What's Next for Wireless: 4G, LTE and WIMAX

BY MICHAEL HARRIS

"It's time for 3GPP. Are you ready?" Jill asked Jack, who was talking on his mobile phone with a client. "What? You want to go see a PG movie in 3D? I'll pass. Avatar gave me a headache," Jack replied.

"No, I don't want to go to the movies. I'm asking if you are familiar with the technologies that support new wireless services through that cell tower you own and lease," Jill explained. "You know, 4G mobile enablers like 3GPP LTE and WiMAX?"

While it's not likely your spouse has asked you about the intricacies of 4G mobility, it's a topic that you probably have questions about as an industry stakeholder. Let's find some answers.

Wireless Industry Evolution

The wireless industry's explosive growth over the past decade has transformed American society. Likewise, surging subscriber counts and demand for new services have caused a rapid evolution of mobile technology (see Figure 1).

The first phase of the wireless industry's growth was about analog voice. The second generation of services (2G), made voice digital and added basic messaging functionality. The third generation (3G) added multimedia messaging, mobile email, video and the wireless web. The fourth generation of wireless (4G) makes mobile a broadband experience.

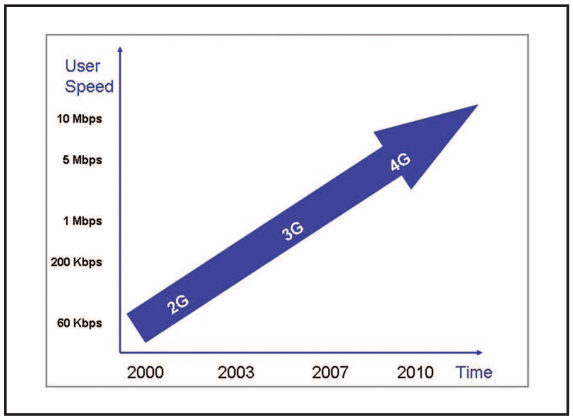

FIGURE 1: The Evolution of Mobile Data

The two leading 4G technologies are known as 3rd Generation Partnership Project (3GPP) Long Term Evolution (LTE for short) and WiMAX (Worldwide Interoperability for Microwave Access). Both bring the broadband data speeds consumers enjoy into the wireless world, enabling a mobile phone to access the Internet as fast as a cable or DSL link. High-performance, handheld devices are capitalizing on this extra bandwidth to deliver richer applications and services, like streaming video, gaming and video calling.

In short, while the wireless market has historically been driven by reliable voice, mobile is all about super-fast data. 4G technologies are designed to deliver data services far more efficiently and effectively.

The Need for Speed

So how fast is 4G? On average, mobile users of 4G technologies can expect data speeds about 5-10 times faster than 3G solutions. Additionally, 4G technologies like LTE offer lower latency, making time-sensitive applications like video, gaming and financial trading more responsive.

Sprint made headlines earlier this year with the launch of the first 4G mobile phone in the U.S., the HTC EVO 4G, shown in Figure 2. Using WiMAX technology, the EVO offers downlink data speeds as fast at 6 Mbps. The device is packed with advanced features, including an HDMI output that can deliver high-definition video to a television. The phone also features a WiFi mobile hotspot application, enabling its 6-Mbps data connection to be shared with up to 8 computers via WiFi.

For carriers, the total mobile link capacity with 4G is far greater than legacy technologies. For example, with LTE, the total downlink capacity is up to 100 Mbps, compared to only 2 Mbps for WCDMA, a 3G technology (see Table 1). Unlike mobile voice calls, data traffic is "bursty" by nature

FIGURE 2: Sprint HTC EVO 4G

TABLE 1: Mobile Data Speed Comparison

2.5G & 3G Technologies	Maximum Speed	Avg. User Speed
CDMA2000 1xRTT	153 Kbps downlink 153 Kbps uplink	60-80 Kbps downlink 60-80 Kbps uplink
1xEV-DO Rel. O	2.4 Mbps downlink 153 Kbps uplink	400-700 Kbps downlink 60-80 Kbps uplink
1xEV-DO Rel. A	3.1 Mbps downlink 1.8 Mbps uplink	600K -1.4 Mbps downlink 500-800 Kbps uplink
UMTS WCDMA	2 Mbps downlink 768 Kbps uplink	100-320 Kbps downlink > 100 Kbps uplink
EDGE	237 Kbps downlink 237 Kbps uplink	100-130 Kbps downlink 100-130 Kbps uplink
HSPA	1.8-14.4 Mbps downlink 384K - 2 Mbps uplink	Up to 2 Mbps downlink 384K – 2 Mbps uplink
HSPA+	42 Mbps downlink 22 Mbps uplink	5 Mbps downlink 3 Mbps uplink
4G Technologies	**Maximum Speed**	**Avg. User Speed**
3GPP LTE	100 Mbps downlink 50 Mbps uplink	5-12 Mbps downlink 2-5 Mbps uplink
WiMAX 802.16e	46 Mbps downlink 7 Mbps uplink	3-6 Mbps downlink 500K-1.5Mbps uplink
		Sources: AT&T, Verizon, Sprint

with bits only being sent and received when needed. Because the burst patterns of applications and users vary, proportionally more users can be fit in a higher-bandwidth channel than a lower bandwidth one. This statistical multiplexing effect makes 4G data networks more efficient for carriers than their narrower 3G counterparts. Additionally, the advanced antenna and digital modulation technologies available with 4G offer transmission efficiencies.

"In summary, with 4G, carriers can support more users and services at higher speeds with fewer antennas and towers than would be possible with 3G technology."

- Michael Harris

Finding MIMO

There are two groups of technologies that enable capacity or coverage gains in LTE and WiMAX networks: smart antennas and advanced modulation.

The heart of 4G smart antenna technology is called MIMO (multiple-input and multiple-output). Clearly, the key concept here is "multiple," specifically, coordinating multiple antennas – both in cell site transmitters and mobile handset receivers - to improve performance. On the transmitter side, beamforming is used to transmit the same signal from multiple antennas, creating a "one-plus-one-equals-three" effect, boosting link capacity without using additional power. It's up to the receiver antenna to process the multiple antenna streams.

OFDMA (Orthogonal Frequency Division Multiple Access), an advanced digital modulation and access scheme, is used with MIMO to boost radio link efficiency further. The approach dynamically allocates network resources to mobile users by scheduling transmissions in slices of both time and frequency (rather than one or the other), allowing more transmissions to be packed into the same link. Additionally, higher order modulation is used, increasing the available capacity for data bits.

The challenge for wireless carriers is that deploying 4G with MIMO and OFDMA typically requires that they install new radio access network (RAN) equipment. That means upgrading both their cell site base stations and requiring customers to purchase new 4G handsets.

The 4G upside: using larger frequency blocks along with enabling technologies like MIMO and OFDMA may enable 4G LTE networks to offer up to 24 times more capacity than existing 3G solutions.

Getting There from Here

For initial 4G deployments, carriers are planning to use only 4G spectrum and technologies to deliver higher-speed data access and applications. That means they will rollout 4G overlay networks for broadband data, while continuing to rely on their 2G and 3G networks for voice service delivery in the near term. Flashy fourth-generation mobile devices will therefore be multi-mode devices, supporting 2G, 3G and 4G frequencies and protocols.

Among major carriers, LTE has the most traction, as both AT&T and Verizon Wireless are implementing the 4G technology. The largest advocates for WiMax are Sprint and its partner Clearwire, which have started a phased national rollout using the solution.

"Well, now that we've covered the future of wireless technology, it's time to relax a bit," Jack said. "I'll have to go pick up one of those new 4G phones and watch a movie in the palm of my hand."

About the Author

Michael Harris is principal consultant at Phoenix, Ariz.-based Kinetic Strategies, Inc. Applying more than 15 years of experience as a strategist, research analyst, journalist, public speaker and entrepreneur, Michael consults with select clients in the networking, Internet and telecommunications industries.

About Unison Site Management

Unison Site Management is the largest independently owned cell site management company in the United States, managing thousands of wireless leases. As wireless lease consultants, Unison helps cell site owners protect against uncertainty, maximize return and provide peace of mind.

340 Madison Avenue,
New York, NY 10173
Phone: 1-866-434-8495