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Industry Voices—Rysavy: How 5G will solve rural broadband

by *Peter Rysavy* | Jan 29, 2018

Originally published at: **https://www.fiercewireless.com/wireless/industry-voices-rysavy-how-5g-will-solve-rural-broadband**

Covering distance by radio has always been less expensive than laying wire, and nowhere is this more true than in rural areas. Until now, though, wireless broadband could not match the capacity and performance of wireline approaches, so fiber, cable, and copper constitute the bulk of broadband connections.

Starting with advanced versions of 4G LTE and then continuing with 5G, wireless technologies will not only displace many wireline endpoints in dense population areas, but also in low population density areas, including rural areas. The differences between rural versus urban deployments, however, are cell sizes and radio frequencies used. The cost advantage of wireless connections is overwhelming. A spokesperson for the Wireless ISP Association (WISPA) **estimates** that a wireless connection to a rural endpoint costs one-fifth to one-tenth of a wireline connection.

Rural wireless throughput rates are already competitive, with 25 Mbps a typical downlink throughput rate offered by WISPs such as Rise Broadband, and technology roadmaps showing rates as high as 200 Mbps in the near future. These rates may fall below the 1 Gbps rates that wireline and wireless networks can achieve today in urban areas, but they are far better than Digital Subscriber Line (DSL) rates of 10 Mbps, assuming DSL is even available.

A number of factors are converging in 5G to create critical mass for broadband transformation: lower costs through global mass commoditization of cellular technology, ability to use spectrum all the way from UHF at 600 GHz to mmWave at 100 GHz, shared spectrum about to come online in Citizen's Broadband Radio Service (CBRS), massive MIMO that extends range and capacity, and advanced interference mitigation techniques.

My 2017 **report**, "Broadband Disruption: How 5G Will Reshape the Competitive Landscape," analyzed how 5G will be able to match, and even exceed, coaxial broadband network capacity and performance in dense areas. In urban areas, depending on desired capacity, 5G networks using small cells and mmWave radio channels will need between 10 and 100 base stations per square kilometer. Clearly, such dense deployments will be impossible in rural areas. Instead, sub-6 GHz frequencies enable cells that have multimile range, resulting in much less dense and therefore practical networks. Many WISPs today use unlicensed 5 GHz radio channels, but some also use 3.65 GHz. 4X4 MIMO is typical for service based on LTE technology, but higher-order MIMO, and eventually massive MIMO, will boost capacity and ranges further. Cellular operators are also offering service. For example, in some parts of the country, AT&T uses its licensed 2.3 GHz to offer **fixed wireless internet service**.

Technology will keep improving, and 5G, just like LTE, will not be static. Today's newest LTE networks can exceed 1 Gbps peak rates, at least ten times higher than LTE when it was first deployed around 2010. Similarly, 5G will keep improving through items such as massive MIMO optimizations that will extend range through more focused beams and integrated wireless backhaul expected in the second phase of 5G specifications in 2019.

Proprietary technologies highlight what may eventually make its way into standards. For example, Tarana Wireless, using intelligent signal processing and massive MIMO, **reports** that it can achieve 50 Mbps in a non-line-of-sight connection of up to 3.5 km in distance with a 20 MHz unlicensed 5 GHz radio channel. For rural areas, the relentless progress of wireless technology means an expanding coverage footprint with ever higher speeds. A competitive global market also means smaller service providers can now afford cellular technology, the most efficient and reliable approach for broadband.

A variety of spectrum bands will play a role in rural broadband. Cellular operators, whose licenses for spectrum are driven by urban capacity demands, may have lightly-used spectrum assets in less dense areas that they could use for fixed wireless service. Unlicensed 5 GHz bands will also continue to play a role. The band gaining the most attention, however, is the one used by CBRS, which spans from 3.55 to 3.70 GHz.

Expected to become available in 2018 for initial, unlicensed use, the lower frequencies are ideal for rural broadband.

The Federal Communications Commission (FCC) is still finalizing rules, and under debate is the size of license areas for priority access licensees. Mobile operators prefer larger license areas called Partial Economic Areas (PEAs), but smaller WISPs prefer licenses for much smaller areas called census tracts. The FCC could decide in favor of one or the other, or it could create a hybrid approach with larger license areas in cities and smaller license areas elsewhere. Alternatively, the FCC could authorize secondary markets in which licensees could lease spectrum in areas where they don't actively use the spectrum. According to CBRS Spectrum Access System (SAS) vendor CommScope, the SAS database that controls CBRS could handle such licensing and leasing arrangements.

Particularly tantalizing about the 3.5 GHz band is that the FCC is looking at a potential **expansion** over time all the way to 4.2 GHz, which would result in a massive capacity increase sub 6 GHz. One question, however, is whether 3.5 GHz will mostly be used for LTE, the current focus of CBRS Alliance and WinnForum development efforts, or for 5G, the direction that many other countries are taking with **this band**. Regardless, the band will play an important role for rural broadband.

The FCC **reports** that more than 20 million rural Americans do not have access to broadband. Wireless broadband has the potential to significantly decrease this number.

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