Fiber Will Enable 5G and a Lot More

By Mark Hearn, Product Manager, MilesTek

MilesTek
301 Leora Ln., Suite 100
Lewisville, TX 75056
1-866-524-1553 | www.milestek.com

Fiber Will Enable 5G and a Lot More

By Mark Hearn, Product Manager, MilestTek

It may seem ironic that the success of a next-generation wireless technology depends on the availability of a wired counterpart, but without adequate fiber-optic resources 5G simply will not be able to deliver its vast benefits. While that may not be a news flash for many, what may not be appreciated is whether those wired resources are available now or will be when they're needed in only a few years.

Logic might dictate that the U.S. should have fiber to spare, as telecommunications companies deployed millions of miles of optical fiber in the years of irrational exuberance between 1990 and 2000 before the dot-com bust. In 1999 for example, the FCC estimated that 3.6 million miles of long-haul fiber was deployed in that year alone and that more than 16 million miles of fiber were then in place. Today, much of that fiber remains unused, along with additional fiber that has since been deployed.

However, even with all this "dark" fiber, analysis by organizations such as Deloitte reveals that even with these existing resources, America still will not have the fiber density required to satisfy the bandwidth demands of 5G. A report by Deloitte in 2017 projected that the U.S. will need to spend at least $130 billion by 2021 to meet those needs along with rural broadband, and Fiber to the Home (FTTH). Like other infrastructure deficiencies, there is more to this story than meets the eye.

First, there are competitive reasons why the telecom companies that deployed this fiber have been resistant to leasing it to others. For example, when Verizon acquired XO Communications' fiber assets, most of the fiber in XO's top 20 markets was dark. These companies also realized it would eventually be necessary. That turned out to be a wise decision as it's arguable that every foot of this cable and much more will be needed, and soon, for cellular backhaul, distributed antenna systems, FTTH, and provisioning cellular base stations.

Second, almost all fiber in the U.S. has been deployed in areas of high population density where a good return on investment is assured rather than in rural areas where it is not and might never be. This is arguably the largest single factor impeding broadband deployment in rural areas. FTTH deployment in the U.S. began in 2005 when Verizon introduced Fios in Texas, and the company has since been joined by AT&T and others in the ensuing years. The result is that today, 26 million residences can be served by optical fiber, but this is only about 20% of total U.S. homes. That said, cable MSOs have made huge improvements to service over the years and nearly 90% of U.S. residences can avail themselves of download speeds up to and sometimes faster than 200 Mb/s.

Collectively, about 90% of the homes in America are served by either FTTH or cable, and in a few places both. The rest are served to varying degrees by Wireless Internet Service Providers (WISPs) via point-to-multipoint microwave links. Unfortunately, between 15% and 20% of people in rural and some other areas do not have technologies available that meet the FCC's definition of broadband, which is 25 Mb/s in the downlink and 3 Mb/s in the uplink (Table 1).

Finally, while stating its goal of providing true broadband to every American, the federal government has simultaneously created barriers to entry for new providers. Various rules have made the process of deployment unnecessarily complex and are antiquated today or in contradiction to the government's stated goal of extending the reach of broadband.

A good example of how these rules have hindered fiber deployment by new entrants is exemplified by Alphabet, whose Google Fiber initiative has faced multiple legal challenges. In Nashville, while the city has backed Google, both the company and the city have spent two years fighting off challenges by

AT&T and Comcast that claim the FCC, not the city, has jurisdiction over what can be placed on utility poles.

A federal judge first ruled against the city and Google but in July of this year the FCC effectively overruled the decision, allowing the city to rely on its "One Touch Make Ready" (OTMR) ordinance. Nashville was one of the first cities in the country to adopt OTMR, which requires that new entrants and owners of utility poles must agree on specific rules that ensure reliability and other requirements are maintained.

There are currently 20 states that have claimed their right to self-regulate which gives them the ability to pass OTMR legislation (Figure 1). This scenario is likely to be repeated throughout the country until some federal legislation makes OTMR or some variation of it the law of the land. Such is the state of telecommunications competition that AT&T, while attempting to fight off Google Fiber in Nashville, Louisville, KY, and other cities, already has fiber in place and is enhancing it to provide the same type of service as Google.

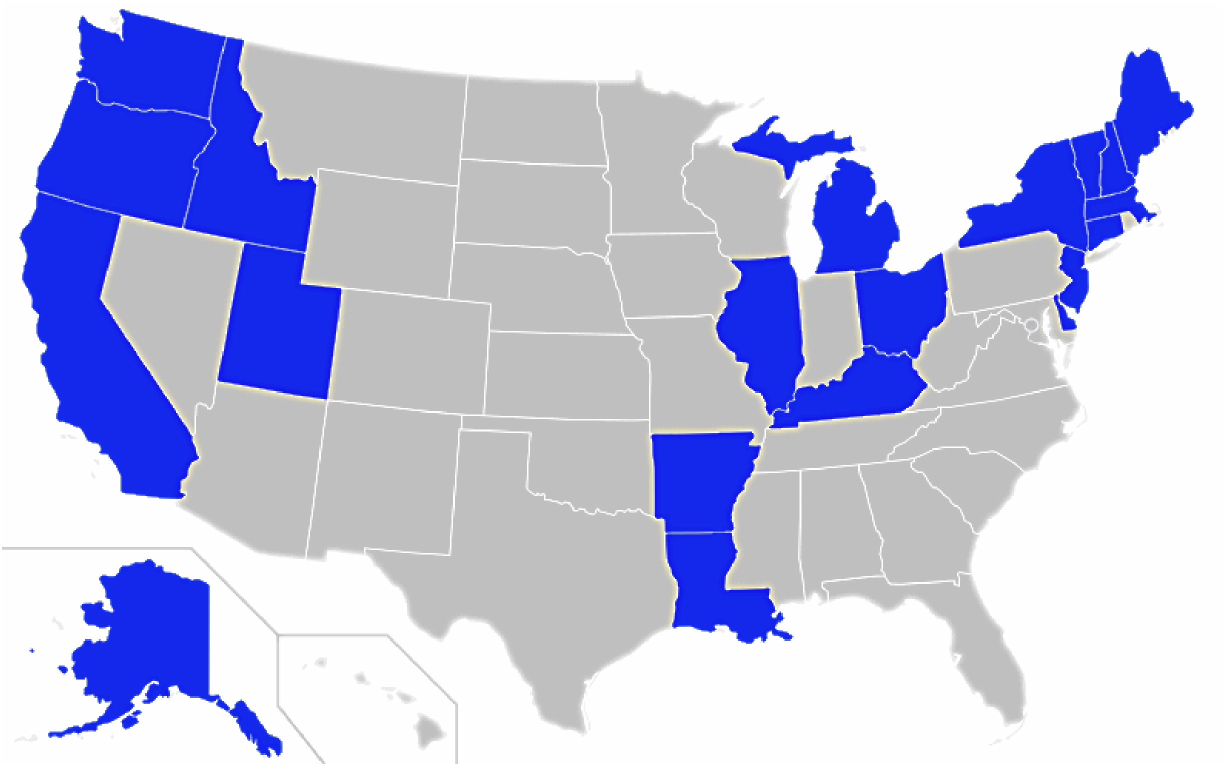

Figure 1 States where One Touch Make Ready can legally be implemented, according to the Federal Communications Commission. (Source: Wikipedia)

Once Google got through its teething pains, it began to use a fiber-laying technique called micro trenching (Figure 2), which rather digging deep trenches, digging up streets and sidewalks, slices a narrow groove in pavement about a 1 in. wide and about 1 ft. deep, which is enough to accommodate cables stacked one above the other. Google says the technique has reduced the cost of laying fiber by

75% to 300% depending on the situation and reduces installation for a city block to 24 hr. from a month using standard techniques. According to Tech Republic, this translates into 12,000 ft. per day with 3 crews, versus up to 2,000 ft. that AT&T was laying at the time. Although developed some time ago, the technique has become the go-to method for some cities, including New York where it is now standard practice.

Figure 2 It took only 5 months for Google to lay its fiber in Louisville, KY, mostly using microtrenching. (Source: Tech Republic)

Taken together, all three of these issues must be resolved if 5G is to succeed. The reason is that in terms of the sheer breadth of the applications it's designed to serve, 5G bears little resemblance to its predecessors, and represents the technological future not just for traditional cellular communications for smartphones and tablets, but the huge number of applications within the broad umbrella of IoT, and potentially as a competitor to broadband currently delivered by wired solutions.

5G builds on LTE Advanced Pro but goes far further, using an entirely different network architecture (5G New radio) along with software-defined networks and virtually-defined functionality. It will ultimately use frequencies tens of gigahertz higher in frequency, deliver download speeds of 10 Gb/s indoors and outdoors, and reduce latency to 1 ms over short distances.

Low latency and extremely high-speed data transfer require wired infrastructure for macro cell, intra-cell, and small cell backhaul. Although microwave radio links can satisfy some of this demand, only optical fiber can do it all, without requiring massive changes to infrastructure for many years to come. For many applications, such as communications required for vehicle autonomy, IoT, virtual reality, and telesurgery, extremely low latency is not just desirable but mandatory.

But as the laws of physics dictate that any level of latency is directly related to the distance the signal must travel means that the almost instantaneous levels required for 5G applications can only be achieved over short distances. This means that truly enormous numbers of small cells will need to be deployed indoors and outdoors, basically almost everywhere or at least in the places they are most needed. Each one of these small cell base stations must be backhauled via a very high-speed backbone, which is most likely to be Ethernet delivered over optical fiber.

It doesn't take much imagination to realize that a significant amount of this fiber currently doesn't exist or is adequate, even in office buildings, airports, stadiums, and many other places. This being America, arguably still the world technology and innovation leader, it's frustrating to think that other countries, principally China and South Korea have taken the lead in fiber deployment.

However, although China currently leads the world in fiber deployment this shouldn't be surprising as the government heavily subsidizes its industries. And although China's telecom carriers do compete, nationally there is no discussion at high levels of government about whether such infrastructure should be built and by whom, but rather only when it can be accomplished. The only rules are regulations that are those dictated by the government, which is why, in large measure, China has accomplished unprecedented amounts of development in less than half a century.

In 2017 alone, China's telecommunications companies have deployed home gateways to more than 30 million residences to deliver fiber to the home (FTTH). A few months ago, the countries Ministry of Industry and Information Technology announced that 80% of the country broadband users will be getting their service from fiber by the end of the year. In 2015, China laid more than 1.6 million miles of fiber-optic cable throughout the country. In second place is South Korea, and third is Japan. In contrast, the U.S. ranks 10th among OECD countries in broadband penetration and has the fourth highest prices where competition is minimal.

When comparing fiber deployment in the U.S. to other countries, such as Canada for example, it's important to recognize the vast geographical and population differences between them. While Canada has nationwide population density much lower than the U.S., it is concentrated in far fewer places. So, to achieve a fiber footprint over more than 90% of the population requires covering only 4% of the country. Achieving this in the U.S. requires that 31% of the country must be covered. This makes creating truly nationwide fiber deployment in the U.S. potentially orders of magnitude costlier as about half the country lives in areas with very low population densities.

Getting It Done

For those Americans fortunate enough to live in places where high-speed broadband is available, sometimes from more than one source, it's easy to ignore the fact that between 15% and 20% of residences and businesses in rural areas have nothing of the kind. Fortunately, there is currently an up swell an interest at the FCC and in the government in general to strip away regulations making it economically unfeasible for cable MSOs telecommunications companies to serve these areas.

In theory at least, a massive rollout of last-mile fiber would benefit not just the wireless industry and consumers (i.e., customers) but electronic equipment manufacturers and dozens if not hundreds of other industries as well. The fifth generation of cellular would be assured of having the required back-and fronthaul infrastructure, broadband would finally come to more of the nation's underserved areas (some with more than one choice of provider), over-the-top providers (Netflix, Hulu, etc.) would be able to serve more customers, and IoT would be available to more places as well.

The question, of course, is where the money will come from, which may or may not be a massive problem depending on how well the government and private industry can work together. Viewed at a high level, the potential long-term benefits for so many sectors of the economy are so obvious that the incentive for cooperation is obvious; the overall economy should even experience a measurable uptick, if not immediately then over the coming years and decades. There is also the intangible but nevertheless meaningful issue of the U.S. falling behind China and other countries in advanced telecommunications.

Although the wireless industry would have to provide a significant part of the cost, it's already doing so purely for its own benefit as it moves closer to deployment of 5G. AT&T and Verizon are deploying more fiber in more places and they are finally working more with other "non-mainstream companies to light up dark fiber. Public-private partnerships, investors, and other entities have realized that fiber will be on of the cornerstones of growth for years to come.

Another appealing approach is treating fiber as leased real estate, similar to publicly-traded Real Estate Investments Trusts (REIT) in which companies that own or finance income-producing real estate. This latter approach would potentially produce huge amounts of income for the investors, who would underwrite some of the cost of rejuvenating existing dark fiber and rolling out more.

A REIT-type approach is defensible today because fiber previously of questionable value now would be producing revenue. Further, tower companies, which have expanded their portfolios in recent years could invest in rolling out fiber as well. These are just a few of the private-industry approaches, and others will no doubt develop in the coming years as, generally speaking, any entity with a vested interest in ensuring that high-speed data is available is a potential investor.

While it's true that private industry can move fast while Congress and government agencies move slowly, the current administration is dedicated to stripping away burdensome rules across the board, sometimes to excess and almost always to the mortification of those whose oppose them. In the case of improving the nation's telecom services however, the government has a rare chance to demonstrate its ability to bridge the partisan divide and provide changes that will positively affect Americans regardless of their political persuasion. There are already more than a half dozen government initiatives in various states of development or implementation that could provide even greater monetary incentives to private industry.

Summary

The goals for 5G and its successors are massive, matched only by the initial deployment of the cell-based architecture when it was first deployed, so it's not surprising that massive changes in infrastructure will be needed to bring them to fruition. Of those, deploying optical fiber everywhere is as important as any other enabling technology, from operation at millimeter wavelengths to radically new network architectures. However, unlike the wireless portion of these networks, fiber has the potential to not just enable 5G, IoT, and other applications but to make truly high-speed data services available nationwide.

This article was originally published in Microwave Product Digest Magazine