Industry Voices—Rysavy: Latest tech aims to solve riddle for rural broadband

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The coronavirus crisis has heightened the urgency for increasing rural broadband availability. (Pixabay)

Recent advances in wireless technology and broader spectrum options are providing new ways to deliver rural broadband and decrease the digital divide in the United States. Factors such as physical reach, capacity, and broad market usage, however, determine which technical approaches are most effective.

The type of network operator best positioned to deliver service, for instance cellular, operator versus regional wireless ISP, can also vary depending on population distribution and geography. Finally, even if a technology works, the high cost of delivering the connection to some customers can undermine business models.

Tradeoffs between technology and spectrum are complex but need to be understood if policy makers are to encourage the most effective strategies to deliver broadband widely to rural environments, especially with the government proposing funding to promote such networks. For example, in a Notice of Proposed Rulemaking (NPRM), the FCC has proposed a $9 billion 5G fund for wireless broadband in rural areas.

The coronavirus crisis has heightened the urgency for increasing rural broadband availability. The FCC states that 97% of Americans can access broadband service in urban areas, but only 65% in rural areas. The FCC also estimates 21 million Americans lack broadband access, although depending on the analysis, the number could be as high as 42 million. Expanding broadband options is thus a high priority, and wireless is the most promising option. According to the Wireless ISP Association (WISPA), in rural environments, a wireless connection averages 15% the cost of fiber.

Technology options are improving rapidly and include 4G/5G, Wi-Fi, point-to-multipoint solutions, and non-terrestrial networks (NTN). Spectrum options are also diverse, including unlicensed bands expanded recently by the 6 GHz band, licensed cellular bands, Citizen's Broadband Radio Service (CBRS), and white spaces.

Of all the technology options, 5G provides the most flexible and cost-effective toolkit. 5G currently works with any frequency from 600 MHz to mmWave, and with 3GPP Release 16 just completed, 5G also operates in unlicensed spectrum with a capability called New Radio-Unlicensed (NR-U). 5G can also work in CBRS systems, again in a flexible manner, using unlicensed channels such as General Authorized Access (GAA) or with licensed Priority Access Licenses (PALs). Moreover, operators can aggregate CBRS bands with licensed or unlicensed channels in other bands.

The 5G Standalone Architecture (SA) approach provides a simplified deployment model for new entrants that do not need to support LTE. 5G will also benefit from virtualized frameworks, such as O-RAN, that allow radio functions to operate on commodity computers. Cloud-native architectures, still in their infancy but gaining momentum, could further simplify network deployment. These developments translate to a massive commoditization and softwarization of cellular technology, lowering costs, and making it accessible to a wide range of potential operators.

Although rural broadband today misses many potential subscribers, the situation would be worse without today's existing mobile cellular networks. Cellular operators have also deployed fixed internet services, such as AT&T's Fixed Wireless Internet Service, based on LTE, with U.S. Cellular and Verizon also offering LTE-based solutions. Looking ahead, T-Mobile, as part of Sprint merger conditions, is on the hook to deliver 5G download speeds of at least 50 Mbps to 90% of the rural population within six years, and T-Mobile's spectrum resources, particularly in mid-band, puts it in a strong position to accomplish that goal.

Using mid-band spectrum, my spectrum and capacity modeling shows that a 50 MHz radio channel, depending on site density, can provide 1 to 5 Gbps of aggregate capacity per square kilometer. Until C-Band spectrum becomes available in late 2021, CBRS spectrum, including both unlicensed General Authorized Access and Priority Access Licenses, will be the most widely available mid-band spectrum option for rural broadband. Furthermore, the FCC is considering increased power limits for CBRS, which could make the band even more effective for rural broadband.

Verizon's 5G Home service, in contrast, uses mmWave spectrum. Although a good broadband solution for cities, the mmWave fixed wireless networks require a site density that in rural situations will only work for denser clusters of homes. Similarly, unlicensed mmWave approaches such as Terragraph, operating at 60 GHz, are generally best suited for urban environments.

5G will also expand in scope through its future support for non-terrestrial networks (NTNs), including High Altitude Platform Services (HAPS) and satellite. Customers will not need specialized gear because the goal is for any 5G handset, as well as other 5G devices, to be able to communicate with many of these NTNs. Satellite support, however, will not be standardized until 3GPP Release 17 in 2022, but before then, high-altitude, solar-powered planes flying at 65,000 feet could provide coverage for over 3,000 square miles. Capacity relative to area will be lower than terrestrial networks, but the resulting service could still supply important coverage for low density households, as well as in locations such as national parks or over rural highways.

5G, however, is not the only approach. Many regional wireless ISPs use point-to-multipoint solutions with spectrum options including unlicensed channels at 2.4/5/6 GHz, as well as the CBRS band. Even at 5 or 6 GHz, directional antennas with line of sight can carry the signal for multiple miles, a good approach for locations that cannot be easily served by cellular networks.

White space networks, although well suited for some developing countries that have almost no connectivity, will play a limited role in U.S. rural broadband due to the limited amount of spectrum available.

Regardless of technology, business models to support a sparse population can be challenging, so selective government funding could play an important role. In addition, all wireless technologies for rural broadband will have to address the increasing demand that people put on their internet connection, especially if the solution has to address television cord cutters, who now burn through 500 GBytes/month. Nevertheless, improving technology and spectrum options means that wireless will be the primary solution for most new rural broadband connections over the forthcoming decade.

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