5G Fixed Wireless Access Investment Case

5G is the next generation of high-capacity wireless technology intended to support fixed and mobile broadband. With peak speeds exceeding 1 Gbps and latencies on the order of 1 ms, 5G will complement rather than replace existing generations of wireless technology with fiber-speed performance. This paper describes the motivations behind 5G, its role in the access network, and the investment case for fixed residential broadband using 5G technologies at 28 GHz.

Problem

New applications and devices are fueling bandwidth demand among consumers and businesses. 4K TV, virtual reality, and other formats will increase bandwidth demand among consumers nearly 10-fold through 2025. New commercial use cases, such as video-based IoT and connected car, likely will drive bandwidth demand among businesses at similar rates.

To keep pace with demand, operators are considering a range of access solutions, from fiber and DOCSIS to advanced versions of DSL. 5G has the potential to meet or exceed the performance of these modalities without the high-cost of deploying sheathed networks. As a result, 5G is garnering the attention of operators as a viable alternative for consumer and business broadband.

Solution

In North America, 5G will operate largely in the 28 GHz, 39 GHz, and 60 GHz spectrum bands, which the FCC recently identified for wireless broadband applications. The FCC opened up nearly 11 GHz of spectrum for 5G, creating the potential for high-capacity channels many times larger than those used in 4G networks. Unlicensed spectrum at 3.5 GHz and 5.8 GHz also may play a role in 5G, albeit at lower peak speeds and throughputs.

RF advancements, such as multi-input, multi-output (MIMO) antennas, beam forming, and higher-order QAM, also will play a role in 5G, delivering continued improvements in spectral efficiency beyond those typical of 4G wireless systems today.

Investment Case

In this section, we describe the investment case for 5G at 28 GHz under various conditions framed by household density, market share, cell-edge speed, and busy hour throughput. We consider densities ranging from 2,400 homes per square mile (urban) to 25 homes per square mile (rural), market shares from 20% to 40% of homes covered, cell-edge speeds from below 100 Mbps to over 500 Mbps, and guaranteed throughputs of 25% to 100% of busy hour household demand.

Applying these and other assumptions, we compared 5G to fiber in greenfield markets, where fiber does not yet pass homes. We found that 5G performs best in markets with higher household densities, and becomes challenged in lower density markets where coverage limitations constrain site densities relative to homes covered. In this latter case, we have found that 3.5 GHz may be more suitable than 28 GHz, albeit with lower peak speeds and throughputs.

- Cost per Home Covered: 5G @ 28 GHz vs. Fiber -

Cell edge speed →			basic				moderate				fast				very fast				ultra			
Busy hour throughput →			basic	med	high	ultra	basic	med	high	ultra	basic	med	high	ultra	basic	med	high	ultra	basic	med	high	ultra
Urban	high tower	low																				
		med																				
		high																				
	low tower	low																				
		med																				
		high																				
Suburban	high tower	low																				
		med																				
		high																				
	low tower	low																				
		med																				
		high																				
Rural	high tower	low																				
		med																				
		high																				
	low tower	low																				
		med																				
		high																				

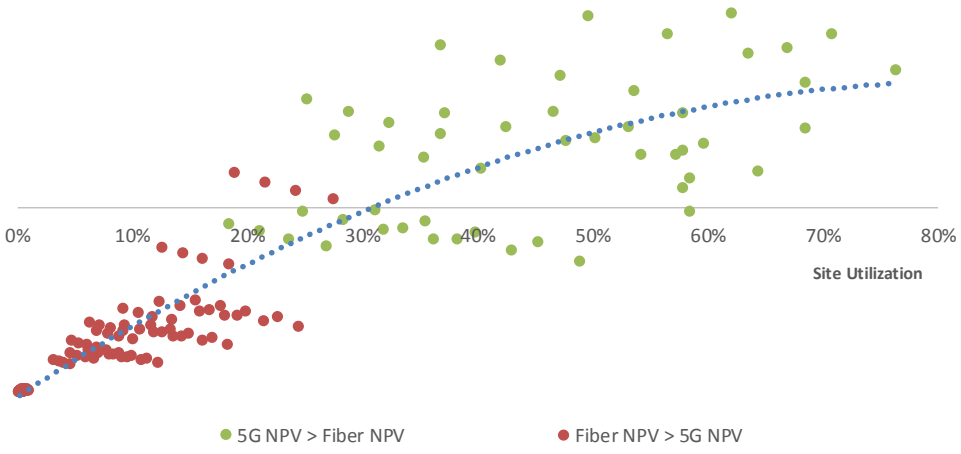
Radio elevation ↑ ↑ Market share

5G cheaper than fiber | 5G comparable to fiber | Fiber cheaper than 5G

This matrix compares the cost per home covered of 5G to that of fiber under a range of conditions. In urban markets, 5G performs well due to its high-capacity channels and the ability to cover a large number of homes within close proximity of the site. Coverage limitations in lower-density markets yield excess capacity and fewer homes covered per site, driving up capital investments relative to demand. As a result, 5G appears to be best suited for higher-density markets with high bandwidth requirements, including 'urban clusters' within suburban and rural markets.

This next chart shows the relationship between site utilization and NPV under a range of market conditions.

- Site NPV vs. Utilization -



Based on our current assumptions, site utilizations above 30% to 50% are needed in most cases to deliver positive 5G performance. Below these thresholds, the NPV of fiber often exceeds that of 5G (red dots), even though both may be negative. Utilization is an important driver for 5G that operators should work to improve

through targeted deployment strategies, and also through layered use cases, such as IoT and mixed consumer-business connectivity, to drive additional traffic and revenue through 5G sites.

The case for 5G is sensitive to a range of factors. Foliage and precipitation, for example, can impede propagation and drive up site densities, particularly at mmWave frequencies. However, these factors are mitigated by 5G's wide channels and smaller cell radii, which enable powerful short-range transmissions able to partly overcome the impact of interference. Subscriber economics also play a critical role. The case is sensitive in particular to recurring customer margin, which depends on ARPU and costs of customer support, content, and subscriber acquisition, among others. Finally, capital outlays for sites, spectrum, and CPE are important drivers that must be well understood before finalizing deployment strategies.

Conclusions

We believe that 5G will become an important part of operators' broadband access portfolio. As new applications and devices fuel demand among consumers and businesses, 5G will offer a cost-effective means for operators to keep pace with demand, particularly in higher-density markets where its performance can meet or exceed that of fiber. However, because 5G does not always outperform fiber, operators should identify the optimal mix of wired and wireless modalities for access networks. With our 5G and fiber models and data sets, inCode can help operators to find the right balance of 5G, fiber, and other modalities to optimize broadband economics.

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