



Strong Capabilities, Difficult Decisions

WHEN CHOOSING A METHOD OF MOBILE DATA ACCESS, FIRST KNOW YOUR USERS. THEN CHECK OUT OUR ROUNDUP OF SMARTPHONES AND WWAN PC CARDS TO HELP ENSURE A GOOD FIT

BY PETER RYSAVY AND DAVE MOLTA



We had to cram a lot into this article—the devices and platforms we’re evaluating could fill an entire issue. IT pros wading through piles of “marketecture” from carriers looking to provide wireless data access—for a price—can likely relate.

In “Dial M for Maybe” (page 31), we discuss whether mobile users can really enjoy ubiquitous access to enterprise applications and data. Our take: More so than last year, but still less than we’d like. To find out what today’s wireless data networks can—and cannot—do, we evaluated performance of a trio of PC Card modems from Cingular Wireless, Sprint/Nextel and Verizon Wireless on EDGE (Enhanced Data Rates for Global Evolution), CDMA2000 1XRTT and EV-DO (Evolution-Data Only) networks.

We also evaluated the latest crop of smartphones—from Nokia (Nokia 9300 designed for GPRS/EDGE networks), Sprint (Treo 650 running 1XRTT), T-Mobile (RIM BlackBerry 7290 running

GPRS) and Verizon (Samsung i730 running EV-DO, 1XRTT and Wi-Fi)—to determine their strengths and weaknesses in wireless data accessibility. In the case of T-Mobile, Research In Motion supplied the device directly with a T-Mobile account. We could not get our hands on a Windows Mobile 5 device, but we examine upcoming enhancements in “Preview: Windows Mobile 5,” page 51.

PCs vs. Phones

In our reader poll for this article, we asked which cellular data services offer the greatest value for mobile employees. PC Card cellular modems that provide wireless service for notebook users got only 40 percent of the vote, while smartphones with integrated data services received 60 percent.

There’s reason for this smartphone dominance: These phones are quite capable, with computing and networking capabilities exceeding those of early PCs. With fast connectivity from just about anywhere,

they are becoming indispensable tools. And in some cases, they can be used as wireless modems for laptops, getting the best of both worlds. However, no smartphone is perfect. Each excels in different areas, many are more consumer-focused than enterprise IT would like, and choosing among them can be an agonizing process. Integrating smartphones into your enterprise network also can be a complex undertaking, with significant security and management implications. Companies concerned with being able to secure and centrally manage mobile devices will still find laptops a better choice.

E-mail remains the undisputed king of mobile applications, followed closely by calendar and contact synchronization. Indeed, 60 percent of respondents to our poll said they expect smartphones to be used for multiple data applications within two years. We expect many of these hot application areas for smartphones to be more vertical—think salesforce automation, couriers, real estate and instant messag-

HOW WE TESTED WAN PC CARDS AND SMARTPHONES

WAN PC Cards

We took three WWAN (wireless WAN) cards for a test drive around the Syracuse, N.Y., metropolitan area, home to our Syracuse University Real-World Labs®. With a population of 732,000 people, Syracuse is the 59th largest metropolitan area in the United States—second-tier when it comes to cellular data services, though Verizon did add Syracuse to its list of EV-DO-capable metro areas this year. Our primary goal was to evaluate these systems for throughput, latency and overall user experience.

We installed each card in an identically configured Toshiba Satellite notebook computer equipped with a 1200-MHz Celeron processor and 256 MB of RAM running Windows XP Professional. We also loaded the client connection utilities provided by the wireless operators.

To control for location variations, we performed all of our tests in seven different locations around the Syracuse metro area, including Syracuse University, the airport, downtown and in major suburbs where businesses exist. We performed multiple iterations of each test at each location and averaged our results.

To evaluate throughput, we con-

ducted FTP transfers of a 1.67-MB Word document, both upstream and downstream.

To evaluate latency, we performed ping tests on three different Web sites, which included a server in our lab, Yahoo and Google. Because the initial ping requires the radio to shift from dormant to active mode, a process that takes about a second, we performed 11 pings and averaged the results of the last 10.

To provide a sense of performance on a media-rich Web site, we arranged to access an unloaded test version of the www.suathletics.com Web site, which contains 701 KB of content on its home page. Using a stopwatch, we measured the amount of time it took to load the entire page, clearing the browser cache between visits. We also disabled Web acceleration clients, where provided, though we did find that these clients significantly improve performance for typical Web activities.

Smartphones

Our testing measured throughput involved with accessing a specific Web test page, www.dslreports.com/mspeed, that provides a steady 200-KB download size. We tested in

several locations, including a rural site in Idaho, a Los Angeles suburb, and an urban area, Los Angeles International Airport.

For our browser tests, we measured download times for a variety of Web pages, including www.nytimes.com, www.cnn.com and www.rysavv.com. The CNN home page was particularly demanding, at over 200 KBs with some 100 separate objects, and presented our worst-case scenarios of how these devices would handle broadband-oriented Web sites.

To evaluate keyboards, we measured how long it took to type a long sentence. We used these keyboards long enough to get familiar with each of them. In reality, people will adapt to whatever keyboard they use and become more proficient over time.

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ing. Many current mobile applications are enabled by vendors that started in wireless e-mail gateways and are now expanding to support other types of applications (see “BlackBerrys and Treos and iPAQs, Oh My!,” our recent review of mobile messaging gateways, at ID# 1614f2).

SMARTPHONES

To get an overview of smartphone adoption for business applications, we spoke with Cingular and Verizon. Both stressed that they offer a variety of smartphones and said they seek to nurture the ecosystem for each platform type through developer support and close partnerships with wireless middleware vendors and by providing technical assistance to customers in defining their mobile deployment strategies. We’re sure, but we’d also note that carriers are in a position to pressure device manufacturers and discourage certain developments, so it pays to keep an eye on how well your carrier supports new technologies, such as Bluetooth DUN (Dial-Up Networking), richer integration of Wi-Fi and dual-mode VoWi-Fi (voice over Wi-Fi) capabilities. We’re happy to see increased adoption of these advances.

We define smartphones as both devices in a phone form factor that run operating systems like Symbian or Windows Mobile and devices that look and feel more like PDAs. Some in the industry separate these into distinct camps, but there’s sufficient blurring between the two—especially with units like the Nokia 9300 that looks like a phone when closed and a PDA when open—that we think it’s time to group them into a single category.

Network Testing

We tested the data performance of the Nokia 9300, Sprint Treo 650, RIM BlackBerry 7290 and Samsung i730 on the following networks: EDGE from Cingular Wireless, 1XRTT from Sprint and EV-DO from Verizon. We also examined their features and general usability as well as the ability to use them as modems for laptops. To test performance, we measured both throughput and Web page downloads. In throughput tests, Wi-Fi for the i730 scored the highest—no surprise—followed by EV-DO for the i730, then the Nokia 9300, which supports EDGE.

However, results varied significantly from test to test, and by geography and time of day as well. Although Wi-Fi was consistent, EV-

DO ranged from a low of 88 Kbps to a high of 360 Kbps.

The same goes for the 9300, with a low of 51 Kbps and a high of 187 Kbps. This is not surprising given that both EV-DO and EDGE adapt their modulation and error coding based on the quality of the radio signal. Network loading moment by moment is another huge factor. As for throughput with the phone as a modem (available for the Nokia 9300 and Treo 650), we noted speeds similar to the download test on the device itself.

Limitations to Consider

One consideration in using any phone as a modem with Bluetooth is whether the technology might be a limiting factor. In researching this question with the Bluetooth Special Interest Group, we learned that the Bluetooth link should have no problem supporting speeds up to 500 Kbps and should not be a bottleneck for any of the devices we tested.

We did a long series of browser tests, measuring download times for busy Web pages such as www.cnn.com and www.nytimes.com. We also tried simpler Web pages, like www.rysvavy.com. We found considerable variability from test to test due to variations in cellular network throughput. Predictably, the faster the throughput capabilities of the device, the less time it took to render Web pages. However, even with EV-DO on the i730, the CNN page took an average of a minute

FYI

Bearing Fruit: Cingular Wireless and Research in Motion announced last month that BlackBerry Connect will be available on the Nokia 9300 to provide BlackBerry functions for Symbian OS.

to load, and some two minutes with the Nokia 9300 and Treo 650. The Nokia 9300 browser demonstrated good caching, which greatly sped up reload speeds on previously visited sites. We didn't see any caching with the other devices.

To evaluate keyboards, we measured how long it took to type the following sentence: "Shipments of smart handhelds pale in comparison with those of notebooks (roughly 60 million annually) or cell phones (more than 700 million worldwide), but they're growing fast." We found the RIM 7290 easiest to type on, followed by the Nokia 9300, then the Treo 650 and finally the Samsung device.

As for preferred smartphone platform, our reader poll confirmed our gut feeling that through RIM remains the most popular platform, both Palm OS and Windows Mobile have considerable support. Although Symbian rules the smartphone scene in Europe, it has barely any visibility in the United States. Maybe the highly capable Nokia 9300 will help change that. The bottom line on these smartphones is that each one is a miniature workhorse, but one size does not fit all.

Feature Factors

All the smartphones we tested are packed with capabilities and features. Of course, a feature that might be crucial to one user or company might not be of any importance to another. Here are the factors we deem most important in selecting a device.

» **Connectivity.** This is the place to start. All the smartphones tested offer voice and cellular data support. But only the Samsung i730 and Nokia 9300 support cellular 3G data services, and only the Samsung i730 supports Wi-Fi. Speed is not generally a concern for e-mail, but it could be for other applications. All four phones support Bluetooth for some level of hands-free operation and syncing with PCs, but only the Nokia 9300 and the Treo 650 support the Bluetooth DUN profile.

» **Platform.** The dominant operating system platforms are Palm OS, RIM BlackBerry, Symbian and Windows

Mobile. Although all support a rich computing experience on small-form-factor devices, this choice more than any other will determine the scope of available applications. Palm OS and Windows Mobile have the greatest range of available applications, but many also are available for RIM and Symbian. You must do your homework to find out what applications are available for which platform. Look at the vendors' device-specific Web pages, operating system vendor Web pages and application vendor sites.

» **Computing capability.** Devices can readily support their included applications, but does your company depend on a computationally intensive app? Do you need multitasking, for example, downloading data while a user interacts with another application? All the platforms we tested support multithreaded multitasking, with the exception of Palm OS.

» **Memory.** How much data and application memory comes with the device? Is it nonvolatile? How easily can you expand it? The devices we tested varied widely in this area. The Nokia 9300 and Samsung i730 had the greatest amount of available memory.

» **User experience.** Some devices are easier to use than others, and as with any technology, ease of use will directly impact helpdesk calls. The Treo 650 is popular for a reason—practically every aspect of its design, including keyboard, display, location of controls and software interaction, have been refined to provide a pleasant user experience. BlackBerry users also are passionate about their devices. Items that boost the user experience include backlit keyboards, well-placed keys, high screen resolutions, convenient controls and well-designed applications. We liked the BlackBerry and Treo devices, which let us access all common functions using just one hand.

» **Expandability.** Most devices provide an expansion slot, usually SDIO (Secure Digital I/O Card) or MMC (MultiMediaCard). Research In Motion is the exception. Make sure the expansion slot supports the functions you really need. Memory is a given, but Wi-Fi may not be an option.

» **Device management.** If you intend to deploy these devices broadly, it's a must to have management systems that can centrally maintain software configurations and provide security features, such as remotely wiping or disabling devices if they are lost. Only RIM provides a comprehensive management system for its

Smartphone Performance Results

	Nokia 9300	RIM 7290	Samsung i730	Samsung i730	Samsung i730	Treo 650
Network used	Cingular	T-Mobile	Verizon	Verizon	Hotspot	Sprint
Service used	EDGE	GPRS	EV-DO	1X	Wi-Fi	1X
Peak throughput to device (Kbps)¹	187	38	360	112	764	116
Smartphone confirmed to operate as modem	Y	N/A	N/A	N/A	N/A	Y
Browser-rendering rank	2nd fastest	Slowest	Fastest	Not tested	Not tested	3rd fastest
Minutes to type test sentence	1.8	1.7	2.5	N/A	N/A	2.0

Y=Yes, N=No ¹Using www.dslreport.com/mspeed

products. With other devices you may need to add a third-party management system, which can get expensive—\$40 to \$110 per device or user, as we found in our review of these products (see “Herding Highly Mobile Cats,” at ID# 1516f3).

Stay Connected

One recent innovation that's included in all these smartphones is the ability to maintain network connectivity even when the phone is in dormant mode. This is a crucial enabler for push applications like wireless e-mail. Finally, consider extras such as whether the phone has a camera or the ability to play audio files. Real estate pros, for example, will want camera functionality. See “Smartphone Features,” page 46, for information on how the devices stack up in these areas.

The best device for you is dependent on your company's location and unique needs. Our detailed impressions are listed below. In a nutshell, we liked the Nokia 9300's rich user interface, wide screen, large keyboard and separate phone functionality with the unit closed. However, screen updates were slow at times, and the lack of a vibrate option will limit its use in some settings.

The RIM 7290 provides the best overall e-mail experience. It also has a comfortable keyboard and is easy to use and carry, and enterprises should evaluate the included management system. The Samsung i730 shines when it comes to connectivity, with its Wi-Fi and EV-DO support. We also like its large amount of memory.

Last but not least, the Treo 650 provides an excellent user experience and good connectivity options, and its large application base will be a plus for corporate deployments. However, non-multithreaded operation and limited included memory are downfalls.

Nokia 9300 The latest member of the Nokia Communicator series was not available from any operator at testing time (after we completed our testing, Cingular announced it will be selling this phone; general availability is expected next month). Our version came directly from Nokia, provisioned for use on the Cingular network. What distinguishes this product is its clamshell design that provides a phone when closed, but opens to reveal a large display (640x200) and well-spaced keyboard, which addresses the difficulty we had dialing numbers using the other

devices' small keyboards.

The Nokia 9300 is a Symbian device, though it runs a Nokia version of Symbian as part of Nokia's Series 80 platform. This means you can't necessarily run all Symbian applications on this device. However, a rich set of applications is available (see www.forum.nokia.com/catalogs).

We found the device easy to use, thanks to detailed menus and four available soft keys. However, the 9300 was sluggish at times; we waited several seconds for some menus to update. We also wished the device had a vibrate alert option. On the bright side, we liked the display's power-management capabilities. After a time-out period, the screen backlight goes to a dim setting, which is less annoying than other devices, such as the Treo 650, where the display turns off after a short time-out period.

For communications, the Nokia 9300 is an EDGE Class 10 device, capable of handling four time slots for the downlink and two slots for the uplink. Each EDGE time slot has a peak throughput rate of 50 Kbps, making it as fast as PC Card modems on the downlink, but only half as fast on the uplink. Peak downlink throughput rates were close to 190 Kbps



with a good signal. The browser performed well, and our complex Web pages were rendered in a reasonable time frame. The wide screen helps here; it was easier than with the other devices to view complex Web pages because we could often see the full width.

The 9300 is the only device we tested that sports a browser with caching, which dramatically helped when revisiting sites. We also liked Nokia's PC Suite, which gave us complete control of the device from a USB/Bluetooth/IR-connected computer for transferring information and setting up Internet connections.

The 9300 supports ActiveSync for connectivity to Microsoft Exchange and will be one of the first non-RIM devices to include a BlackBerry client. Bottom line, this is a highly capable, well-designed smartphone that's suited for a broad range of business applications.

Nokia 9300, \$299.99. Nokia, (800) 456-5553.
www.nokiausa.com/phones/9300

Research In Motion BlackBerry 7290 RIM pioneered the wireless e-mail device category and thumb-style keyboard and has continued to refine its devices and add to their capabilities. The 7290, in our case provisioned through T-Mobile, is an attrac-

tive, easy-to-use and intuitive device, and with the integrated back-end support for e-mail through the RIM network operations center, it provided by far the best out-of-box e-mail experience.

RIM packages its devices for global use and was the only vendor to provide multiple AC plug adapters for different countries. It also provides four-band support on its GSM model. With the four-band support, you can use the phone both on the two common U.S. mobile phone bands and on the two common Asian and European bands.

From a networking perspective, however, this was the most sluggish device. It supports only GPRS, which is slower than the EDGE, 1XRTT and 1xEV-DO networks used by rivals. The peak speed we measured was 38 Kbps. If your users mainly access e-mail, they may never know what they're missing because e-mail is processed in the background and they receive notifica-



Smartphone Features

	Nokia 9300 (Cingular)	RIM 7290 (T-Mobile)	Samsung i730 (Verizon)	Treo 650 (Sprint)
Cellular connectivity	GSM: 850 MHz, 1.8 GHz, 1.9 GHz, EDGE/GPRS class 10	1xRTT: 850 MHz, 1.9 GHz; GSM version: 850 MHz, 900 MHz, 1.8 GHz, 1.9 GHz, GPRS class B ¹	1xRTT, EV-DO: 850 MHz, 1.9 GHz	1xRTT: 800 MHz, 1.9 GHz, GSM: 850 MHz, 900 MHz, 1.8 GHz, 1.9 GHz, EDGE/GPRS class 10 ²
Wi-Fi	N	N	Y	N
Bluetooth connectivity/DUN support	Y/Y	Y/N	Y/N	Y/Y (with latest firmware—Cingular and Sprint only)
IR	Y	N	Y	Y
OS	Symbian 7.0/Nokia Series 80	RIM proprietary	Windows Mobile 2003 Second Edition	Palm OS 5.4 Garnet
Weight	5.89 oz	4.90 oz	6.44 oz	6.30 oz
Size	5.2x2.01x0.83 in	4.5x2.9x0.9 in	4.49x2.28x0.97 in	4.4x2.3x0.9 in
Keyboard	Clamshell design reveals interior keyboard	Small keys on front of device	Slider design exposes keyboard with small keys	Small keys on front of device
Expansion	Multimedia card	None	SD, SDIO	SD, SDIO
Processor	ARM 9 150 MHz	Not disclosed	Intel PXA 272, 520 MHz	Intel PXA 270, 312 MHz
Multithreaded multitasking	Y	Y	Y	N
Memory	80 MB for user data and applications	32 MB flash memory plus 4 MB SRAM	64 MB RAM, 57 MB available to user; 128 MB ROM, 86 MB available for data	23 MB available to user
Memory, volatile	N	N	Y	N
Battery	Removable Li-ion battery	Removable Li-ion battery	Removable Li-ion battery	Removable Li-ion battery
Display	128x128 front display, 640x200 internal display	240x160	240x320	320x320
Navigation	5-way navigation button front, 5-way joystick internal	Thumb-operated track wheel and ESC key	5-way navigation button, touch screen	5-way navigation button, touch screen
Camera	N	N	N	Y
Speakerphone	Y	N	Y	Y
Vibrate function	N	Y	Y	Y
E-mail client	Internet protocols, BlackBerry client	Internet protocols, Exchange, Lotus Notes/Domino, Novell GroupWise	Internet protocols, ActiveSync	Internet protocols, ActiveSync

Y=Yes, N=No ¹Only GSM version available from T-Mobile. ²Only 1XRTT version available from Sprint.

tion once it's available. However, Web browsing was slower than with other devices we tested, though the browser still performed quite well for us because of optimization that RIM performs on Web content in its network operations center. Speeds will increase significantly with upcoming EDGE and EV-DO versions. Bluetooth support is included primarily for headset use.

There aren't as many applications available for the RIM platform as there are for Palm OS or Windows Mobile, but you're not limited to the applications on the device. Options include third-party Java apps or the ability to push general corporate information over a BlackBerry Enterprise Server using the RIM Mobile Data Service—something RIM told us many enterprise customers are doing.

The device packs 32 MB of flash memory, more than enough for most typical uses, though less than the Nokia 9300 and Samsung i730. There is no means of memory expansion.

The 7290 has no touchscreen, but we liked the very effective thumbwheel that can be clicked to make selections and another button that serves as an escape key. The device also is optimized for one-handed use. The screen is smaller in pixels than the other devices we tested, but this translates to a more compact and lighter device. Companies that buy the BlackBerry Enterprise Server also get an extremely capable management platform for provisioning and managing devices, including features such as disabling lost devices and deleting their contents. Bottom line, the 7290 is our top choice if you're mainly looking for a wireless e-mail and PIM synchronization unit, but don't count it out for other applications as well.

BlackBerry 7290, \$349 but varies with plan. Research In Motion, (519) 888-7465. www.rim.com/products/handhelds/index.shtml

Samsung SCH-i730 The Samsung i730, sold by Verizon, is based on Windows Mobile Pocket PC 2003. It has a clever slide-out keyboard, which allows a nice-size display in a compact unit. The keyboard was narrower than the other devices we tested, and this slowed us down a bit on our typing tests. We found the buttons on the side of the unit frustrating because they were easy to press by accident, and we frequently activated them just by picking up the device.

Samsung includes an extra, high-capacity battery, and the processor, at 520 MHz, is quite powerful for a phone device. We also liked the 128

MB of nonvolatile storage ROM, most of which is available. However, the rest of the memory is volatile, so make sure users keep the unit charged and back up regularly. Nonvolatile-memory support will come with Windows Mobile 5, the successor to this current system (see "Preview: Windows Mobile 5," page 51).

The i730's strongest point is its connectivity. Not only does it support Verizon's 1X service, but also EV-DO and Wi-Fi. We measured fast throughput tests with EV-DO, with a peak rate of 360 Kbps. Wi-Fi performed well, and we had no problem connecting to the Internet at a public hotspot. WPA security is not supported on the phone, possibly limiting its enterprise use. One other important item: With Wi-Fi running, your users cannot make or receive calls, other than emergency calls, which disable the Wi-Fi connection. Bluetooth is available for ActiveSync and for headsets, but Verizon does not support the Bluetooth DUN, so we could not use this phone as a modem.



SCH-i730, \$599.99, but varies with plan. Samsung Electronics, (201) 229-4000. www.samsung.com

PalmOne Treo 650 Our test Treo 650 came from Sprint and works on its 1X network. However, this pop-

ular product is available from all the major carriers except T-Mobile. And it's no wonder: The Treo 650 provides a pleasing blend of capability and ease of use. The Treo 600 was a good product, but the 650 significantly improves on a good thing with its higher-resolution display, improved keyboard, addition of Bluetooth, support for EDGE in GSM versions, removable battery, nonvolatile memory and updated applications.

The Blazer browser was tops at rendering complex Web pages. Versamail, the included e-mail application, has a strong feature set and supports Microsoft ActiveSync, which lets it access Exchange servers, and it was the only e-mail client we tested flexible enough to let us access a particular SMTP server that required a port address change. As for ease of use, we could access nearly all functions with one hand and rarely had to pull out the stylus.

With respect to connectivity, Bluetooth worked well and we were able to use the phone as a modem. Sprint allows this, as does Cingular. However, configuring phones as Bluetooth modems can be an involved process, requiring assistance by IT unless your users can install the latest firmware from the Palm site to get the Bluetooth DUN feature.

The Treo 650 has less available nonvolatile memory than some of the other products we tested. Though not a true multitasking system, the Treo saves application states so that when we returned to an application, it was exactly where we left it. One gripe about Palm OS: There's no escape key for backing out of menus and operations.

The future of Palm OS changed dramatically when PalmSource announced it would not pursue its Palm OS Cobalt strategy (the previous successor version to its current OS 5, aka OS Garnet), and would instead pursue a Linux kernel (see "PalmSource, MontaVista



Team Up On Mobile Linux," at www.linuxpipeline.com/168600327). Presumably, the user interface will stay largely the same.

Treo 650, \$599.99, but varies by plan. Palm, (888) 223-4817, (408) 617-7000. www.palm.com/us/products/smartphones/treo650/

WIRELESS WAN PC CARDS

Smartphones ship with embedded 2.5G or 3G wireless modems, but if you want to enable your notebook users to take advantage of cellular data services, you'll probably have to buy and install a PC Card wireless modem. These cards are produced by Kyocera, Novatel Wireless, Sierra Wireless and Sony/Ericsson, among others. In most cases, consumers buy the cards directly from carriers, often at a subsidized cost in conjunction with a service contract; sometimes carriers offer multiple card choices. Sony offers its T-series notebook with an embedded EDGE modem, while Lenovo and Panasonic offer a model with embedded EV-DO. Meanwhile, Dell and Hewlett-Packard have announced plans to integrate EV-DO into select models of their notebook computers by the end of 2005 or early 2006. But unlike Wi-Fi NICs, which are bundled without additional charge, limited volumes on these cards mean you can expect to pay a significant price premium for notebook models equipped with cellular NICs.

For those who want to use their phones as modems, our testing showed performance almost as good as wireless WAN PC Cards. Compared with the EDGE-capable Treo 650, the Sierra Wireless EDGE PC Card has better latency performance and supports faster uplinks, but downlink throughput is the same. For 1XRTT, we didn't see any difference. As for EV-DO, Bluetooth DUN was not enabled on the

CELLULAR DATA SERVICE VENDORS AT A GLANCE

PUBLIC COMPANIES

Company name	Subscribers Q2 2005	Technology Used Q2 2005	Revenue Q2 2005	Covered PoPS Q2 2005	News
CINGULAR WIRELESS (joint venture of SBC Communications and BellSouth)	51.6 million	AMPS, TDMA, GSM, GPRS, EDGE, UMTS/850, 1900 MHz	\$8.6 billion	286 million	Partnership with Dell will bring HSPDA wireless broadband services to Dell notebook customers in Q1 2006
SPRINT NEXTEL	44.4 million	CDMA, 1x, EV-DO, iDEN/800, 900MHz, 1900 MHz	\$10.9 billion	268 million	Assumes additional debt with \$287 million acquisition of Gulf Coast Wireless earlier this month
T-MOBILE USA (subsidiary of Deutsche Telekom AG)	19.2 million	GSM, GPRS, EDGE/1900 MHz	\$3.6 billion	232 million	Received No. 1 ranking in J.D. Power and Associates wireless customer care study in June
VERIZON WIRELESS (joint venture of Verizon Communications and Vodafone)	47.4 million	CDMA, 1x, EV-DO/850, 1900 MHz	\$7.8 billion	246 million	Parent company moved closer to acquisition of MCI when shareholders voted for merger on Oct. 6

Source: Company reports

Samsung i730, so we couldn't compare. Bottom line, you'll find the best performance with PC Cards (or future embedded modems), but for companies that want to combine accounts and devices, tethered performance is good enough for many usages.

Some carriers aren't too excited about enabling Bluetooth DUN because they often price their smartphone data plans below those for notebook computers and they're worried about customers beating the system. Given the ugliness associated with configuring notebooks and smartphones for Bluetooth DUN, we're not sure how many users would care to go this route, but for IT organizations willing to preprovision devices, it could be a concern.

We tested three WWAN cards provided by three different wireless operators. Cingular sent us the Sierra Wireless AirCard 775, which we tested on its EDGE network. Sprint provided the Sierra Wireless AirCard 580, which we tested mainly on its CDMA2000 1XRTT network. Finally, Verizon shipped the Novatel Wireless V620, which we tested on its EV-DO network. T-Mobile supported only GPRS at testing time, so we didn't test on its network. T-Mobile now offers EDGE services on 90 percent of its network.

We put these WWAN cards to work in and around our Syracuse University Real-World Labs® to evaluate them for throughput, latency and overall user experience (for more testing details, see "How We Tested WAN PC Cards and Smartphones" on page 42). Our primary goal was to provide a comparative assessment of 3G technologies rather than the carrier networks, which vary from area to area. Although we weren't able to test Sprint's new EV-DO service in Syracuse, we did ship a card to a colleague in the Washington, D.C., area. Sprint's EV-DO throughput there was about 20 percent less than what we experienced on Verizon's EV-DO network in Syracuse. Our evaluation provides real-world tests of the three most commonly used cellular data services: EDGE, CDMA2000 1XRTT, and CDMA2000 EV-DO.

Independent field measurements for HSDPA (High-Speed Downlink Packet Access) are not yet available, but various operators and vendors have disclosed preliminary information. For example, in August, Vodafone Italy and Nokia announced HSDPA test results of 1.5-Mbps peak throughput. Actual downstream throughput for first-generation HSDPA networks is expected to be somewhere between 550 Kbps and 800 Kbps.

Test results for EDGE and EV-DO were generally consistent with our expectations, but 1x performance was less than we anticipated, though still within Sprint's advertised performance range. Verizon's EV-DO service offered the best average downstream throughput (589 Kbps), followed by EDGE (119 Kbps) and 1XRTT (69 Kbps). Upstream, EV-DO (97 Kbps) and EDGE (95 Kbps) were roughly comparable, followed by 1XRTT (66 Kbps). For latency, EV-DO turned in an average of 242 ms, followed by EDGE at 457 ms and 1XRTT at 503 Kbps. All latency numbers are quite high when compared with typical WLAN connections and have a detrimental effect on the perceived quality of network connections, so be sure to educate end users about what to expect.

Most WWAN cards are configured as dial-up networking adapters and use Connection Manager utilities provided by the carriers to initiate connections, either manually or automatically. Novatel also supports a native NDIS (Network Driver Interface Specification) driver interface to provide a more LAN-like experience, and Sierra Wireless offers automated connection tools for its cards that deliver a similar user experience. All of the carriers support Web acceleration technology. Although we did not systematically evaluate these tools, our impression was that they deliver an enhanced user experience, albeit at the expense of graphics resolution on Web images.

For our content-rich Web-page tests, EV-DO loaded the page in 21 seconds, besting EDGE at 75 seconds and 1XRTT at 90 seconds. For comparison, we saw an average load time of 4.5 seconds on the Syracuse Uni-

PREVIEW: WINDOWS MOBILE 5

We couldn't obtain a Windows Mobile 5 device, but this system was close enough to being available in new smartphones that we wanted to report on some imminent enhancements.

We interviewed John Starkweather, group product manager in the Mobile and Embedded Devices division at Microsoft. Starkweather says important features of Windows Mobile 5 include client support for close coupling with Exchange Server 2003 Ser-

vice Pack 2 for an enhanced push e-mail experience (see www.nwc.com/showitem.jhtml?articleID=165701547&pgno=11), nonvolatile memory, an improved browser and the ability to flip between landscape and portrait modes on all devices.

He adds that Microsoft intends to continue supporting both smartphone (single-handed, no stylus) and PDA (two-handed, stylus-oriented) form factors, but Windows Mobile 5 will offer greater code

compatibility between the two platforms, making it more likely that the applications will run across both.

Other improvements include support for USB 2.0, hard drives and enhanced multimedia support. Some newer Windows Mobile devices based on Pocket PC 2003 will be upgradable to Windows Mobile 5, but this will vary by vendor. We were unable to confirm whether the Samsung i730 would be upgradable to Windows Mobile 5.

versity wireless network using an 802.11b connection on the same notebook computer.

Cingular Wireless EDGE, GSM/GPRS

Card: Sierra Wireless AirCard 775; Carrier: Cingular Wireless; Access Method: EDGE, GSM/GPRS

Cingular Wireless now offers EDGE services across its U.S. network, providing a significant improvement

over its earlier-generation GPRS service. We tested the Cingular network using a Sierra Wireless AirCard 775. This PCMCIA card is broadly supported on all Microsoft Windows desktop platforms from Windows 98 to the present.

After installing Cingular's Communication Manager application, we were able to manage both our EDGE and Wi-Fi connections. Cingular's utility also provides

Wireless WAN PC Card Performance

Service/site	Standart Street	Museum, Downtown	South Bay, Airport	Tully's Liverpool	Fayetteville	North Syracuse	East Syracuse	Average	Minimum	Maxium
Latency Test (in milliseconds)										
EV-DO¹										
Signal	3 bars	3 bars	3 bars	3 bars	3 bars	3 bars	3 bars			
cent.nwc.com	198	235	537	182	356	188	170	267	170	537
yahoo.com	154	201	271	165	175	246	243	208	154	271
google.com	160	N/A	457	213	266	237	188	254	160	457
Average								243		
1XRTT²										
Signal	-73 dBm	-76 dBm	-92 dBm	-86 dBm	-64 dBm	-97 dBm	-72 dBm			
cent.nwc.com	498	494	619	550	452	529	583	532	452	619
yahoo.com	488	490	466	487	430	535	506	486	430	535
google.com	534	539	451	502	437	487	482	490	437	539
Average								503		
EDGE³										
Signal	-74 dBm	-70 dBm	-82 dBm	-86 dBm	-74 dBm	-60 dBm	-47 dBm			
cent.nwc.com	370	383	736	649	474	322	327	466	322	736
yahoo.com	354	352	591	849	298	306	349	443	298	849
google.com	349	336	861	499	469	357	374	464	336	861
Average								457		
FTP/Upload Speed (in Kbps)										
EV-DO¹										
cent.nwc.com	118	107	111	100	47	106	90	97	47	118
1XRTT²										
cent.nwc.com	115	Test failed ⁵	Test failed ⁵	Test failed ⁵	48	65	37	66	37	115
EDGE³										
cent.nwc.com	98	118	49	Test failed ⁵	99	100	106	95	49	118
Wi-Fi⁴										
802.11b								3,881		
FTP/Download Speed (in Kbps)										
EV-DO¹										
cent.nwc.com	565	658	710	495	175	762	762	589	175	762
1XRTT²										
cent.nwc.com	120	Test failed ⁶	Test failed ⁶	Test failed ⁶	52	56	48	69	48	120
EDGE³										
cent.nwc.com	154	162	75	71	122	118	134	119	71	162
Wi-Fi⁴										
802.11b								4,291		
Loading of Webpage (http://suathletics.internetconsult.com, in seconds)										
EV-DO¹										
	13	13	15	19	65	12	12	21	12	65
1XRTT²										
	63	110	97	104	86	95	76	90	63	110
EDGE³										
	58	56	71	163	63	60	54	75	54	163
Wi-Fi⁴ 802.11b										
								4		

¹EV-DO testing performed using Verizon's network.

²1XRTT testing performed using Sprint's network.

³EDGE testing performed using Cingular's network.

⁴Wi-Fi testing performed on moderately loaded Syracuse University AirOrange Wi-Fi network.

⁵While uploading a file using FTP in Sprint, the transfer failed. The test was repeated several times and was unsuccessful.

⁶While downloading a file using FTP in Sprint, the transfer failed. The test was repeated several times and was unsuccessful.

access to SMS (Short Message Service) messaging. Cingular has bundled the ByteMobile Acceleration Client with this product, which let us optimize performance by dynamically reducing image quality.

Although the Cingular Communication Manager is aware of both WWAN and Wi-Fi interfaces, it didn't let us easily roam between networks. Instead, we were notified when we came within Wi-Fi coverage, at which point we could switch to a Wi-Fi network manually, provided we had defined appropriate security credentials within Windows. However, the WWAN connection was maintained until we manually disconnected it.

Cingular Wireless offers several pricing plans. The unlimited access plan runs \$59.99 per month. More budget-conscious options include the \$49.99-per-month plan for 50 MB, \$39.99 per month for 20 MB, \$29.99 per month for 10 MB and \$19.99 per month for 5 MB of data.

Sprint 1XRTT

Card: Sierra Wireless AirCard 580; Carrier: Sprint Wireless; Access Method: CDMA/CDMA 2000 (EV-DO/1XRTT)

Sprint launched its EV-DO network in July and currently offers service in 75 metro areas. We tested a Sierra Wireless AirCard 580 provided by Sprint that supports EV-DO and 1XRTT networks, but because EV-DO service is not yet available in Syracuse, the bulk of our testing focused on its 1XRTT service. We performed a subset of our tests on Sprint's network in Washington, D.C. The AirCard 580 supports Windows 2000 and Windows XP.

Like the other cards we tested, the AirCard 580 functions as a dial-up modem, which means that we could use the Windows Dial-Up Networking utilities to manage connections. However, Sprint provides the Sprint PCS Connection Manager, its client utility designed to facilitate connections to Sprint's WWAN services. Sprint's utility is solely focused on this task and does not include the ability to manage Wi-Fi connections, like the others we tested. Sprint supports WWAN optimization using the Bytemobile accelerator.

We found significant variability in 1x performance on Sprint's network. In some locations we experienced throughput of approximately 120 Kbps, while in other places we got about half that number, a result that illustrates the trade-offs carriers face when allocating limited resources between voice and data users. In addition, some large FTP file transfers timed out before completion. We suspect these performance issues are capacity-related, but Sprint couldn't provide a technical explanation. It did note that our overall performance results fell within its advertised performance range.

Sprint Wireless offers several pricing plans. Unlimited access runs \$79.99 per month, discounted to \$59.99

if you also have a Sprint voice plan. Another option includes the \$39.99-per-month plan for 40 MB of data.

Verizon Wireless EV-DO

Card: Novatel Wireless V620; Carrier: Verizon Wireless; Access Method: CDMA/EV-DO

Verizon Wireless is in the process of rolling out its nationwide EV-DO network as part of its Broadband-Access WWAN offering. Mobile professionals who want to access this EV-DO network have multiple PC Card options. Verizon sent us the Novatel Wireless V620 card, which supports EV-DO and is backward-compatible with CDMA-2000 1XRTT. The Novatel product is designed to work on all Windows desktop platforms from Windows 98 on.

Like the Sierra Wireless cards we received from Sprint and Cingular, the Novatel card functions as a dial-up modem, but it also can be configured as an NDIS network device, as long as you use drivers provided by Novatel.

We used the client utility provided by Verizon—VZAccess Manager—to connect to its EV-DO network. The utility offers a number of useful features. For example, VZAccess Manager is designed to manage both WWAN and WLAN connections, which let us effectively choose the best connectivity option. When we were connected to the EV-DO WWAN and came within range of a Wi-Fi network, the application notified us that a WLAN connection was available via a popup on the Windows task bar. If we switched to WiFi, the utility prompted us to disconnect from the WWAN. In addition, VZAccess Manager gave us WWAN usage statistics that let us track cumulative connection activity, an important feature for those not on an unlimited data plan. The VZAccess Manager also provides access to SMS messaging services and quick-launch features for regularly accessed applications, including VPN software.

Verizon has bundled the Venturi Wireless compression and optimization client with the VZAccess Manager. This client, which can be configured in the VZAccess Manager, provides several settings for optimizing WLAN connections, based on a chosen image quality.

Verizon's BroadbandAccess WWAN service comes in several flavors. The unlimited data plan runs \$59.99 per month. **NWC**



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