

5G and the Future of Wireless Networks

By Jesse Cryderman

According to the latest data from the GSMA, 206 commercial LTE networks in 79 countries have now been deployed. In December 2011 there were only 50. The superfast wireless technology is being rolled out faster each year, but it has yet to be widely adopted by consumers; in Europe, for instance, just 1.3 percent of wireless connections are 4G LTE.

Next on the wireless roadmap is LTE-Advanced, or LTE-A. One of the prime reasons the industry chose to embrace LTE over WiMAX as its preferred fourth-generation technology was because it offered a clear path to the next generation.

But what comes after LTE-Advanced, and when will we see these next-generation wireless networks? Following the naming convention of “xG,” 5G is on deck, and although there’s no standard definition for it, analysts, vendors and communications service providers (CSPs) estimate that networks with 5G technologies will start to be deployed around 2020. So, who’s investing today, what will 5G look like, and is it too early to begin framing your 5G strategy?

Telefónica, Alcatel-Lucent and Bell Labs

The first whisperings of 5G began during a press event at Mobile World Congress in 2012, when executives from Telefónica, Alcatel-Lucent and Bell Labs discussed the nascent technology. The first question posed by the audience was: since only a sliver of the world’s population has 4G (and only if you stretch the definition of it), what exactly is 5G, and who needs it?

“5G is more about providing the services people need at the appropriate quality of service,” said Marcus Weldon, CTO of Alcatel-Lucent’s wireline-networks product division.



In other words, creating a new speed potential isn’t as important as matching the right speed to the right application, which is increasingly important as mankind

experiences the “rise of the machines.”

Mobile traffic today is driven by somewhat predictable activities: making calls, receiving email, surfing the web, and watching videos. Over the next 5 to 10 years, billions of

new devices with less predictable traffic patterns will join the network, including cars, machine-to-machine (M2M) modules, video surveillance that requires 24-7 bandwidth, or even a biohazard sensor that sends out tiny bits of data each day. Stir in the effects of the meteoric rise of cloud computing and it’s easy to see why new network strategies will be crucial to the fifth evolution of mobile.

5G represents a convergence of network access technologies. As Ian Miller, director of radio access networks (RANs) at Telefónica, said at last year’s Mobile World Congress, “It’s all about how we stick these varying access technologies together seamlessly—right now it’s a little clumsy.”

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Additionally, baked into the idea of fifth-generation wireless is customer experience. While past Gs have seemed focused on network abilities, 5G's goal is to always offer the right ability for the right service. "Of course there will be substantial speed increases," said Tod Sizer, head of wireless research at Bell Labs, at Mobile World Congress 2012. However, weaving different access technologies together in a fluid fashion and creating smart gateways that choose the "best" connectivity for a given situation, not to mention in a transparent manner, will be the DNA that gives life to 5G.

Intel goes back to school

Intel has formed a research collaboration with nearly a dozen leading universities worldwide to explore technologies for next-generation wireless networks, investing at least \$3 million at Stanford, ITT Delhi and Pompeu Fabra University in Barcelona, among others. The work focuses on topics such as how to improve quality of service (QoS) via context awareness, wireless-device power efficiency and the enablement of new radio spectrum. The Intel Strategic Research Alliance includes industry partner Verizon.

Samsung claims 5G speeds

In May, Samsung announced a breakthrough in 5G: a mobile-phone network that can download a high-definition film in one second.

As stated in its press release, "Samsung's latest innovation is expected to invigorate research into 5G cellular communications across the world; the company believes it will trigger the creation of international alliances and the timely commercialization of related mobile broadband services."

5G mobile, according to Samsung, will transmit data several hundred times faster than 4G networks and enable services like 3-D movies, video games and even medical services. Its solution is a millimeter-wave band technology that transmits data "at a frequency of 28 GHz at a speed of up to 1.056 Gbps [gigabits per second] to a distance of up to 2 kilometers."

Analysts believe, however, that Samsung is full of hot air,

because it's not the only company to have broken the wireless speed barrier in a controlled setting: NTT Docomo has also demonstrated lightning-fast wireless broadband. In both cases, however, these achievements took place in laboratory settings, and over spectrum that isn't yet licensed for cellular use. Whether or not Samsung and NTT Docomo's technologies will fuel the future or just future press releases remains to be seen.

Ericsson and 5G

If you ask Ericsson, 5G doesn't describe any particular specification in any official document published by any official telecommunications standardization body. This is, in fact, true, as neither the International Telecommunication Union (ITU), the 3rd Generation Partnership Project (3GPP) nor the European Telecommunications Standards

Institute (ETSI) have developed a 5G standard. But that doesn't mean these organizations aren't considering 5G: ETSI, for example, is holding a summit in Mandelieu, France, on November 21 to discuss 5G standardization. Furthermore, based on the direction of standards like

IMT-Advanced (International Mobile Telecommunications) and discussion panels at industry trade shows, the rough outline of 5G can be ascertained.

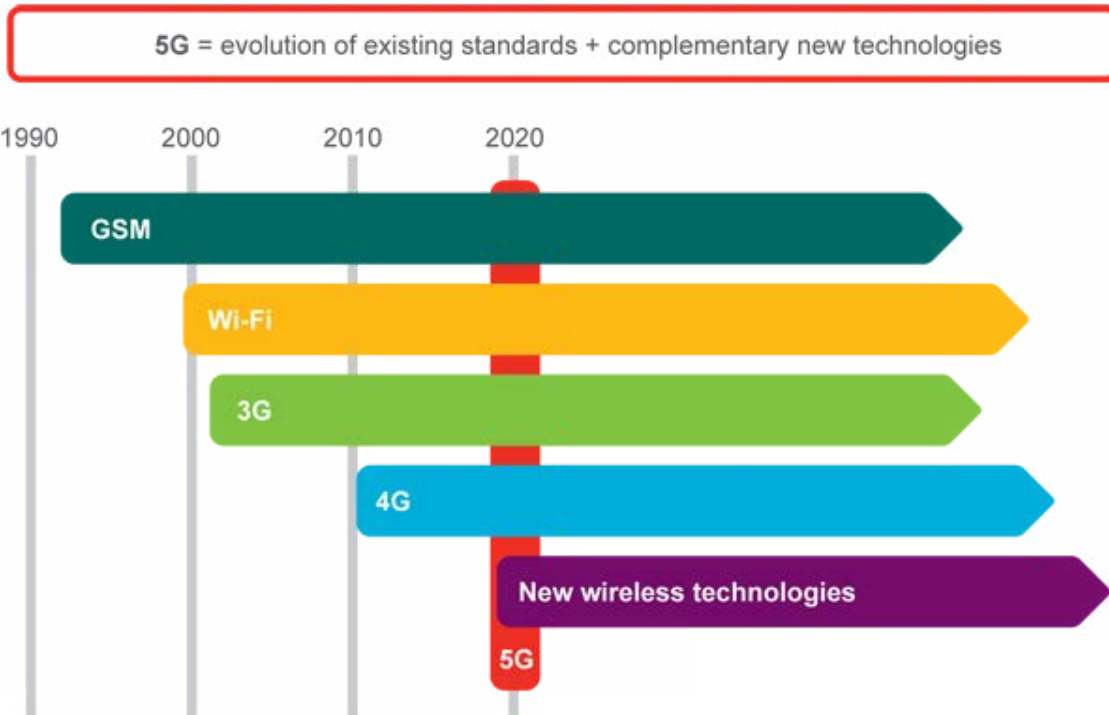
Some of the qualities of a 5G network include:

- mobile data rates of multiple gigabits per second;
- higher spectral efficiency and advanced beam-forming technology;
- a dramatic reduction in power consumption by both devices and macro- and microcell sites;
- latencies of less than five milliseconds end to end;
- a larger number of supported devices;
- pervasive coverage;
- extreme reliability;
- self-healing capabilities.

As you can see in figure 1 below, 5G will encompass both legacy transport as well as new technologies. (Interestingly, Wi-Fi has longer legs than 3G on this roadmap.)



Figure1:



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Ericsson 5G Roadmap, 2013

One can also reverse engineer a 5G network based on the capabilities it will require by 2020, at which point Ericsson believes traffic volume will be more than 1,000 times the size it is now. To meet these needs, the company states in its June 2013 white paper “5G Radio Access” that “the 5G system will not be a single technology but rather a combination of integrated RATs [radio access technologies], including evolved versions of LTE and HSPA [high-speed packet access], as well as specialized RATs for specific use cases.”

5G work at Huawei

Whatever 5G becomes, new technology from Huawei will undoubtedly be a part of the equation. The company announced last year that it had seriously jacked up mobile speeds with its Beyond LTE technology, and we’re not talking a modest, incremental increase here: Beyond LTE promises to deliver a peak of 30 Gbps, which is 20 times faster than the top speeds of commercial LTE networks. Huawei’s technology relies on advanced antenna arrays, frequency management and MIMO (multiple-input, multiple-output) to improve spectrum utilization and achieve greater efficiency.

“Future technologies will bring revolutionary advances in network evolution—higher spectrum efficiency, wider spectrum aggregation and faster access rates,” said David Wang, president of Huawei’s wireless-network business unit, in a corporate news release. He boldly added, “Our Beyond LTE technology signifies the future of mobile broadband.”

Near the end of July the Chinese network equipment manufacturer (NME) let the world know that its researchers are answering the call of 5G R&D: Huawei is participating in industry collaborations such as METIS, which stands for “Mobile and Wireless Communications Enablers for the Twenty-twenty Information Society” and whose main

Five vendors
Alcatel-Lucent, Ericsson, Huawei, Nokia, NSN

Five Operators
Deutsche Telekom, DOCOMO, Orange, Telecom Italia, Telefonica

Automotive Industry
BMW

Thirteen academic organizations
AAU, Aalto, CTH, HHI, TB, KTH, NKUA, Oulu, PUT, RWTH, UB, UKL, UPV

METIS Consortium – Partners' names

objective is to build the framework for 5G. The other members of the METIS project can be seen in figure 2 below.

The intersection of the cloud, Big Data, M2M, and 5G will bring about an exciting new automated future, said Dr. Wen Tong, Huawei fellow and the head of its Communications Technologies Labs, in a June press release. "5G wireless will, first of all, open the frontiers of a new end-user experience. For example, visual communication will become the mainstream, and people will use wireless devices to interact instantly with people remotely, as if they were meeting face to face. 5G wireless will also wirelessly connect an enormous number of 'things' to the network. Therefore, in combination with cloud computing and Big Data technologies, we can essentially automate the entire society."

Start prepping now

Ultimately, 5G is about the way networks interrelate and the customer experience they deliver. To that end, a network must be designed with the future in mind, as a loosely affiliated grouping of provider partners whose hardware can be dynamically utilized through virtualization technologies, which is why a holistic software-defined networking (SDN) strategy is paramount. Similarly, heterogeneous networks, or HetNets, must be fully ironed out, and new access technologies like Wi-Fi and satellite must be carrier grade. By making the correct investments now, mobile service providers can both roll out 4G LTE and pave the way for the 5G future.