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SUMMIT
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Broadband Access Involves a Lot More Than Smartphones

Gary Breed
Editorial Director

When it comes to wireless broadband, most media attention is from the end user's perspective—the "last mile" connection and the type of hardware involved, whether a fancy new smartphone or some type of home receiving unit. While these are important, it's too easy to forget that there is—as the Verizon Wireless commercials point out— a vast network operating beyond the view of the average citizen.

This is a timely topic because the rapid growth in bandwidth usage requires similar expansion of the network. The effect is multiplied by the number of circuits that must be maintained to individual users. To implement a 10× increase in data rate, every single cell site must have 10× the capacity in its connection to the network hub, and the hub must be able to handle 10× throughput ... and the backbone (the Internet and dedicated lines) must do the same. That's a lot of bits and bytes!

The word *backhaul* is wireless lingo for the connection from cell sites to hubs, and this part of the system uses point-to-point microwave or fiber optics (typically T1/E1 channels) as the transmission medium. Backhaul comes up in conversation a lot these days because in some parts of the U.S. and Europe, the available spectrum for more point-to-point links in the traditional bands is running out. Switching to 20, 30, 70 or 80 GHz links brings new issues with cost and range limitations. Changing from a T1/E1 based system to SDH/SONET based fiber backhaul requires a major investment in manpower and hardware.

Similar upgrades are needed for network hubs and long-haul backbone communications. The fiber optics industry is working as hard as their wireless industry partners to support the big step up in bandwidth. Gigabit Ethernet has become 10 Gb, with 40 Gb and 100 Gb now being promoted. Some versions will require new high-purity fiber, which adds to the time and cost equation.

New and faster technology requires parallel development of the supporting tools. Thus, adding to the cost of broadband upgrades are new test equipment and training of installation and maintenance personnel. A 10 Gb digital signal requires a 50 GHz 'scope, since the typical benchmark for

measurement of square waves is the ability to pass the fifth harmonic. Displaying an eye diagram at these higher rates will be a big challenge for instrument designers. (I assume they are working on it right now.)

So, the next time you wonder why the super-duper 3G network promoted by your wireless provider doesn't seem to perform as advertised, just remember that your local cell site may not yet have the right backhaul upgrade.

Engineers' Personal Time

With the amount of space allowed for this column, I often get to comment on two subjects. This month, I'll add some notes on the way engineers spend their personal time, with some suggestions.

Of course, some of us have technical hobbies, such as ham radio (as in my photo), robotics, high-end audio, etc. Among ham radio operators, I know engineers with highly advanced knowledge of antennas, signal processing, microwave communications, power amplifier design and low noise circuits. They apply their professional knowledge to their hobby, sometimes using their "fun" projects to evaluate advanced technologies in the real-world laboratory of radio communications.

Many engineers are involved in music, too. I've met some concert-quality pianists, oboists and violinists—as well as a few bluegrass mandolin, guitar and dobro players. Clearly, these engineers are highly capable in both the time and frequency domains.

Beyond the fun of hobbies, though, I want to promote volunteer activities that are especially suited to engineers. I was reminded of this topic just a few days ago, when I got my annual e-mail asking if I would help judge the local high school science fair, hosted by the University of Wisconsin Engineering Department. This will be my fourth year, and I'm looking forward to it!

Other typical ways to help at the local level are mentoring and tutoring at all levels in the schools, or even teaching merit badge classes for scouts.

Typical professional volunteer work involves serving on conference committees, supporting local engineering association chapters, and participating in online forums in your area of expertise.

Be a volunteer! We make products for the future; we should help develop future engineers, too.

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