer grant application writing and filing assistance. If you are looking for application help, please get in touch with your trusted Cisco advisor or the Cisco Public Funding Office to guide you in finding the right fit.

Cisco Public Funding Office help identify the grants, bonds, and other funding sources that align to your programs and technology needs.

https://www.cisco.com/c/en/us/solutions/industries/education/us-education/resources/e-rate/public-funding-office.html

In choosing a company to assist your tribe's application, do some reasonable "due diligence." Find out from each candidate company how many tribes they have assisted in writing broadband grant applications. Ask how successful these applications have been. Ask, "Did the tribes receive a grant award? How big was the grant award? And "How close was the award to the originally applied-for amount?" Then, ask for some "satisfied customer" tribal references to contact to confirm the information and to find out what the experience was like from the tribe's perspective in working with the company, and whether they would use that company again. Finally, if, after some due diligence, you find a company that seems to fit your needs, ask how many other clients they are preparing applications for at the same time. Make sure the company has time to give your tribe's application priority.

Network construction

What to consider and where to find help

Most of the tribal broadband network construction projects our company has seen cost at least $10 Million and upwards to $60 Million and will take one to three years to complete. Simply put, such projects are not suitable for any tribe or person to undertake without long and successful experience in managing large, multi-million-dollar building projects. It is, therefore best to hire an experienced general contractor, and your professional engineering firm will have recommendations for your tribe. Some professional engineering firms may even provide the general contracting service for you. In selecting a general contractor, use the same due diligence approach you used for choosing a grant application consultant, asking, *"How many similar projects have you supervised, for whom (references), and how did they turn out in terms of timeliness of completion, adherence to budget, and overcoming inevitable challenges?"* The best tip: See if your general contractor has a clean vs. lawsuit-heavy legal history. The general contractor who sues a lot or is sued a lot is rarely a good choice.

The general contractor's job will be to supervise the entire project from start to finish, including selecting, retaining, and managing the many qualified, bonded subcontractors needed to perform the various parts of the project. Types of subcontractors will include fiber installation companies, boring companies, tower construction companies, telecommunications equipment providers and installers, electricians, etc. Your general contractor will also be responsible for proper bookkeeping, expenditures, accounting, and requests for payment of all project funds.

The NTIA (or other funding agency) will be funding the grant in phases like any other large construction project and will require periodic proof of completion of phases backed by third-party inspections. Your general contractor will be responsible for making regular, periodic, and accurate reports to your tribe and to the NTIA (or other funding agency) on the progress of the construction project, including a showing of whether the construction is on, behind, or ahead of schedule. If behind schedule, the general contractor will have to provide reasonable explanations for the delay, such as supply chain problems or unanticipated labor issues, and how the general contractor intends to minimize or overcome the delay.[3]

Above all, once the construction project is underway, you should have regular meetings with your general contractor. Ask for regular, at least monthly, reports on progress, making sure the reports speak generally on progress but address specifically where the project is respecting its schedule, budget, and compliance with grant program requirements.

Broadband business operations

How to operate sustainably and where to find help

There will come a day when your broadband network is ready to "GO LIVE," and your tribe will suddenly be in the broadband service business. Remember, you must run the business "sustainably," meaning "profitably," meaning you are more than covering your expenses. As you ponder this impending reality, ask your tribal decision-makers: "*What tribal member has the most experience running a successful broadband service company?"* One imagines that the answer for most tribes is the same when the question arose*: "What tribal member has the most experience running a casino?"* The answer for casinos was "No one," the same likely answer for broadband service company experience. But today, your tribe is running its own casinos, having learned how to do so under the supervision of an experienced industry partner.

When selecting a broadband industry partner, look for some privately held company, preferably one in or near your tribal community, that is already in the broadband service business and has a successful business and an excellent reputation. As you begin to review candidates as a potential operating partner, educate your tribe on all the management and operational activities, skills, and tools that a suitable broadband service partner must have mastered, including:

- **Financial**: Administer and supervise all the finances of the Broadband Network Business, including billing of customers, collections, filing monthly government assistant programs, as applicable, payment of all installation costs including payroll, and all applicable taxes, accounting, bookkeeping, banking, financial records, and reporting functions as they pertain to the Business. Prepare, maintain, and present (i) quarterly financials for the operation and management of the Business; (ii) auditable annual financial statements for the Business according to generally accepted accounting principles consistently applied; (iii) monthly operating reports consisting of customer numbers, revenues, expenses, accounts payable and accounts receivable balances.

- **Employees & Subcontractors**: Hire, retain, manage, and terminate, as necessary, all employees and subcontractors required to staff and service the Business.

[3] Supply chain delays and labor shortage problems are highly likely, if not certain. Consider, the most prosperous country in the world has the NTIA and all 50 states awarding broadband tens of billions of dollars in broadband grant funds to hundreds of entities, all of whom will be building, expanding, and modernizing broadband networks at the same time, counting on many of the same suppliers and labor pools to complete their projects.

- **Procurement:** consider customer satisfaction and the total cost of ownership when selecting equipment, particularly customer premise equipment. Business sustainability depends on customer adoption rates, and low customer satisfaction will adversely affect these rates. Moreover, the cost of the truck roll to replace unreliable equipment is likely to cost more than the equipment itself.

- **Assets, Inventory, Equipment, & Facilities**: Supervise and control the installation and maintenance of all customer premise equipment; install equipment (to the extent not installed by third parties); and maintain telecommunications tower equipment, fiber nodes, and associated materials and supplies; and acquire, lease, dispose of and repair equipment and facilities necessary to provide safe and adequate service to customers of the Business.

- **Customer Contracts & Broadband Package Pricing**: Manage all costs and all pricing of broadband services on a customer-by-customer basis, including assisting customers in establishing governmental program support for subsidies for internet service (e.g., Lifeline and Affordable Connectivity Program benefits).

- **Disputes**: Commence, defend, and control all Business legal actions, arbitrations, investigations, and proceedings that arise in operating the Business.

- **Capital Asset Maintenance**: Maintain the Broadband Network assets in good repair, order, and condition, including determining and implementing equipment upgrades and modernizations.

- **Licensing & Permitting**: Obtain and pay all amounts necessary to maintain all licenses and permits required to continue to operate the Business.

- **Marketing**: Marketing of broadband services via websites, social media, direct customer mailing, and outreach.

- **Sales**: Sell broadband services via inside and outside sales staff to residential, commercial, educational, and governmental customers.

- **Customer Installations**: Installation of broadband service for customers, including the installation of customer premise equipment, making and installing the last mile fiber connection or wireless connection to customers' locations, and the establishment and continuation of broadband service to such locations.

- **Customer Support**: Provide customer technical support using modern customer resource management software and via telephone, text, email, and service calls to customer locations, including the scheduling of installations and service calls and the dispatching of personnel for such installations and service calls.

- **Vendor & Lessor Management**: Negotiation and implementation of (i) internet connectivity agreements with third parties for backhaul, transit, transport, and middle-mile fiber/wireless connections and bandwidth; and (ii) leases of space for radio equipment.

- **Regulatory Compliance**: Filing all required reports, disclosures, and forms necessary for timely and full compliance with all applicable regulations of the FCC, USDA, NTIA, etc.

When selecting a grant application consultant and a general contractor, perform your due diligence on your industry partner candidates. Visit their facilities, visit their websites, look at their online reputations, check financial performance, the number of active customers (are they big enough to manage their broadband business AND your tribe's business?), and credit history. See if their executive team is actively involved and perhaps helping serve as officers and directors of broadband industry associations and boards. And just like finding the ideal general contractor, see if they are often involved in litigation. If so, it's a bad sign.

Tribal interests vs. Industry partner interests

When Native tribes partner with broadband industry experts, they leverage specialized knowledge and resources crucial for successfully implementing their initiatives. However, it's essential to recognize that industry partners, driven by commercial objectives, might have expectations and strategies that differ from those of the tribal community. This difference in perspective isn't a barrier but rather an opportunity. Through collaboration and transparent dialogue, both parties can align their goals, ensuring that the partnership brings value and serves the community's broader objectives while meeting the industry's commercial benchmarks.

Let's briefly outline the factors that, based on our experience, influence tribal decision-making versus industry partner perspectives when contemplating a collaborative venture in establishing a new tribal broadband service.

Topic	Tribal interest	Industry partner interest
Broadband Asset Ownership	Will want to own infrastructure assets so that tribe can change partners if needed and eventually run the business on its own	Would prefer to own the assets but will concede ownership to the tribe if the initial investment is secured by the assets or something else (maintenance should be an operating expense)
Jurisdiction & Venue for Disputes	Will not want to waive sovereignty and will want jurisdiction and venue for all disputes in tribal courts exclusively	Must concede this issue or the tribe will not sign contract, but will want some contract duty to try to resolve disputes amicably
Business Operations & Management	Will want industry partners involvement to end after a period of years - meaning the service agreement must also require management training of tribal members and transition period	Will want to operate until a healthy return is achieved (5-7 years) but happy to conclude early given a community buyout
Employment for Tribal Members	Will want business to provide good-paying employment opportunities and skills development for tribal members	Will normally be quite receptive to hiring tribal members for staff positions; good labor pool always needed
Division of Revenues	Will want net revenues of business to be split between tribe and industry partner at regular intervals	Will be ready to share revenues with tribal business from day 1 given there exists a path to a healthy return (3-5 years), and revenue share eventually ends.
Allocation of Operational Expenses Before Profitability	Will want the business to cover expenses as soon as possible, and will want to minimize having to fund operations after exhaustion of grant funding	Will expect tribe to cover operating shortfalls before profitability unless the industry partner has a permanent, salable equity interest in the business, in which case the parties split fund expense shortfalls in proportion to relative equity ownership

Ongoing Authority for Decision-Making	Will want to rely on tribal law and government as to contracting and decision-making authority throughout the industry partner's involvement	Will want a single point of contact with contracting and decision-making authority throughout its involvement so that changing administrations with different priorities do not undermine or imperil the investment of time and money

Funding sustainable broadband business

To start a successful broadband business, funding is needed for company setup, expert recruitment, tool acquisition, physical infrastructure, networking technology, equipment installation, sales and marketing, and customer support.

Tapping into the benefits of many federal and state grants, like the BEAD program, necessitates a robust approach to sourcing matching funds. Partnering with private investors emerges as a critical strategy in this context. By collaborating with the private sector, tribal broadband providers can efficiently secure matching capital to qualify for federal grants. Furthermore, these partnerships can aid in covering additional expenses that the grants may not directly support.

Different funding models can be combined to support various aspects of a broadband business, resulting in the most financially effective model.

Funding Models	
	**Equity** Selling a portion of your business (shares) to investors. In exchange for their capital, investors become partial owners of the business and may have a say in its operations, depending on the amount and type of shares acquired. They aim to gain returns through the appreciation of the company's value and possibly dividends.
	**Debt** Borrowing money, typically in the form of loans from banks or other lenders. Businesses are expected to pay back the borrowed amount along with interest over a specified period. Unlike equity funding, debt doesn't dilute ownership, but there's an obligation to repay regardless of the company's success.
	**Grants** Funding is awarded to businesses, usually by governments, nonprofits, or institutions, to promote certain activities or causes. They do not need to be repaid and do not dilute ownership. However, they often come with specific criteria or conditions attached.
	**Revenue Share** A funding model where investors provide capital in return for a percentage of the business's future revenues until a predetermined amount or period is reached. It's a middle ground between equity and debt. Investors get repaid from revenues, but if the business doesn't perform well, the repayment might take longer or might not be fully realized.

The above funding models have a mix of benefits in terms of economic dilution, financial covenants, repayment terms, cost of capital, and overall flexibility.

	Equity	Debt	Grants	Revenues Share
	The business sells a % ownership stake in exchange for funding	Borrowed money that will be repaid over time with interest	Funds given to the business, typically by a government or non-profit	Upfront infrastructure funding in exchange for partial revenues
Minimal economic dilution		✓	✓	✓
Limited financial covenants	✓		✓	✓
Outcome-driven repayment terms	✓		✓	✓
Attractive cost of capital		✓	✓	✓
Overall flexibility				✓

You can see an illustration of how Revenue Share works in the next chapter and Figure 9 Illustration of service economics with the Revenue Share model and ACP funding

AtLink is partnering with Digital Alpha Advisors ("Digital Alpha"), a leading digital infrastructure investment firm, to address the broadband requirements of unserved and underserved rural Americans,

- Digital Alpha specializes in providing a mix of equity and revenue share funding propelled by strategically obtained grant funding. In offering the above funding structures, Digital Alpha hopes to align business owners' incentives with its own incentives while providing an efficient avenue for rapid business growth.

- Digital Alpha frequently collaborates with various investment firms, leveraging its extensive telecommunications industry expertise, strategic partnerships with Silicon Valley technology leaders, operating partners, and corporate governance.

DIGITAL ALPHA

Digital Alpha Advisors, LLC is an investment firm focused on the digital infrastructure required by the rapidly expanding digital economy, with total assets under management of over $1.5 billion. The firm has a strategic collaboration agreement with Cisco Systems, Inc. and has partnered with other leading Silicon Valley firms. Digital Alpha believes it is the first firm focused on making private equity investments in the significant growth opportunities required to underpin the Digital Economy, including next-generation communications networks, IoT platforms for urban infrastructure, and cloud-based data management platforms. Digital Alpha was founded in 2017 by Rick Shrotri, former Head of the Global Infrastructure Funds (GIF) team at Cisco, and closed its latest Fund – Digital Alpha Fund II, LP – in early 2021. For more information, please visit www.digitalalpha.net.

Ongoing service economics

The financial dynamics underpinning broadband services revolve around the monthly average revenue per user (ARPU).

Native Nations ARPU will likely originate from either ACP federal grant funding, the customer, or a blend of both.

Affordable Connectivity Program (ACP)

The Affordable Connectivity Program (ACP) created in 2021 through the Infrastructure Investment and Jobs Act, assists qualifying households with their monthly internet bills. Households who qualify for the ACP and are located on qualifying Tribal lands can receive:

- Up to a $75/month discount on your internet service, and
- A one-time discount of up to $100 for a laptop, tablet, or desktop computer (with a co-payment of more than $10 but less than $50).

https://www.affordableconnectivity.gov/do-i-qualify/enhanced-tribal-benefit/

An illustrative example of the Revenue Share model

As outlined above, one of the funding models for building a broadband network is Revenue Share with an investment partner.

After the revenue share capital provider has funded broadband infrastructure and service buildout, revenues from the business are shared until a predetermined amount or period is reached.

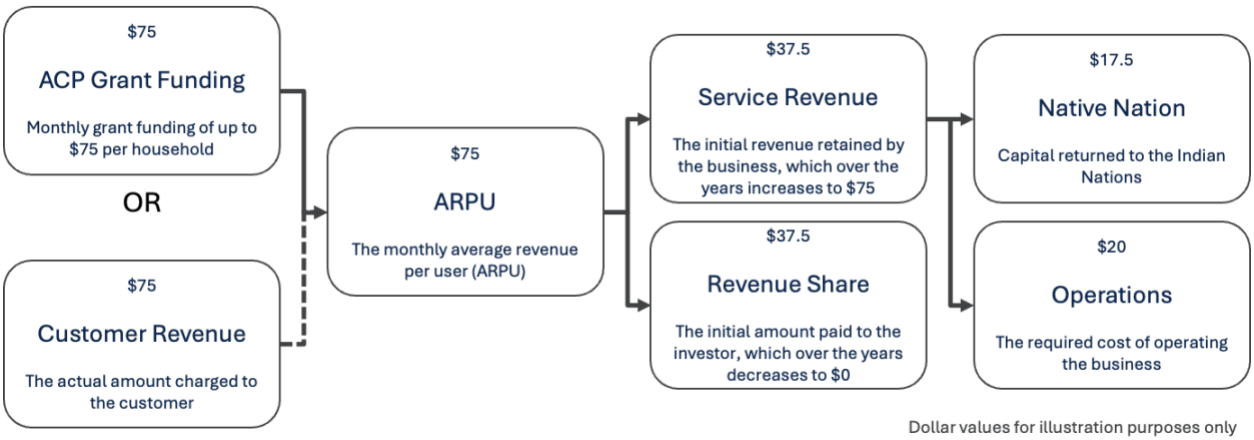


Figure 9 Illustration of service economics with the Revenue Share model and ACP funding

A blend of ACP grant funding and customer revenue collectively shapes the ARPU. This revenue is then divided between the business itself and the revenue share capital provider. As the capital is gradually repaid to the revenue share capital provider, the business's share of ARPU grows, eventually reaching a stage where the business fully retains the ARPU, channeling funds to support operations and contribute to the Native Nations community.

Digital Equity & Social Sustainability

Our partner, Cisco, is committed to creating an inclusive future for all and has several programs to support the creation of sustainable broadband services in Native Nations.

Cisco Network Academy

Cisco Networking Academy is one of the world's longest-running skills-to-jobs programs, offering global and inclusive tech education through strong public-private partnerships, a high-quality curriculum, and inclusive workforce development programs. In partnership with educational institutions, government leadership, and community-based organizations around the world, Cisco Networking Academy leverages Cisco's industry expertise to deliver a cloud-based curriculum and tools, focused on information and communication technologies shaping the future — such as security, networking, programming, and Internet of Things (IoT). Courses are designed to equip learners with the skills required by industry, using gamification, assessments, and problem-solving to support learner success.

Cisco Networking Academy aims to provide digital skills training to 25 million people over the next 10 years to help position them for in-demand jobs and educational opportunities in our efforts to help build an inclusive workforce.

Cisco Network Academy provides its workforce development programs through the American Indian Higher Education Consortium (AIHEC) and is currently assessing the need to expand these programs by taking the training onto individual Native Nations.

https://www.netacad.com

Cisco partners with American Indian Higher Education Consortium (AIHEC), helping harness the power of technology to drive more inclusivity and opportunity for underserved populations and communities by bridging remote digital divides through technology and education.

AIHEC serves more than 27,000 students in 37 Tribal Colleges and Universities across 16 states, serving students from more than 250 federally recognized Indian tribes and 30 states.

https://blogs.cisco.com/csr/bridging-remote-digital-divides-on-tribal-lands-with-the-american-indian-higher-education-consortium

Cisco Native American Network

Cisco's Native American Network (NAN) is an inclusive community dedicated to growing and empowering Native/Indigenous perspectives at Cisco and beyond. NAN raises awareness within Cisco (Native and non-Native) on tribal issues, social justice, events, and provides forums to learn about Native cultures. The community achieves this through its five pillars — Community, Connect, Professional Development, Social Justice, and Talent Acquisition. The community has more than 400 members who volunteer to work on tribal projects.

https://blogs.cisco.com/csr/elevating-native-and-indigenous-voices-through-ciscos-native-american-network

Cisco Country Digital Acceleration

Cisco's Country Digital Acceleration (CDA) program is an acclaimed, industry-leading collaboration framework/business model whereby real-world societal problems faced by government leaders can be solved by strategic co-investment in training, innovation, and mass-scale digitization. CDA fund co-

innovations with public & private sector organizations that strive to solve digitization challenges through innovations and pilots across a variety of sectors, including Education, Smart Communities, Health, Cybersecurity, Critical Infrastructure, and Sustainability. CDA is currently eager to identify priority projects for Native American communities.

https://www.cisco.com/c/en/us/about/country-digital-acceleration.html

Summary

Broadband is crucial for Native Nations to bridge the digital gap, providing vital services like education and healthcare. It also strengthens their cultural heritage, allowing them to connect with the world while maintaining their unique identities.

With the support of federal funds, it becomes feasible for Native Nations to establish and maintain key broadband infrastructure, thereby fully embracing and promoting their cultural legacy.

In collaboration with global tech leader Cisco and industry trailblazer Tarana Wireless, AtLink has developed a comprehensive blueprint for Native Nations. This guide encompasses strategies for ensuring community-wide broadband access, crafting sustainable broadband networks, aligning business models with stakeholders' incentives and goals, and promoting digital equity and social sustainability.

To continue the conversation, contact us:

Samual Curtis
sam@atlink.net

Alistair McGrath
amcgrath@cisco.com

Tim Jaeger
tim@taranawireless.com