

THE MOBILITY REVOLUTION: What Is 4G?

By Russ McGuire

Now that it seems the whole world has adopted mobility for more than just talking, everyone's focused on the data network as the critical element for the future. In fact, while most of us are just getting our arms around 3G, you may have started seeing ads for 4G services. So what is 4G and why does it matter?

4G is shorthand for fourth generation cellular services. The first generation of cellular was a simple, analog voice-only network. The Federal Communications Commission (FCC) started auctioning spectrum for 1G networks in 1982 and by 1985 there were 340,000 wireless subscribers. The second generation was digital, which provided significantly better utilization of the radio frequencies (spectrum) to support more calls. 2G also supported data transmissions, roughly at dial-up modem speeds (generally up to 64kbps). The first 2G network was deployed in Finland in 1991. In the U.S., 2G networks eventually evolved to either GSM (based on Time Division Multiplexing or TDMA) or CDMA (Code Division Multiplexing) technology standards.

Starting in the mid-1990s, people began speaking of advanced mobile communications services that often were referred to as "personal communications services" (PCS). A third-generation cellular architecture, with high-speed packet switching at the core, was expected to support these new services. The FCC began auctioning new spectrum for these services in 1994. However, it took over a decade for 3G networks to actually be ready. In between, most carriers launched networks that were referred to as 2.5G. These interim networks inserted a packet network, but only stepped up the bandwidth to about 144kbps.

Finally, in 2005, Verizon and Sprint started rolling out true 3G services. Today's 3G services (EV-DO for Verizon and Sprint, HSPA for AT&T and T-Mobile) deliver roughly DSL speeds – typically about 1Mbps downstream and about 400Kbps upstream. [3G coverage](#) is fairly comprehensive for Verizon and Sprint, while AT&T and T-Mobile cover the major metropolitan areas. Outside of 3G coverage areas, most carriers still provide 2.5G services, so you aren't completely out of luck.

As cellular technology, 1G, 2G, and 3G all operate with a cellular architecture, meaning that a cell site (think of the towers you see alongside the highway, although many cell sites are more discrete these days) covers a given area, typically with a radius of 1 – 5 miles. As you reach the boundary of that cell, your signal is handed off to the next cell. If you're on a call, the call continues through the handoff. If you aren't on a call, the network recognizes that you've switched cells so that it can route the call to you when someone dials your number.

So, what is 4G? As you would guess, fourth generation cellular networks take it to the next level. Architecturally, packet switching is more deeply embedded, creating an end-to-end IP network. Technologically, time division multiplexing and code division multiplexing are replaced by orthogonal frequency division multiplexing (OFDM). 4G networks make much better use of spectrum. Individual

connections are typically in the 5Mbps range or higher (think cable modem speeds). And the cost to operate is expected to drop to about 20% per megabit compared to 3G networks.

Sprint launched the first 4G network, starting in Baltimore in October 2008. Today, Sprint has expanded the service to about 25 cities covering about 10% of the U.S. population. The company expects to have about a third of the country's population covered by the end of 2010. Verizon expects to launch its first 4G markets late in 2010 and similarly expects to cover about a third of the country by the end of that year. Sprint is using a 4G technology called WiMax. Verizon plans to use a technology called LTE. They are both OFDM-based technologies. Neither AT&T nor T-Mobile plan to launch 4G during 2010.

Who cares?

So, why would anyone care about 4G? Come on – you can't fool me – if you're reading Christian Computing, I'm guessing you care a lot about your broadband speed. And if you're in ministry, then I'm guessing you are very focused on your budget. 4G services promise a 5 fold increase in speed at roughly the same price. Today Sprint charges \$69.99/month for 4G+3G (so the service works wherever they have either 3G or 4G service), while Verizon charges \$59.99 for 3G. But Verizon caps your 3G use at 5GB per month, while Sprint allows unlimited 4G use (but caps you at 5GB per month on their 3G network). Sprint's Clearwire subsidiary is offering unlimited 4G service for \$49.99 (but apparently without the ability to roam onto Sprint's 3G network). I believe that unlimited is an important differentiator for 4G, and one that is hard for the carriers to match on 3G because of the significantly higher operating costs.

But moving beyond the immediate "what's in it for me," the other reason to care about 4G is the broader picture of available network capacity. In a paper titled "Managing Growth and Profits in the Yottabyte Era," Chetan Sharma observed that for 2009, the global mobile data traffic will reach one Exabyte (1000 Terabytes). This year, some carriers suffered from not having enough capacity in their networks to keep up with growing mobile data usage. By 2017, Sharma expects the global mobile data traffic volume to reach one Zettabyte (1000 Exabytes). If 3G networks are struggling today, how will they handle a 1000 fold increase over the next several years?

The answer is 4G. The new networks are not only using technology that makes more efficient use of the available radio spectrum, but are being built with big new blocks of that spectrum. For example, Sprint has about 50MHz of spectrum for its 2G and 3G networks. But the company's Clearwire business holds over 120MHz of new 4G spectrum. That new spectrum with efficient radio technology, combined with new micro-network technologies like picocells and femtocells which offload the needs of users in predictable less-mobile areas like the home and office, will significantly stretch the networks to be able to meet the coming tidal wave of bandwidth demand.

What does that mean for you and me? Most importantly it means that we'll actually be able to enjoy the speed promised by 4G when and where we need it.

And that's what mobility is all about! So, I say – bring on the 4G!

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