CORNING

5G

It's Early in the Game for 5G and
the Future Looks Bright

The broadband industry is at the beginning stages of a monumental transformation, thanks to the introduction of 5G. This latest generation of wireless will be a catalyst for a historic technology evolution that will dramatically change our way of life. It's arriving at an opportune time and will be the underlying fuel to propel technologies like artificial intelligence (AI), the internet of things (IoT), and edge computing, all of which will help drive transformational change for individuals, communities, and industries.

It's still early, yet initial indications are strong. Tens of billions of dollars are currently being invested for spectrum and infrastructure in the United States alone, with national carriers planning for widespread 5G coverage. The coming months and years will reveal a plethora of 5G-enabled applications and use cases, many of which haven't even been thought of yet. For the communications industry, understanding this historic shift and its implications couldn't be more important.

Evolution of 5G

Putting the evolution of 5G in perspective is critical. We're early in the game for what is essentially laying the foundation for how we will use networks in the future. What we're witnessing now is a significant enhancement of the mobile experience. But that's only the beginning, what will follow is the true enablement of the IoT — billions of connections to the network impacting every facet of our daily lives. Transforming the healthcare, manufacturing, automotive, and transportation industries — virtually every aspect of how we live, work, and play.

The first stage of this evolution, enhancing the mobile experience, is already well underway, and the results are encouraging. If 4G brought the equivalent broadband experience of DSL or DOCSIS to the smartphone, 5G will bring a near-fiber experience. Gigabit speed throughput to the handset is in sight.

In fact, Verizon recently reported it achieved 4.2 Gbps throughput on its live 5G network, using millimeter wave spectrum.[1] Speeds like this are for demonstration purposes for now, and won't represent what the average 5G user will experience at scale, but they do highlight the increasing capabilities of 5G technology. Cisco predicts average 5G speeds will reach 575 Mbps by 2023, 13x more than the current average mobile connection.[2]

Different operators have licensed various spectral wavelengths and it's important to note the spectrum they operate on directly correlates to the signal reach. In recent tests performed by industry research firm OpenSignal, Verizon achieved average 5G speeds of 723 Mbps.[3] Due to its exclusive use of more robust millimeter wave spectrum, primarily in the 24 MHz and 28 MHz bands, they enjoy high speeds but require more small cells. In comparison, Sprint, using 2.5 GHz mid-band spectrum achieved an average 5G speed of 183 Mbps, with radio equipment spaced farther apart.

Regardless of initial spectrum choice, U.S. mobile operators are introducing a quite dramatic improvement in mobile network performance. This will enable a new and better experience for smartphones, putting just about any application, regardless of bandwidth requirements, in the palm of anyone's hands. Augmented reality, where subscribers can use their 5G connections to enable unique applications like immersive experiences at live events, is one example of enhanced smartphone capabilities enabled by improved mobile network performance. Verizon and Snap recently partnered to create 5G-enabled experiences such as, transporting fans backstage at a live concert or providing spectators unique in-stadium experiences from their seats during a live game.[4]

The Next Phase

While the initial phase of 5G, with its emphasis on the mobile experience, is encouraging, the next phase will truly bring the promise of IoT to life. An inherent characteristic of 5G is its massive capacity, which can facilitate connectivity to vast amounts of devices and sensors. Cisco predicts that in North America alone, there will be 5 billion networked devices by 2023. Sensors or machine-to-machine modules will account for 63% of these devices.

By leveraging 5G, network operators will be able to capitalize on expanding IoT opportunities, particularly within certain vertical industries. The business-to-business (B2B) opportunities enabled by 5G represent a dramatic growth opportunity and will be a $700 billion market by 2030 for network operators, according to Ericsson.[5] Key industries for this opportunity include healthcare, manufacturing, and energy.

Applications that 5G will enable include automated factories, smart buildings, drones and autonomous connected vehicles, public surveillance and security, and precision agriculture. IoT applications that look particularly promising to Ericsson include real-time automation, forecasted to generate $107 billion by 2030, and connected vehicles, estimated at $89 billion by 2030.

Connected vehicles are of particular interest for 5G applications. Low latency is key for connected vehicle applications, and 5G delivers. A recent cellular vehicle-to-everything (C-V2X) test by Sprint in Chicago resulted in a 40% faster transmission time for alerts using 5G in comparison to 4G LTE. Variance was 72% lower on 5G than on the LTE network.[6] These results are encouraging for public safety applications, according to Sprint partner HAAS Alert. The company believes 5G could help reduce accidents for public safety vehicles using C-V2X technology.

As the Ericsson data notes, automation and robotics hold great promise as well. AT&T has partnered with Badger Technologies to demonstrate this promise. Using 5G, AI, and edge computing, AT&T is providing 5G connectivity for robots in a retail store environment. Robots within stores can be used for a variety of purposes, including identifying out-of-stock, mispriced or misplaced inventory, as well as store hazards. AT&T 5G service is providing these in-store robots with lower latency and higher throughput to process and share vast amounts of data. Otherwise, their data requirements could tax and hamper existing in-store Wi-Fi networks, resulting in poor in-store Wi-Fi customer experience.[7]

While 5G connectivity and the services revenue it generates will be attractive, the opportunity will not stop there. Professional services and managed networks will be lucrative for network operators as well. Indeed, the future is bright for network operators, as they expand their 5G business plans beyond enhancing mobile experiences into the B2B IoT marketplace.

As network operators, wireline and wireless alike, contemplate how to best maximize this 5G evolution opportunity, one common attribute is clear. Leveraging the advantages of deep fiber networks is paramount.

Advantage of One Converged Network for 5G

Fiber networks have evolved, and significantly so, much to the advantage of network operators. Legacy fiber network architectures were built to handle single network functions. One network for residential broadband access. Another network to serve enterprise customers. Perhaps another network dedicated to cell-site backhaul. All requiring separate network management functions, and maybe even separate workforces. It was an inefficient network of networks.

Times have now changed. Network operators now have the luxury of leveraging a single converged network to deliver all these functions. And just in time for 5G. If ever there were validation of the notion that wireless needs wires, it's with 5G. The preferred high-bandwidth, low-latency performance of 5G can only be enabled by a fiber backbone. Network operators now gain tremendous flexibility and competitive advantage by deploying fiber networks directly to antennas.

Luckily, that single converged deep fiber network can serve any market segment and meet any customer demand. The advantage of a single converged network is now within reach. Utilizing next-generation passive optical network (PON) and dense wavelength division multiplexing (DWDM) technologies mean that any application, from residential fiber to the home (FTTH) to 5G small cell fronthaul and beyond, is achievable.

In a 5G world, this advantage cannot be understated. As network operators deploy fiber for residential and business services, they can easily add 5G small and macro cell fiber connectivity when and where it's needed. The foundation for both wireline and wireless networks can be built from a single network. Cost models developed by Corning show that building one network that enables any wireline and wireless application only increases material costs for that network build by approximately 6%.

Network planning is key, though. A converged fiber network that can simultaneously support wireline and mobile applications requires sound network planning. 5G networks will require significant antenna densification. Network operators should ensure they not only have adequate fiber cable counts to support multiple applications and multiple carriers, but also easy network access points for connectivity.

Corning studies not only theoretical limits of wireless technologies but the practical application of transport and access deployments in support of wireless densification. An innovation we're excited about introducing in 2020 is the Evolv™ Hardened Connectivity Solution enabled by Pushlok™ Technology — a smaller-form-factor portfolio of hardened connectivity solutions. By reducing terminal sizes to ¼ of existing solutions, operators can place terminals on street furniture or in tight spaces where traditional solutions may not have been feasible.

Densification of the network for 5G could mean 16x the network nodes of 4G, or more. Network operators should plan accordingly. Identifying partners with the right solutions and the right experience is key. In a 5G world, maximizing your opportunity requires thoughtful network planning and strategic partnerships.

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[1] **Verizon achieves 4.2 Gbps on its live 5G network,** https://www.verizon.com/about/news/verizon-live-5g-network

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[3] **Report: Verizon Has Fastest U.S. 5G Speed, T-Mobile Has Best Coverage,** https://www.telecompetitor.com/report-verizon-has-fastest-5g-speed-t-mobile-has-best-coverage/

[4] **Verizon becomes Official 5G Innovation Partner to Snap Inc., the creator of Snapchat,** https://www.verizon.com/about/news/verizon-innovation-partner-snap-inc

[5] **Ericsson 5G report: industry digitalization could be a USD 700 billion market by 2030,** https://www.ericsson.com/en/news/2019/10/ericsson-5g-for-business-a-2030-market-compass

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[7] **AT&T and Badger Technologies Bringing 5G-Enabled Autonomous Robots to Retail,** https://www.businesswire.com/news/home/20190730005179/en/ATT-Badger-Technologies-Bringing-5G-Enabled-Autonomous-Robots

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