

Tribal DIY: Self-deploying high-speed Internet networks on remote tribal lands in the United States

Mariel Triggs

Within a few days of being granted permission by the Federal Communications Commission (FCC) to use the 2.5 GHz spectrum on their reservation, the Havasupai Tribe made their first end-to-end high-speed Internet connection using the long-term evolution (LTE) network they built. A week later, 12 homes and the Head Start¹ building were connected to the Internet and students could pursue their studies at home. This feat is particularly notable because their village of Supai, Arizona is the most remote community in the contiguous United States. Supplies are flown in by helicopter or transported by mule train. And they self-deployed their network at no cost to the tribe.

Nearly two-thirds of people living on tribal lands in the United States lack access to high-speed Internet. Efforts continue to digitize education and move to online resources. Many rural schools are being updated with fibre and modern computer equipment, but most students on tribal lands cannot access those increasingly essential resources from home. This lack of off-campus access has been termed the “homework gap,” and arguably creates a greater disadvantage for rural tribal students than existed before the advent of digital education.

Today there exist technologies that bring down the cost of providing broadband access to rural areas

dramatically. Unfortunately, rural areas tend to be too sparsely populated to attract large telecom providers to build the necessary cellular infrastructure, and satellite broadband costs are prohibitively high for most of the population. Therefore, large swaths of reservations remain unconnected. However, through strategic partnerships and favourable federal policies, tribes like the Havasupai can have full operational control and governance of their own networks and provide free broadband access to their people.

Deployment process

Since May of 2017, Havasupai Tribal Council member Ophelia Watahomigie-Corliss has been working with a team of educational institutions, Internet service providers (ISPs) and nonprofits to bridge the homework gap in Supai. Dr. Chad Hamill, Vice President of Native American Initiatives at Northern Arizona University (NAU), connected Council member Watahomigie-Corliss to Kelly Cullen from Niles Radio Communications, and Mural Net, a nonprofit that provides equipment, administrator training, engineering support and legal services to create in-home wireless high-speed networks on tribal lands. Together, they proposed to the Havasupai Tribal Council a plan to get FCC approval and construct a point-to-multipoint LTE network completely funded by donations. There

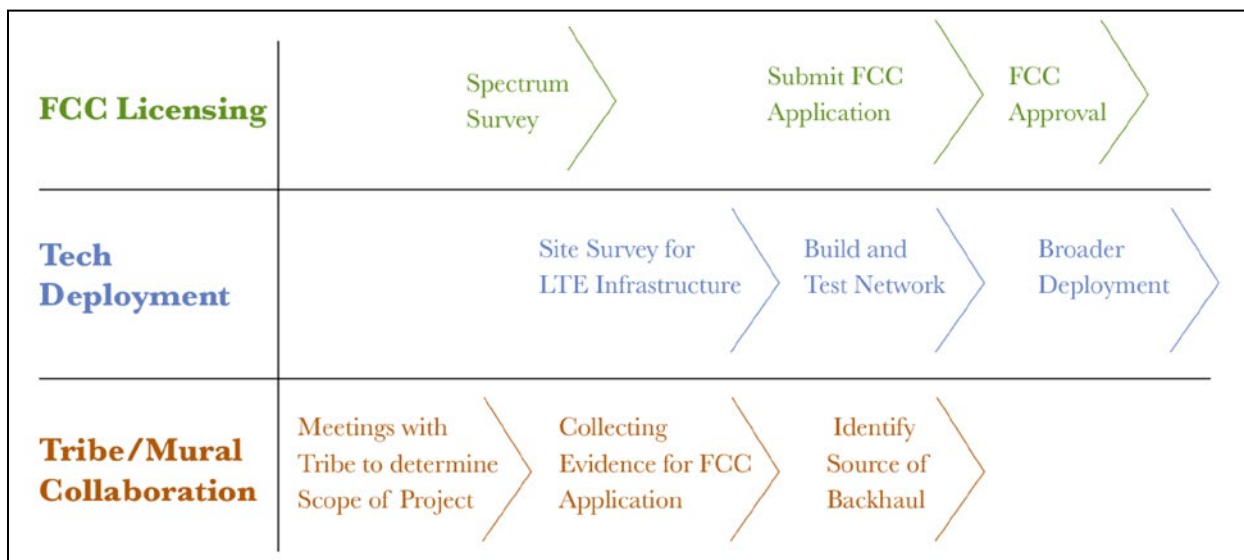
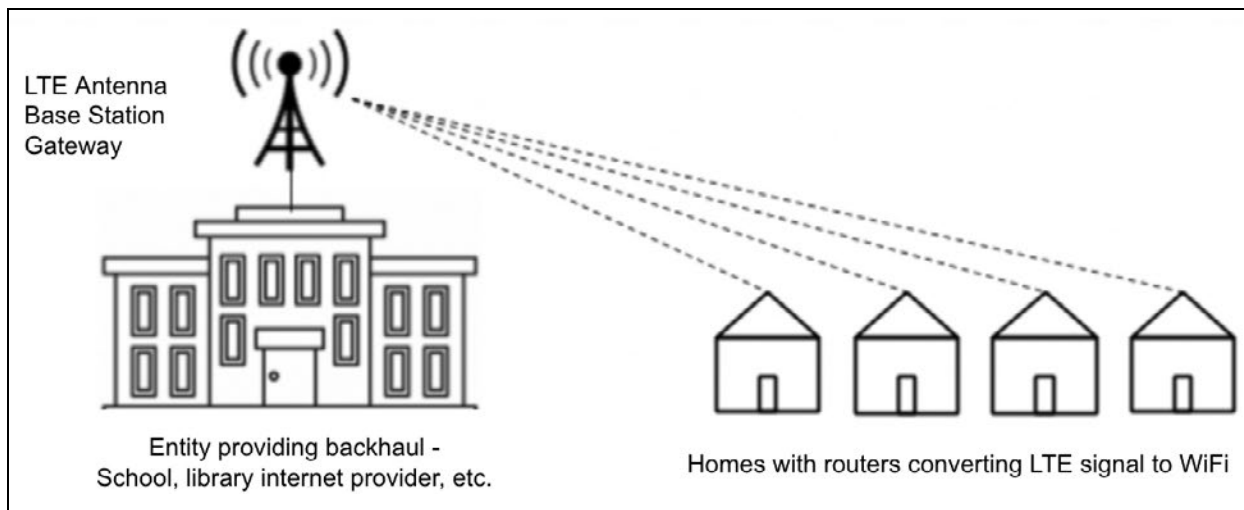


Image credit: Mariel Triggs

Network Deployment Timeline



Fixed wireless point-to-multipoint LTE network

were three simultaneous strands to the plan: attaining FCC licensing, deploying the technology and coordinating the collaborations to sustain the network.

Tribal/Mural Net collaboration

Tribal Council member Ophelia Watahomigie-Corliss worked with her community for a few months in order to ensure that there was agreement amongst the Tribe to collaborate with outside institutions and bring high-speed Internet to the town. Afterwards, she coordinated efforts to gather necessary support and evidence to apply for an emergency Special Temporary Authorization for the Havasupai Tribe to use the 2.5 GHz Band, otherwise known as Educational Broadband Services spectrum (EBS), which is accessible because the Havasupai's LTE network focuses on educational initiatives.

Tech deployment

Cheap last-mile, right-now solutions for the rural homework gap do exist. For example, point-to-multipoint LTE networks can be built fast and at a low-cost. Use of LTE reduces set up and repair costs. LTE also reduces the line of sight dependency that is disrupted by vegetation, and it has better power density for improved range. Implementation is simplified and management costs reduced by relying on an open-source software designed networking evolved packet core (SDN EPC) that has a cloud management and orchestration layer. The SDN EPC allows a tribal administrator to check on the health of the network, add subscribers and adjust data plans remotely. Mural Net hosts the management stack free of charge.

The LTE antenna is connected to existing backhaul that can be provided by fibre, microwave, satellite or other innovative methods. The LTE signal is then beamed to homes equipped with modem/routers

(CPEs) that convert it to WiFi, similar to what smartphones do when creating hot spots. For Supai, the antenna, base station, and gateway were installed on an existing cell tower on a cliff overlooking the town in one day. CPEs were then distributed to households and set up within ten minutes. The total costs of the equipment for the first phase of the Havasupai deployment was less than \$10,000, paid for by Mural Net. Niles Radio donated their time to install cell infrastructure. The Tribe is negotiating directly with Niles Radio to provide Internet for the entire town rather than each individual household having to procure service.

The strength and effectiveness of the LTE network were tested throughout Supai. A BaiCells Atom ID04-5 CPE2 was driven to every cluster of houses, testing download/upload speeds and other measures of signal strength from the tower on the rim of the Grand Canyon, approximately two miles away. Broadband speeds up to 32 Mbps were achieved in the centre of town. The network was found to have such a strong LTE signal that every home could have access to high-speed Internet, sufficient to support streaming video and student needs, if homes were equipped with the appropriate CPE. If backhaul throughput is increased, speeds are expected to increase.

Currently 16 of the 40 tribally owned CPEs are permanently installed in the homes of teachers and students. The rest of the CPEs are available for students to borrow on an as-needed basis. Another base station and antenna were installed over Supai last summer in order to increase capacity. Theoretically, every household in the town can now be served.

FCC permissions to access the 2.5 GHz Band

Each phase of the project was completed within days once appropriate permissions were obtained from the FCC and the Havasupai Tribal Council.

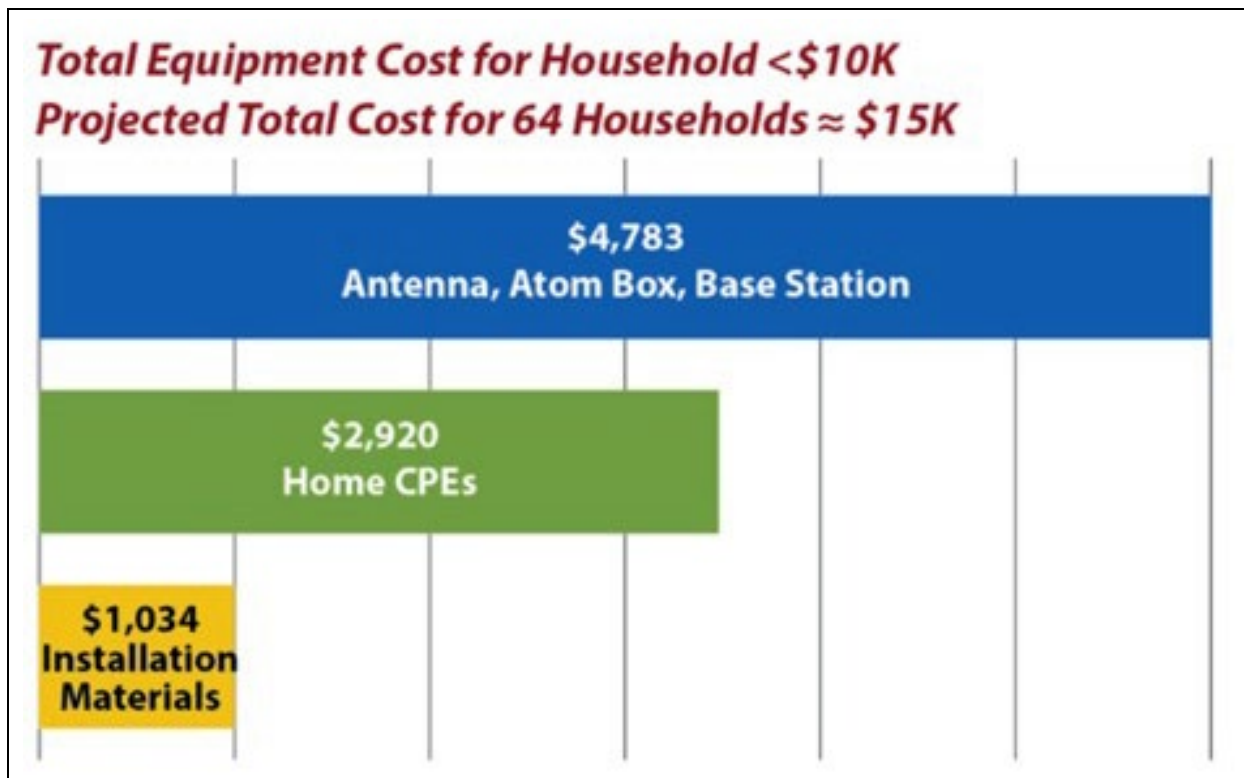


Image credit: Mariel Triggs

Cost of equipment breakdown

The major delays were around securing the necessary permissions from the FCC to access the EBS. Our previous experience with the FCC’s Special Temporary Access (STA) applications took only a few weeks to be processed. However, special circumstances due to possible changes in the FCC licensing of EBS spectrum delayed the process for four months. Eventually the Havasupai Tribe’s STA and STA extension was approved, and they have an application for a permanent licence pending.

Immediate impact on the community

Before the deployment, Jacqueline Siyuja, the Health and Disabilities Coordinator at Head Start, had to leave Supai every other weekend for a semester to take early education classes at a local community college. Due to Supai’s remoteness, the commute was long and expensive: “It wasn’t ideal. I had to leave my only child at home, but it was the only option.” The Director of the Head Start Program, Carlos Powell, Sr., states that “The Early Head Start teachers on the reservation are now able to begin the certification programs necessary to comply with Early Head Start standards. They were not able to do this from Supai prior to the installation.”

Now, residents pursuing their teaching degrees and accreditation can take these classes at home. Havasupai Chairwoman, Muriel Coochwyetewa, states in a letter to the FCC that “those teachers [with broadband access] can attend trainings from within the village and bring innovative teaching strategies to their

students. Head Start teachers are now able to enroll in Early Childhood Development programs to obtain their needed teaching certificates.” She also shares that “[a]s the infrastructure spreads to student homes, parents and students will have access to invaluable education opportunities to close our community’s educational gaps. The need for quality reliable wireless Internet



Image credit: Mariel Triggs

Connectivity map of Supai



Image credit: Mariel Triggs

Tribal Council Member, Ophelia Watahomigie-Corliss, and Head Start Director, Carlos Powell, Sr., at the Native American Child and Family Conference: Southwest Consortium of Indian Head Start Programs, Inc.

throughout this area is overwhelming.” Havasupai Elementary School teachers report that the SDN LTE network decreases the significant time restrictions as she pursues her master’s degree in Special Education at Northern Arizona University. Now that Supai educators have access to online resources, they can learn about and implement the latest curricular strategies and thus will be well positioned to provide more effective instruction and support for expecting mothers, babies, toddlers, and K-12 students.

Conclusion

By far the most time-consuming and expensive hurdle in bringing high-speed Internet to homes in Supai was obtaining permission from the government to use spectrum for LTE broadcasting. While it is fortunate that the FCC had the foresight 30 years ago to reserve bandwidth for educational use, it is underutilized, and the rules for its use are outdated. Open licensing has not happened since 1995. The FCC rule changes of how licences for the 2.5 GHz Band are granted are timely. Now the FCC is considering giving current licence holders, local tribes, and local educational institutions priority for claiming unlicensed 2.5 GHz spectrum and then auctioning off the remaining spectrum

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rights. But, there is also the possibility that the FCC will not offer priority licencing windows and instead just go straight to auction. If these priority windows are not implemented, tribes and schools will be hard-pressed to compete with the major telecoms who are unlikely to develop broadband on tribal lands due to predicted low return on investment. This would be disastrous for the tribes.

If tribes can obtain FCC licenses for spectrum on their own lands, then they will be able to self-deploy LTE networks just like the Havasupai’s and provide high-speed Internet access to their people. Policy makers determine the rules, but these rules can either empower tribes to provide the much-needed broadband access for their communities or prevent tribes from doing so. Chairwoman Coochwyteewa states that “without a permanent licence, we are worried that the Tribe might lose our EBS spectrum, which would be a terrible blow to the progress that we have made so far. I do not want to see our people’s progress halted by a regulatory hurdle.” Hopefully, policy makers will see that tribes can succeed - and already have succeeded on their own - and already have succeeded on their own and will give them a chance at selfdetermination in the Internet Age.

The homework gap is growing and students on tribal lands are being left behind. However, self-deployed networks by tribes can change that. Council member Watahomigie-Corliss explains:

In Supai, if we can get and utilize Internet education, it would greatly improve the people’s morale. I know that the people are willing and want to help the community and do everything in their power to keep the community thriving. This will be an opportunity, probably the first opportunity Supai has ever had to actually do online courses, extended education courses, Associate’s programs, GED programs, correspondence classes, online training classes, and maybe get a bachelor’s or college degree. That will greatly help the people and that’s what we want. That’s what they want. ●

Mariel Triggs is the Chief Operating Officer of Mural Net. Mural Net was founded by Martin Casado and Brian Shih to bring high-speed Internet to the homes of students on tribal lands and bridge the Homework Gap.

Notes

- 1 Head Start is a United States Department of Health and Human Services program that provides free early childhood education, health, nutrition, and parent involvement services to low-income children and their families.
- 2 The BaiCells Atom ID04-5 CPE is a small in-home wireless router that connects to the Internet via LTE.