



Info on the Run

Giving new meaning to information when you want it, where you want it

BY PETE BARTOLIK

The build-out of third-generation (3G) cellular networks that support high-speed mobile broadband now makes wireless data connectivity widely available. That's good news for businesses that are counting on increasingly mobile workforces to boost revenue and profitability while improving customer service.

According to market research firm Yankee Group, more than 50 million U.S. workers are mobile, in that they spend more than 20% of their time away from their primary workspace. But, says Yankee, relatively few of them today are equipped with the right mobile tools to do their jobs.

Already a wide variety of devices such as smart phones and PDAs can tap into 3G wireless mobile broadband, but mobile workers with data-intensive applications prefer a notebook computer.

Wi-Fi capabilities are now a core feature of today's notebook computers, offering Internet access with some basic limitations:

- Moving away from a corporate campus, users are unable to gain access unless they can find a Wi-Fi hotspot in a public area or hotel room.

- While virtual private network technology can protect wireless data transmissions over public access points, there's no practical way to ensure that workers comply with security requirements away from the office.
- Public access can cost from \$9.95 to \$19.95 a day, making it costly and difficult to administer budgets.
- Some Wi-Fi service providers offer monthly "all you can eat" subscription rates, but there's no guarantee your provider of choice will be available at the closest Wi-Fi hotspot.

Tapping into Mobile Broadband

The growing use of 3G modem-equipped smart phones and PDAs offers one way to tap into broadband cellular networks by tethering—via Bluetooth or USB cable—the device to a notebook computer, which can use the phone's modem to transfer data via wireless. This function, too, has limitations. Initially, some service providers were hostile to tethering efforts and handcuffed devices in efforts to curtail their use. Users also seem to have mixed and inconsistent results with the process, which can require complex configuration and activation steps.

Another means to access 3G networks involves the use of add-on PC cards and USB modems. For the most part, these have been the primary marketing tools with which service providers target business users, as they can subsidize the cost of an add-on card in much the same way they subsidize the



cost of cell phones—a model that really doesn't translate to notebooks with built-in modems.

Such notebook peripherals are relatively quick and easy for the end user. But “businesses have to consider as they are looking at this that the IT department doesn't like loose parts—that's something they will have to track,” says Dan Shey, principal analyst with market research firm ABI Research and author of a study, “Expanding Cellular Broadband Connectivity to the Laptop: PC Cards, Express Cards, Minicards, USB modems and 3G/Wi-Fi Routers.” The study predicts sales of all types of cellular models will grow to exceed 68 million units in 2012.

PC cards represented the majority of sales in 2006, according to the ABI Research report. Internal modems did not meet sales expectations at that point, Shey says, but will begin to lead sales starting in 2009. “The value chain for internal modems is complex, with several issues still needing attention, particularly related to distribution,” notes Shey. “However, operators, notebook vendors and chipset manufacturers are committed to this form factor, and they continue to work together to develop the embedded modem market.”

Performance and Economics

Notebook suppliers like HP say that wireless performance is as much as 26% faster and is more power-efficient with an embedded modem than with an add-on card or USB modem. While the add-ons are useful to retrofit existing notebooks that lack mobile broadband, market research firm Yankee Group

says the limitation is that “radio and antenna performance, power utilization and interference with other internal notebook components have not been optimized to the specific notebook model.”

Furthermore, built-in mobile broadband modems provide general cost savings, says Cindy Goodman, HP product manager for wireless broadband. “There's a lower total cost of ownership,” she says. “With a built-in modem, you don't have the amount of time it takes to install a PC card because the hardware and software are already in there. It doesn't get lost or stolen. And it has a three-year warranty, which comes with our notebooks, whereas a card typically only has one year.”

Beyond Email and Browsing

According to the Yankee Group, “The intersection of 3G and IT in the notebook provides enterprises with a truly mobile tool for their workers.” In a comprehensive report, “Notebook Computers Go Truly Mobile at the Intersection of 3G and IT,” the research firm identified three main categories that summarize the key business benefits of going mobile:



- **INCREASE REVENUE** Mobility solutions can enhance worker productivity by leveraging real-time information and line-of-business applications, which enable workers to make

better-informed decisions and to process orders more rapidly. For example, field salespeople can use time and information more efficiently for business development opportunities.

- **DECREASE COSTS** Mobile applications can reduce workflow volumes through automation utilization and often can reduce an organization's overhead costs by upgrading antiquated paper-based business processes. Also, wireless technologies have been used to automate business processes within field service environments to decrease service costs.

- **IMPROVE SERVICES** Mobility can make a big difference for public safety, healthcare, utilities, travel and other organizations that rely on real-time access to network resources for rapid response. In addition, mobility can provide differentiated services with location and presence information.

Business decision makers are rapidly moving beyond email enablement to justify 3G services and are looking to support rich application access and data transfer. “Among companies that already have invested in mobile broadband, email remains the leading application that corporations are extending wirelessly today,” says Yankee Group. “However, access to third-party corporate databases and applications (such as CRM and ERP) is the top priority for future application expansion in these deployments.”

One of the persistent issues with wireless in the United States, whether it's for a cell phone or a notebook, is the problem of having two vibrant, side-by-side standards that are incompatible. While much of Europe has coalesced around the GSM (Global System for Mobile Communications) cellular standard, the United States is split between that (AT&T Wireless and T-Mobile) and CDMA (Code Division Multiple Access, supported by Verizon Wireless and Sprint).

"One of the biggest challenges with adoption of notebooks that have cellular connectivity is the fact that the notebook is specific to the operator and to a technology," says Shey. "The limitations then are: If I buy a notebook that has cellular connectivity, I'm going with a particular operator—I don't have choice. The other issue is that if I go outside North America—say I'm Verizon and I go to Europe—how am I going to get access in that particular case?"

Being locked into one carrier is a common fear, concedes Keith LeFebvre, vice president and general manager of HP's Americas Regional Business Unit, Business Notebook PCs. HP works with AT&T, Sprint and Verizon on co-marketing programs to notebook buyers. But, he explains, HP notebook users are not locked in to a particular technology the way they are with cell phones, because HP's broadband modems are in the form of replaceable modules, so users can switch from one service provider's transmission technology to another's.

Furthermore, notes LeFebvre, HP this summer will be offering business notebooks with Qualcomm's Gobi chip technology, which allows switch-

ing between CDMA- and GSM-based carriers without having to swap out the modem. That will enable flexibility and choice in North America, while also providing global connectivity options to international travelers.

The other major fear among corporate IT and telecom departments is the speed with which wireless broad-

One of the biggest challenges with adoption of notebooks that have cellular connectivity is the fact that the notebook is specific to the operator and to a technology.

band technology has leapfrogged itself. But, says ABI Research's Shey, it will likely be three or four years—and beyond the typical working life of most corporate notebooks—before service providers begin widespread deployment of the next, fourth-generation (4G) wireless technology.

Another reason not to fear the constant march of technological progress is that upgrading to a faster network may be accomplished by software, rather than by a hardware change, and 4G networks will be backward-compatible with 3G systems.

Cost Comparison

Regardless of which particular transmission technology a user opts for, cost of mobile broadband service

is still a major consideration in any wide-scale deployment. Service providers have been cutting costs, but not as fast as many would like. "I would say that in 2006, the monthly cost for data access was \$60 to \$80 for 'all you can eat,' and in 2007 it moved into the \$50 to \$60 range," says Shey. "So it is slowly coming down, but coming down at a measured pace, not happening really quickly."

Still, in comparison to Wi-Fi fees, 3G wireless might be a bargain, depending on usage patterns. "For anybody who goes into a hotel and pays up to \$19.95 a night for Wi-Fi when they're traveling more than five days in a month, mobile broadband makes a lot of sense," says LeFebvre.

Yankee Group estimated that workers traveling four or more days a week consume more than \$138 a month in Wi-Fi access fees, while a road warrior traveling two to three days a week incurs almost \$90 in monthly fees, compared with a flat mobile broadband cost of \$59.99 per month.

"I think the real issue with Wi-Fi is—and I think we've all experienced this—many times the connectivity is poor; it's very low quality," says Shey. "For people who rely on connectivity—and that can be from an email perspective, from delivery of information, documents and presentations, or it can be just getting access to the Internet—when people want it, they want it now; they don't want to wait around."

Budgeting for Truly Mobile Business

In the meantime, says Shey, many corporate IT departments now have a budget for mobility, even if it may only slowly be filtering down from

top executives to lower levels in the organization.

Internet measurement firm com-Score reported recently that business users accounted for 59% of all those using mobile broadband in the fourth quarter of 2007. The total number of users grew to more than 2.1 million, up 154% from a year earlier when the tally was 854,000.

“The people buying modems and access are certainly mainly business [users], because there is a real value

for them in having connectivity,” says Shey. “It’s sort of working its way from that senior executive level down to more of the manager level and then to field-force occupations. It certainly started at the top, with the most senior managers getting access, and it’s now moving to lower-level occupations.”

The introduction this summer of HP notebooks using Qualcomm’s Gobi wireless solution is likely to speed up the process of pushing mobile broadband further down into the

organization. IT and telecom support staff will be able to support multiple locations utilizing either CDMA2000 EV-DO or the GSM broadband alternative, UMTS HSPA, from one common platform.

That flexibility, along with the eventual move to make wireless mobile broadband more attractive to consumers, will likely continue to push service costs down, making today’s investment an even better buy in the future. ▶

Advantage: H

I

You can't switch your existing cell phone from a GSM-based service provider to a CDMA-based service provider. But HP laptops are making it increasingly easy for notebook owners to make a switch between the two types of mobile broadband carriers.

HP's comprehensive technology product portfolio offers a wealth of solutions to meet a variety of needs, running the gamut from large enterprises to individual consumers, and offering everything from handheld devices to some of the world's most powerful supercomputer installations. The company takes pride in its ability to match the right products, services and solutions to its customers' specific needs.

In the world of mobile broadband, that includes partnering with the three largest service providers—AT&T Wireless, Verizon Wireless and Sprint—to ensure mobile broadband notebook users can select from either the GSM or the CDMA camp, depending on their needs and particular circumstances or preferences. But HP goes a step further by ensuring that notebook users aren't locked into their initial choice.

"There's been pretty wide accep-

tance of mobile broadband wireless using air cards that people have been able to buy, but what's been holding back embedded is the fear of being locked into one carrier versus another," says Keith LeFebvre, vice president and general manager of HP's Americas Regional Business Unit, Business Notebook PCs. "Some have an issue where they have people in areas where one carrier may have better service than another, so they want the flexibility to offer different carrier services," he says.

The common perception is that notebooks are bound to a particular service provider for the useful life of the system. But HP today offers customers its mobile broadband modems in an easily replaceable module, says Cindy Goodman, HP product manager for wireless broadband. "It fits right in a mini-PCI slot, just like your wireless LAN module. Depending on where it's located in a particular system, you just open a door, take out a couple screws, pop the old one out and pop the new one in. It's not too difficult at all," says Goodman.

This summer, HP will go an additional step and begin utilizing a new mobile broadband modem technology from Qualcomm that will support both major flavors of wireless, EV-DO (CDMA) and UMTS HSPA (GSM). That will enable organizations to procure one laptop for multiple carriers, greatly simplifying support and geographic deployment issues. A laptop that can support both EV-DO and UMTS HSPA provides ready access to all three major North American carriers, so a user can switch subscriptions at will without having to change any hardware, or even maintain multiple subscriptions and



n v e n t



i n v e n t

alternate on the fly to obtain the best coverage available.

Notebooks featuring Qualcomm's multimode Gobi module will be able to "take advantage of the high-speed mobile Internet services offered by leading network operators in virtually all parts of the world," according to Qualcomm, when it introduced the technology in October 2007. Global travelers will have access to the approximately 260 wireless networks around the world that support mobile broadband, so a U.S. traveler can fly overseas and be able to access one of the approximately 260 3G networks around the world that provide mobile broadband.

Why Embedded?

There are substantial advantages to using built-in mobile broadband notebooks, rather than utilizing an add-on card or USB modem. "We are maximizing the performance that we can get into the notebook, so we are taking advantage of the speeds the network can provide," Goodman says.

Tests conducted last year by Metrico Wireless on the HP Compaq nc6400 Notebook PC compared its performance with wireless PCMCIA cards against HSDPA and EV-DO embedded modems. The embedded systems performed as much as 36% better in data downloading than the systems with the add-on cards.

While that performance penalty may be acceptable to some users, managing the notebook resources of an enterprise can get complicated when it involves procurement, deployment and support of add-on devices.

"In many cases, an enterprise will use a certain software image, and if they buy an embedded module from

HP, we can put the software for that right in their image," says Goodman. "So then every notebook comes with the hardware already built in and the software in their image, so all a user has to do is start everything up."

With a separate accessory, IT will either have to install and configure each notebook, or rely on the end user to do so. It also requires managing inventory and dealing with lost and stolen cards, Goodman points out. HP's LeFebvre adds that the company "spent a lot of money designing antennas for getting a strong signal with notebooks."

Why HP?

HP also claims bragging rights for performance of its built-in mobile broadband notebooks versus competitors, based on Metrico Wireless' testing of the HP notebook against similar Dell and Lenovo notebooks.

Using the HSDPA modems, the average download task throughput of the HP Compaq nc6400 Notebook PC was at least 24% higher than the throughputs of the Dell Latitude D620 and Lenovo ThinkPad T60, whether tested in stationary or mobile environments.

With EV-DO, the download data throughputs of the HP Compaq nc6400 Notebook PC edged out the Dell Latitude D620, both of which were at least 106% higher than the throughput of the Lenovo ThinkPad T60, whether tested in a stationary or mobile environment.

All of the HP Business Notebooks incorporate a suite of hardware and software features—HP Professional Innovations—to address the needs of mobile business professionals,

ranging from security to ease of use to manageability.

Security

Any mobile Internet access decision these days must consider the security issues involved in accessing sensitive business data remotely.

A wireless broadband connection is more secure than a Wi-Fi hotspot, which is essentially a wide-open public access point. For this reason, many businesses forbid access to the corporate VPN (virtual private network) and other resources via public Wi-Fi hotspots.

Wireless broadband has built-in 128-bit encryption, so the risk of data interception, theft and modification is greatly reduced. This is the same level of encryption used throughout the Internet, and for governmental, banking and military applications.

All mobile broadband data traffic is secured between the notebook and cellular tower with 128-bit encryption—the same level used in e-commerce transactions. This enables a single, secure connection for increased security of email, contacts and other sensitive information via wireless communications. As enterprises look to provide mobile access to sensitive corporate databases such as CRM and human resources management, security is even more critical.

Businesses can further protect their HP notebooks with HP ProtectTools, an integrated suite of security solutions that helps protect every aspect of your mobile office, including the notebook, the data and the user's connection to the company network.

Enterprise notebook security can be managed from HP ProtectTools Security Manager, an extensible framework that allows you to manage security features from a single console. Security software modules give you the flexibility to design a security solution that meets your needs and modify it over time as your needs change.

An additional management tool is Credential Manager for HP ProtectTools, through which IT security administrators can specify how the different available security technologies work together and create a unique authentication method, including alternatives to passwords when log-

To selectively restrict information copying and printing based on user profile

Embedded security for P ProtectTools

A data encryption system to protect key data on systems with a TPM embedded security chip

Advanced security for P ProtectTools

A user authentication system utilizing smart cards that hold user password and PIN information

ging on to Microsoft Windows. Organizations can also take advantage of a **single sign-on capability** that automatically remembers credentials for Web sites, applications and protected network resources.

HP provides a range of expert services for cost-effectively supporting growing mobile/wireless environments. HP Mobility Support Services enable enterprises to increase their mobile infrastructure ROI, provide critical support levels for mobile users, and enhance the ability to adapt to changing market conditions and customer needs.

The security, management and support services from HP represent just part of a comprehensive array of services, both from HP and from third-party suppliers, which make up the HP TotalCare portfolio of service and support options intended to improve the experience of owning and using the company's products.

Making the Move to Mobile Broadband

Today's wireless technologies promise multiple benefits for business. Mobile broadband is the only technology that provides immediate access, no matter where the notebook user is located. All major metropolitan areas today are covered by high-speed services, and more remote locations can still provide access over compatible, lower-speed network bands.

Taking advantage of 3G cellular

PMOBILE PORTABLE

P Mobile Device Management and Security

To streamline implementation, tighten environment-wide control, and help you contain the total cost of mobile device ownership

P Mobility Remote Monitoring

To help enhance performance, availability and capacity utilization across your mobile infrastructure

P Mobility End-user Mobility Application IT Help Desks

To provide expert, responsive problem resolution support to your mobile workforce and technical professionals

technology, mobile workers are no longer tied to a hotspot, and can check email, browse the Internet, and connect to corporate networks from more places—whether stationary or on the go.

“Coverage is extremely good at this point, and service costs are coming down,” says LeFebvre. “We’ll have the technology to move from carrier to carrier and eliminate that issue as a barrier. We’re putting wireless broadband across our notebook line and in 2008 expect to see accelerated growth. And in 2009, you might see this become a very dominant way of providing connectivity.” ▶

The Business Drivers of Mobile Broadband



As principal analyst responsible for developing and leading ABI Research's examination of business mobility markets, Dan Shey focuses on the opportunities and challenges for the wireless industry when business productivity applications are moved into the mobile domain. In 2007, he developed a comprehensive report on the market for cellular modems, "Expanding Cellular Broadband Connectivity to the Laptop: PC Cards, Express Cards, Minicards, USB Modems and 3G/Wi-Fi Routers." Shey was recently interviewed on business trends in that market.

What's driving growth in wireless-mobile broadband notebooks

Shey: The fundamental drivers for enabling notebooks or just providing cellular broadband connectivity, is the fact that cellular operators are upgrading networks to 3G and 3G-plus. What it comes down to is, when we live in a world where we already have an idea of what broadband is like, until those cellular wireless networks get to a level of speed and capacity that is similar to what you get with DSL, with cable and with Ethernet, there wasn't go-

ing to be that much growth; and there wasn't. Now, the mobile broadband experience is the same, so people now have no problem buying the capability.

What is driving these services?

Shey: We've done some survey work there, and what's interesting when I look at some data is that it shows that mobile broadband connectivity—the adoption of modems and then the broadband itself—is not necessarily related to size of business. But it is certainly related to your occupation. The company IT organization now has a budget for this and can look at the workforce and say, "We need this." The smaller company would not necessarily want to pay fees for broadband access, particularly when they have Wi-Fi potentially available.

Early adopters need connectivity. They want to have connectivity where they're at, and they don't want to have to deal with connecting or getting a [Wi-Fi] day pass or this or that; they want to be connected period, so that BOOM!, it's done.

What about the choice between smart phones and notebooks?

Shey: You need to understand the needs of the particular user. If you think, in general, for telecom: What do business customers want? They need voice access, they need messaging capabilities, and they need some sort of information access, which could be broadband through a notebook, or it might be through a smart phone.

For users who can pay for it, who need information at their fingertips and are going to be doing a lot of

computing—and that could be sales, it could be executives, it could be that field-force worker—they’re going to want choice. So the choice could be that they’ll have a handset and they’ll have a laptop with connectivity.

Q: What are the obstacles to adoption of embedded mobile broadband notebooks?

Shey: When you look at changes in cellular networks over the last three years, people say, “Why would I invest in a notebook that I’m going to have at least three years, if not more, with a particular broadband technology, when in two years I might be able to get something that’s two or three times as fast. Why should I go down that route?”

I think, though, that you’re not going to see much in the way of network changes. Upgrading to a higher-speed network can now be done with software, particularly on the GSM [Global System for Mobile Communications] side. That being the case, there is going to be less of that hesitation in terms of taking advantage of high-speed networking.

Q: Is the potential for WiMAX an inhibitor to 3G notebook adoption?

Shey: I don’t see that affecting much. WiMAX is very region-specific. There are only a couple of regions we’re seeing where mobile WiMAX is going to have some potential disruptive

factors. That’s the Asia-Pacific region, with a few operators over there, and in the U.S., with Sprint. Sprint is that big player everybody is keeping an eye on. Intel and Motorola have invested to make that happen, but [WiMAX] is having some challenges.

Early adopters need connectivity. They want [it] where they’re at, and they don’t want to have to deal with connecting or getting a [Wi-Fi] day pass; they want to be connected period, so that BOOM!, it’s done.

■ AN E P IN PA ANA T
■ ABI E EA

One big challenge is, you need to have a network. If you don’t have that network out there and you have these other technologies moving along—the 4G technology that will be equivalent to WiMAX—you’ll have people thinking, “Why am I going to go to WiMAX?”

Q: What does the future hold?

Shey: Beyond 2012, will growth increase or decrease? Once you get 4G, with competition in the market causing pricing to go down, you’re going to see the market open up to more entertainment services, where the consumer is going to be a big player in adoption not only of external models, but also of notebooks.

But operators are not even thinking about this right now. All they are thinking about is increasing adoption and understanding better the impact that will have on their networks. I’ve talked to a few of them and they’re like, “Well, we’re not so concerned about people getting on network and watching video all the time.” But I think it’s something they are very cognizant of, and that’s why you don’t see service prices dropping dramatically.

Right now, it’s a standard strategy, where you set a price to get the people who really need it. Depending on how fast they roll out their networks and what debt is associated with those new networks, that will dictate how they will price this. The bottom line is, you don’t see anybody pricing it right now so that consumers are just being driven to buy it. There’s no reason why they should be doing that. They should be going after the business customers who find real value in that and are ready to pay for that. ▶

Mobile Broadband: Reaching to a Broad Network

The two primary wireless broadband standards in use in North America carry data over the same cell towers used for voice communications, ensuring mobile networking access over a vast infrastructure that covers approximately 200 metropolitan areas.

The practical applications of the two wireless broadband standards—EV-DO and HSDPA—are as varied as the businesses that implement them:

- Sales executives can access vital information from the customer's site without the hassles of trying to connect to their network.
- Construction foremen (or women) can order the building materials their crews need from the job site and then send someone to pick up the order at the store, saving significant time on the project.

According to market research firm Yankee Group, "As mobile operators continue to light up the country with high-speed 3G wireless access, con-

nectivity over wireless cellular networks will become an increasingly popular access solution because of the ubiquity of service and the decreasing price points."

Yankee Group offers three broad categories of mobile workers:

- Mobile professionals: Comprising 46% of total mobile workers, this includes knowledge workers such as consultants, managers and senior executives
- Mobile field force: Salespeople or remote technicians—another 33% of the mobile workforce
- Mobile specialty workers: Physicians, factory staff or couriers, accounting for the remaining 22% of mobile workers

Yankee Group says today's enterprise mobility market is dominated by what it calls the "prosumer"—professional end users who pull devices and services into the organization that they feel will make them successful, often without IT oversight with regard to standards and security.

As companies develop strategic mobility plans, says Yankee Group, they must consider adopting a broad set of technologies and mobile tools to create a "mobility package" that includes integration and coordination among voice, data and remote access services.

The analyst group recommends including embedded-modem notebooks in IT planning today, predicting that notebooks will remain "the most widely used mobile device for the mobile workforce in the near term," and noting that "integration

of mobile broadband is key to enable true mobility.”

The benefits of adopting a standardized wireless mobile broadband option include:

- Maximizing productivity by accessing information and applications remotely at a much higher data transfer rate than with a dial-up modem
- Increasing security of email, contacts and other sensitive information
- Staying in touch and sharing data anywhere without the need for a wireless hotspot

As companies develop strategic mobility plans, they must consider adopting a broad set of technologies and mobile tools to create a “mobility package.”

- Reducing the number of help desk calls from remote employees who are unable to make a connection to the

Internet using conventional methods

- Enabling a single, secure connection for all wireless communications

The first step in justifying an investment in wireless mobile broadband notebooks, says Yankee Group, is to understand the roles of mobile workers and their need to connect to critical information. The technology, the firm says, “untethers mobile workers and creates a truly mobile office, enabling quicker response times to your customers and increased productivity in your workforce.” ▶

Making Sense of the Mobile Broadband Alphabet Soup

Perhaps more than any other sector of technology, that of wireless data is dominated by a multitude of acronyms seemingly designed to make an end user dizzy. The following primer will, hopefully, provide a simple navigation path to understanding mobile wireless broadband.

Broadband wireless technologies are commonly referred to by the generation (G) of their technology:

- **1G**—first-generation, original analog mobile voice networks
- **2G**—second-generation, digital circuit-switched mobile voice and data networks
- **2.5G**—digital technology added to 2G networks, which provides packet-data service and improved data rates
- **3G**—third-generation, high-speed digital mobile voice and data networks

The introduction of 2G networks resulted in two types of multiplexing architectures:

- **CDMA** (Code Division Multiple Access) transmits streams of bits over channels that are divided using codes, which permits several radios to share the same frequencies.
- **TDMA** (Time Division Multiple Access) also allows several radios to share the same frequencies, but by enabling each radio to transmit in rapid succession, each using its own time slot.

In the United States, three competing TDMA standards were deployed: cdmaOne, D-Amps and iDEN. However, in Europe, all networks standardized on a single TDMA technology called GSM, for Global System for Mobile Communications.

Global Packet Radio Service (GPRS) is a 2.5G digital technology that adds packet-data service to the existing 2G network. EDGE (Enhanced Data Rates for Global Evolution) is a software/hardware enhancement for GPRS networks that is designed to provide higher data rates.

3G broadband packet-switched networks provide speeds that can enable a range of features, from mobile email to large file transfers. Two 3G technology standards emerged as the clear choices among mobile network operators:

- **CDMA2000** is the 3G technology chosen by most CDMA mobile network operators to digitally transmit voice and data.
- **WCDMA** (Wideband Code Division Multiple Access, also

known as UMTS) is the 3G technology chosen by most GSM/GPRS mobile operators.

The advent of 3G networks has decreased the fragmentation of network technologies around the world. Today the majority of 3G networks are deployed with either 1xEV-DO (Evolution Data Optimized) or HSDPA (High-Speed Downlink Packet Access), which are based on the CDMA2000 and WCDMA standards, respectively.

CDMA2000 1xEV-DO provides up to 2.4 Mbps downlink and 150 Kbps uplink speeds. 1xEV-DO Rev. A has a somewhat faster downlink and a much faster uplink speed of 1.8 Mbps. 1xEV-DO networks are now widely deployed in North America and in various countries around the world, such as Brazil, Japan and Korea.

HSDPA is a packet-based data service feature of the WCDMA standard, initially introduced at 1.8 Mbps peak downlink data rates and peak uplink currently of 384 Kbps. Some

networks began to support 3.6 Mbps downlink data rates in 2006. HSDPA will evolve with successive improvements in downlink data rates and, with the introduction of High Speed Uplink Packet Access (HSUPA), substantial improvements in uplink data rates and quality of service.

Then there is 4G—fourth-generation—cellular technology. But the acronyms comprising those standards are best left for another day, when we're a little bit closer to implementation. ▀

All stories written by Pete Bartolik, a freelance writer in Hopkinton, Mass.