

Solutions for Traffic Backhaul in Community Networks



What are community networks?

Community networks are networks often collectively owned and managed by a community for non-profit and community purposes. Collectives, Indigenous communities or non-profit civil society organizations use them to communicate under the principles of democratic participation of their members, fairness, gender equality, diversity, and plurality.¹

The Internet is a global network. All interconnected networks require backhaul to operate. Backhaul is the first-mile or middle-mile infrastructure that brings the Internet to the community; users can then use last-mile technologies to bring services over the internet connection to their homes, businesses, and other institutions.

There are two types of backhaul: fixed and wireless. The type of backhaul that best suits the needs of a community depends on a variety of factors, including geography, budget, community requirements, among others. Below is a brief overview of the different types of backhaul, particularly for communities in North America.

Backhauling traffic from a community network or a small ISP is a critical component of the network operation and delivery of service.

Fixed (Wired) Backhaul Solutions

Fiber-Optic Backhaul

Optical fiber is fiber made of glass or plastic that can be used to transmit data in the form of light waves for distances up to about 300km. It is the only technology that can support large bandwidths. It is generally the most preferred physical medium for the interconnection of networks, as well as for collecting traffic from the end-users to the network core.² As the cost of fiber-optic cable has steadily come down in price and more efficient deployment solutions have come to the market, as well as new government

¹ Internet Society, Community Networks in Latin America, Nov. 2018,

<https://www.internetsociety.org/resources/doc/2018/community-networks-in-latin-america/>

² GSMA, Mobile Backhaul Options, Nov. 2018, <https://www.gsma.com/spectrum/resources/mobile-backhaul-options/>

funding in certain areas to deploy fiber, it is the most popular option for service providers.

The relative cost of deployment and ongoing maintenance depends on the amount and type of civil work required for installing fiber cable. The price of the fiber optic cable is not significant. Another important consideration is the requirement of permissions and consent from relevant authorities may be needed for digging.

Copper (DSL) Backhaul

Copper lines are the traditional way to backhaul traffic from the subscriber access to the high-speed core network. Available Digital Subscriber Line (DSL) technologies can boost the bandwidth on the copper lines while supporting lower bandwidth for distances reaching several kilometers.³

Where copper is already deployed, the cost of service is relatively not high. Distance limitations for high bandwidth service are the key challenge. If not already deployed, either optical fiber or wireless technologies could be used.

In summary, wired backhaul is the preferred solution in cases where the cost of digging the optical fiber can be covered, and the needed permissions are secured.

Wireless Backhaul Solutions

Satellite Backhaul

Satellite backhaul is typically deployed in rural or remote communities where other backhaul solutions are either not available or not reliable. While satellite backhaul provides great coverage suitable for remote areas such as the Arctic, it traditionally suffers from communications delay and interruption, and limited bandwidth for both uplinks (from the end-user) and the downlink (to the end-user).

Satellite vendors have improved bandwidth and latency by implementing technologies such as different caching solutions, aiming at storing data in locations closer to the end-user. These approaches allow for connections of 5Mbps downlink and 1Mbps uplink, with high-end satellite solutions supporting 150Mbps on the downlink and 10Mbps on the uplink. Satellite backhaul uses licensed spectrum (for information on the spectrum, please see the Internet Society's "Innovation in Spectrum Management" report).⁴

Time to deploy a satellite service could take a significant amount of time, particularly in remote and hard to reach communities. Also, the cost of bandwidth is very high compared to backhaul over fiber optic, and the available bandwidth per satellite connection is limited. The key benefit is the reach of satellite service to remote communities.

³ GSMA, Mobile Backhaul Options, Nov. 2018, <https://www.gsma.com/spectrum/resources/mobile-backhaul-options/>

⁴ Internet Society, Innovations in Spectrum Management, https://www.internetsociety.org/wp-content/uploads/2019/03/InnovationsinSpectrumManagement_March2019-EN-1.pdf

Low Earth Orbit (LEO) Satellite Backhaul

Low Earth Orbit Satellites (LEOS) are the next generation of satellite technology. The advent of LEOS has the potential to improve satellite technology as a type of Internet backhaul, addressing some of the current challenges like communications delay.

More recently, several initiatives have started to explore the viability of utilizing large number satellites positioned at significantly lower orbits (1500 km instead of 36,000 km) to provide reliable communication services.^{5,6} Being at lower orbits significantly reduces the roundtrip delay from hundreds of milliseconds to just a few milliseconds.⁷

LEOS may provide connectivity and backhaul services to remote communities delivering higher bandwidth and lower delay compared with traditional satellite services. Deployment time frames for LEOs would be similar to those of satellite, while the cost of service is expected to be lower given the number of constellations providing coverage.

Microwave Backhaul

Microwave backhaul involves the transmission of data via microwave radio waves between towers. It is a well-proven technology for traffic backhaul; it is low-cost, can be deployed in a matter of days, and supports a range of up to several miles. Technical solutions provide microwave with high bandwidth capability (hundreds of Mbps).

Typically, Line of Sight (where no hills or mountains impede direct propagation of the microwave signal between the sending and receiving antennas) is a requirement for the deployment of microwave links, but techniques, as well as operating at higher frequencies (e.g. E-band) allow for non-Line of Sight deployment over shorter distances.⁸

The cost of deploying a microwave solution is relatively low. A key consideration for microwave backhaul is its use of a licensed frequency range, requiring regulatory approval to operate.

Microwave backhaul is an attractive solution in case the line of sight is available, and a license to the needed spectrum is secured.

In conclusion, optical fiber is the preferred backhaul solution whenever feasible. In remote or rural communities satellite service may be the only available backhaul solution.

⁵ OneWeb, <https://www.oneweb.world/technology#video>

⁶ Telesat, <https://www.telesat.com/services/leo/why-leo>

⁷ MIT, "A Technical Comparison of Three Low Orbit Satellite Constellation Systems to Provide Global Broadband", Portillo I. et al, International Astronautical Congress 2018, <http://www.mit.edu/~portillo/files/Comparison-LEO-IAC-2018-slides.pdf>

⁸ GSMA, Mobile Backhaul Options, Nov. 2018, <https://www.gsma.com/spectrum/resources/mobile-backhaul-options/>