

***5G AND
NEXT GENERATION
FTTH***

A Symbiotic Relationship

5G AND NEXT GEN FTTH

Fiber and 5G are creating a symbiotic relationship. They are driving each other's business case.

Introduction:

The evolution to 5G wireless is already well underway, and the implications for the broadband industry and society as a whole are enormous. Unlike other wireless evolutions that brought incremental improvements in wireless performance, 5G will enable a major societal paradigm shift, powering the Internet of Everything.

It is a transformational technology that will bring Gigabit performance to mobile devices; enable smart cities, large and small, to reach their full digital potential; empower industry to achieve massive efficiency; revolutionize automobile transportation; and help give rise to amazing new consumer and societal applications like virtual reality and remote surgery. And that's just the start.

But despite its wireless pedigree, 5G is nothing without a deep fiber broadband network to support it. Indeed, deep fiber networks are the nervous system for 5G, and the implementation of 5G will drive unprecedented investment in fiber networks across the globe.

The Future is Now

Adoption of 5G is not only underway; it is accelerating. Original timelines that once identified 2020 as a target for 5G are now discussed in terms of late 2018 in the U.S., with 5G at scale in 2019. Both AT&T and Verizon have identified 2018 as their targeted commercial launch date. Acceleration of the 3rd Generation Partnership Project (3GPP) 5G standards is helping 5G get to market faster¹.

¹ *Wireless Week - AT&T Targets 5G Rollouts in 2018 After 3GPP Standards Acceleration, <https://www.wirelessweek.com/news/2017/03/t-targets-5g-rollouts-2018-after-3gpp-standards-acceleration>*

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Verizon began testing fixed 5G in 11 different markets across the U.S. in 2017. Those tests will position the carrier to launch commercial 5G in 2018². AT&T began 5G testing in Austin, TX and Indianapolis, IN in 2017. Like Verizon, they also plan a 2018 commercial launch³. As a result, both carriers are busily investing in their fiber networks.

Fiber Densification

The introduction of 5G will drive massive demand for fiber-based bandwidth. The combination of a shorter range of 5G transmission through the mmWave spectrum, combined with demand for Gigabit capability to the device means significant changes to traditional wireless network topologies are coming. Macrocells (or traditional wireless towers) will no longer suffice alone. What is needed is a dramatic increase in the deployment of fiber-fed microcells, or small cells. The introduction of small cells and the underlying fiber that feeds them are what drives this requirement to densify the network with deep fiber.

Earlier generations of wireless including 3G and 4G can be supported by a tower network that numbered around 215K across the U.S. In a 5G world, that macrocell environment increases by 100x or more, with millions of microcells needed to support it. While all carriers will aim to maximize fiber assets for backhaul/fronthaul, that doesn't mean other options won't also be used. Familiar methods used with 4G including micro-wave or copper-based technologies will apply in certain

circumstances, especially among pure play wireless carriers, with different economic realities than wireless operators with large wireline assets. These diverse circumstances will lead to a multitude of different design approaches. Fiber-based approaches may include dark fiber, point-to-point (P2P) fiber, CWDM, DWDM or PON connections.

In ongoing urban environment 5G testing, Verizon estimates it will need to place a microcell every 1,000 feet to support 5G⁴. That could potentially turn every light pole located in a downtown urban core into a 5G microcell. Some estimates put the potential number of microcells needed for 5G at 7 million in the U.S. alone.

This densification process is changing the fiber landscape in the U.S., Verizon, for example, has contracted with its suppliers for over 37 million miles (60 million kilometers) of fiber to be deployed over the next three years⁵. At a May 2017 investor conference, Verizon CEO Lowell McAdam commented that the carrier's densification efforts with 5G will help Verizon create the largest fiber network in the country⁶.

Verizon's competitors will also need to keep pace with AT&T, T-Mobile, and Sprint all implementing wide-scale fiber densification plans. In a recent report from Deloitte, "Communications Infrastructure Upgrade—The Need for Deep Fiber," the management consulting firm advocates investing an additional \$130 billion to \$150 billion in fiber broadband in the U.S. to truly prepare for 5G⁷.

2 Telecompetitor - Verizon CFO Ellis Shares Verizon 5G Roadmap, Including Nationwide Fixed 5G Plans, <http://www.telecompetitor.com/verizon-cfo-ellis-shares-verizon-5g-roadmap-including-nationwide-fixed-5g-plans/>

3 Light Reading - AT&T Expects 5G in Late 2018 or Early '19, <http://www.lightreading.com/mobile/5g/atandt-expects-5g-in-late-2018-or-early-19/d/d-id/733953>

4 IEEE - Verizon's Huge Increase in Fiber Investments for "5G" Small Cell Backhaul & FTTP, <http://techblog.comsoc.org/2017/06/15/verizons-huge-increase-fiber-investment-for-5g-small-cells-ftp/>

5 Verizon - Verizon agrees to \$1.05 billion three-year minimum purchase agreement with Corning for next-generation optical solutions, <http://www.verizon.com/about/news/verizon-agrees-105-billion-three-year-minimum-purchase-agreement-corning-next-generation>

6 Telecompetitor - CEO: Verizon Wireless Network Densification Will Drive Deployment of Largest Fiber Network Nationwide, <http://www.telecompetitor.com/ceo-verizon-wireless-network-densification-will-drive-deployment-of-largest-fiber-network-nationwide/>

7 Deloitte - Communications Infrastructure Upgrade – The Need for Deep Fiber, <https://www2.deloitte.com/us/en/pages/consulting/articles/communications-infrastructure-upgrade-deep-fiber-imperative.html>

All That Fiber, So Many Options

Fiber and 5G are creating a symbiotic relationship. They are driving each other's business case. As carriers lay the millions of miles of fiber necessary to support 5G, they also create multiple monetization paths. As a result, fiber design is evolving. Historically, fiber design would focus on constructing a fiber network for a single use case, such as a point-to-point fiber connection to the enterprise.

Now, fiber design lays a path for multiple uses of that fiber, including backhaul/fronthaul for 5G microcells, Fiber-to-the-Home (FTTH) for consumers, and Fiber-to-the-Premises (FTTP) for small and mid-sized business (SMB) and enterprise applications. The applications are plentiful. With the Internet of Things (IoT) now emerging, the demand for high-bandwidth connectivity for the home, business, and enterprise is multiplying exponentially. Securely interconnecting private, hybrid, and public clouds drives increased demand for secure symmetrical multi-Gigabit bandwidth. Consumer applications including 4K and virtual reality will drive more adoption of Gigabit broadband tiers.

Existing FTTH providers are well positioned too. There are already tens of millions of homes passed with point-to-multipoint fiber in the U.S., and hundreds of millions globally. Those existing fiber networks are ideally suited for the ongoing fiber densification process driven by 5G, which in turn justifies additional investment for and expansion of FTTH. This growing symbiotic relationship is one reason why existing fiber networks look so attractive for acquisition. Merger and acquisition activity is on the rise and is a leading indicator of the appreciation in value for fiber networks. CenturyLink is acquiring Level 3. Windstream acquired EarthLink. There are numerous smaller deals being driven by firms like Uniti Fiber⁸ and Oak Hill Capital⁹, all demonstrative of the increasing worth of the fiber networks that will fuel the penetration of 5G.

NG-PON2 is the Preferred Option

Like 5G, there is another transformational evolution happening in broadband. Fiber network operators across the globe are evaluating their next-generation 10G PON fiber platform. But the drivers for this evolution go well beyond just added capacity and throughput. A primary use case for this evolution is support for 5G, but it is not the only use case. Operators need a single platform that can converge multiple use cases, 5G included, onto a single, common platform, and NG-PON2 is emerging as the preferred option.

An NG-PON2 solution offers a scalable architecture that easily supports residential, business and enterprise applications, and 5G backhaul/fronthaul across that single platform. This is a critical advantage over previous generations of PON. Previously, operators had to build and maintain separate networks to adequately service these different customer segments. Building and managing these separate networks created significant inefficiencies.

With NG-PON2, operators now have the lowest-cost approach to deliver high-density, multi-Gigabit connectivity to multiple customer segments, including enabling

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⁸ Uniti Fiber - Uniti snaps up Southern Light for \$700M, enhances wholesale, enterprise fiber customer mix, <http://unitifiber.com/uniti-snaps-up-southern-light-for-700m-enhances-wholesale-enterprise-fiber-customer-mix/>

⁹ Oak Hill Capital - Oak Hill Capital Partners Completes Acquisition Of FirstLight Fiber, <http://oakhillcapital.com/2016/09/08/oak-hill-capital-partners-completes-acquisition-of-firstlight-fiber/>

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5G microcells. NG-PON2 delivers the required scalability and low latency required for 5G and other applications, including high-margin business and enterprise services.

As a successor to GPON, NG-PON2 offers significant improvements. GPON's limitations of 2.5 Gbps and 1.25 Gbps are vastly improved, now offering symmetrical 10 Gbps on a per-wavelength basis. NG-PON2 will initially support four wavelengths for 40 Gbps total throughput per fiber. Later generations will increase to eight wavelengths, supporting 80 Gbps. NG-PON2 is totally compatible with GPON, allowing the two technologies to coexist.

With tunable lasers, each wavelength can be dedicated to a specific application: FTTH for residential, FTTP to business/enterprise, and 5G backhaul/fronthaul as one example. The use of multiple wavelengths creates other advantages including network resiliency and more secure connections. With resiliency, operators can offer SLAs, an important factor when serving the enterprise segment. Multiple wavelengths on the same fiber provide a higher level of security, another important attribute when serving businesses.

The introduction of virtualization and software-defined networking (SDN) into the access network adds additional value for operators. Provisioning, managing, and troubleshooting access networks have been labor intensive and costly tasks. SDN and virtualization help to automate these processes, lowering operational costs and improving margins. Interoperability of ONTs, OLTs, and other networking equipment is a promise of SDN and virtualization as well, adding to its appeal for fiber network operators.

The largest FTTP provider in the U.S., Verizon, has already signaled their move to NG-PON2 for its next-generation FTTP platform. "Verizon has chosen NG-PON2, which is an ITU-T-developed international standard, for its next-generation network," said Dr. Denis Khotimsky, distinguished member of the technical staff in a January 2017 press release¹⁰.

NG-PON2 is a perfect symbiotic partner to 5G. It can deliver the multi-Gigabit backhaul/fronthaul bandwidth required to support 5G applications. Additionally, NG-PON2 can meet the low-latency requirements of 5G standards. When utilizing NG-PON2 for 5G, operators can leverage its capability for other fiber business cases across the same network, dramatically improving the business case for fiber.

Conclusion

The introduction of 5G fundamentally changes the game. It is the true embodiment of Internet to Everything and society will forever be changed. It has the attention of all levels of industry and government, because of the economic development implications are vast. An Accenture Smart Cities report pegged the 5G economic impact as worth approximately \$500 billion to U.S. GDP and three million new jobs¹¹. The transformation is well underway.

Its true promise will never be reached though without its symbiotic partner – deep fiber. Millions of 5G microcells will require low latency, multi-Gigabit capable backhaul and fronthaul connections. The only solution to accomplish this is deep fiber. Enormous investments in fiber networks are occurring as a result.

With wide-scale U.S. availability of FTTP networks, soon to be 36 million homes passed between Verizon and AT&T alone, with another 5 million from other U.S. providers, PON networks already provide a dramatic scalability advantage over point-to-point fiber networks for 5G support.

The broadband industry is at the beginning of a massive program to dramatically increase fiber connectivity, with business use cases beyond 5G. NG-PON2 is ideally suited to leverage all of the business opportunities that deep fiber enables. It's a future-proof technology, built specifically to meet the needs of fiber network operators who not only want to exploit 5G opportunities but a variety of other fiber broadband applications from a single, common platform.

10 Verizon - Verizon claims first completed interop trial of NG-PON2 technology, <http://www.verizon.com/about/news/verizon-claims-first-completed-interop-trial-ng-pon2-technology>

11 Accenture – Smart Cities Report, <https://newsroom.accenture.com/news/new-research-from-accenture-strategy-highlights-economic-and-societal-impact-of-investing-in-5g-infrastructure.html>



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