

On The Horizon: 3G: The New Generation of Wireless

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Introduction

In the beginning, there was first generation wireless. Not cool by today's standards, it was wireless' equivalent to the long-playing record album, namely analog in nature. Like LPs, it's now hard to find. There are reports 1G is still found in some rural areas, but no right thinking IT manager uses it.

Just as the compact disc followed the LP, 2G wireless followed first generation, and it was digital. That's cool, as every teenager can tell you. Of course, never experienced analog anything. Today, 2G is well entrenched, and virtually all those folks you see walking or driving with a phone seemingly attached to their ear are enjoying the benefits of digital wireless technology.

We are now on the cusp of the next greatest thing. Well, sort of. We're moving towards 3G wireless, but are making a stopover in 2.5G land. In fact, in some ways we're taking a wait-and-see attitude, with not much happening in the short term. Seems that moving directly to the third generation is a stretch for the technology, the infrastructure and probably the market. That's caused confusion and skepticism. Naysayers abound, wondering when we'll ever see 3G and, when it comes, if the wait was worth it.

In this program, we will look at where we are today, wirelessly, and where we are going. Third generation, or 3G as it is commonly called, is the goal, but getting there is not a straight and narrow path. We will be looking at the detours involved in getting to 3G and provide an idea of what to expect when we finally arrive.

The name of our program is, "On The Horizon: 3G: The New Generation of Wireless," which sums up the scope of what we want to cover today. We have developed this program for IT managers, with the goal of providing a good grasp of what the technology is and when we are likely to have it in hand.

The program will cover the wireless technology we now have, the technology we are moving towards, the time line we are likely to follow and the benefits and downsides of future wireless technology.

By watching this program, you will learn about the most important aspects of wireless technology, especially 3G. We have gone to the most reputable sources for our information. Dozens of articles, books, white papers and other materials were researched, and we spoke to leaders in the field. You will hear from Mike Walters, 3G Business Development Manager at the international telecom company, Nokia. You will also hear from XXXX.

The Market

The wireless industry is expected to experience dramatic growth during this decade. Wireless

data users, who numbered an estimated 200 million or so in 2001, are expected to reach 1 billion by 2005, according to statistics developed by The ARC Group, as published by the CDMA Development Group. Worldwide wireless subscribers, of which there were a bit more than 800 million in 2001, will just about double to 1.6 billion in 2001, says EMC Database in data also published by the CDMA Development Group.

The research company Ovum says that penetration for mobile data reached about 5 percent in 2001, and it expects penetration to grow to 90 percent of the population by 2011. In fact, it says, penetration of devices could, quote, easily surpass 100 percent as machine-to-machine interfaces are developed and as mobile communication is designed for automobiles, refrigerators and other household appliances and devices, end quote.

The research firm IDC predicted in late 2001 that the number of U.S. wireless subscribers will increase from 5 million in 2000 to 84 million in 2005, for a compound annual growth rate of 73 percent. Of the subscribers in 2000, about 52 percent, or 2.6 million, were business users. Business' share of the market is expected to grow to 58 percent or 49 million users by 2005

In a survey done for the newsletter Wireless Outlook, which is published jointly by Forbes and Andrew Seybold, it was found that two-thirds of the IT professionals from larger companies who were surveyed indicated that at least a portion of their budget has been earmarked for wireless deployment. Almost one-third of all those surveyed stated that the IT/MIS department was leading the charge toward wireless implementations in their organizations. Five percent said that between 40 and 60 percent of their entire IT budget is earmarked for wireless data solutions, 12.5 percent said 20 to 40 percent, and 67 percent indicated from 1 to 19 percent is budgeted for wireless,. Only 15 percent were not placing any of their budget into wireless technologies.

The UMTS Forum predicts that worldwide, 3G subscribers in 2010 will be 28 percent of all mobile subscribers, and that 3G revenues will top \$320 billion that year. Non-voice service revenues will dominate voice revenues by 2004 and comprise 66 percent of 3G service revenues by 2010, says the Forum. In 2010, subscribers using a 3G device will generate almost \$88 billion in revenues from simple voice services, compared to \$233 billion for all other services.

What we see is that 3G wireless, which today is essentially non-existent market, is expected to grow dramatically during the next three or four years, and come to be a dominant force in wireless for much of the first decade of the twenty-first century.

Mike Walter sees not just the continued deployment of wireless, but a change in how it is used.

WALTERS: What's happening today is actually the first step to 3G, that is, we're seeing GPRS being implemented, as well as networks are being expanded more into the IT realm. In the past, cellular has been more of a traditional telecom network, the same thing you have in wireline networks only we have the wireless infrastructure as well. What we're seeing now is the implementation of more and more along the lines of an IP infrastructure. This infrastructure is allowing us to build a bridge between the cellular network and the Internet

END WALTERS

What It Is

Before we go further let's define what we're talking about when we say 3G or 2.5G or 2G. The 2G network which is used by virtually all American wireless users, is circuit-switched, which means each call gets its own, dedicated circuit, whether the call involves someone speaking or transferring data. The circuit cannot be used by anyone else while the connection is in place, even if no one is talking or no data is being transmitted.

2G in the United States comes in several flavors. One is GSM, which stands for Global System for Mobile Communications. This is a standard used by most of the world including all of Europe. It has a limited share of the U.S. market and is offered by VoiceStream, and in limited areas, by AT&T Wireless and Cingular Wireless. Another widely used standard in the U.S. is TDMA, which is the acronym for Time Division Multiple Access, and used by AT&T Wireless. Nextel offers a variant of TDMA, developed by Motorola, called iDEN, which is optimized for data. The other standard is CDMA or Code Division Multiple Access, offered by Sprint PCS and Verizon Wireless. According to EMC Database, as of June 2001, GSM had 7 percent of the market in the Americas, CDMA had 30 percent, TDMA had 39 percent, with the remaining market shared by other technologies.

No matter the technology, 2G networks transmit data at between 9.6Kbps and 14.4Kbps.

What is 3G? Third-generation became a goal in 1992, when an international study group related to the industry-standards setting organization, ITU or International Telecommunications Union, predicted that mobile phones would rival fixed lines within 10 years, a prediction that largely proved true. The ITU began a project aimed at uniting the world under a single wireless standard, which became known as IMT-2000, or International Mobile Telecommunications, with an implementation target date of 2000, which didn't happen.

The standard covered both mobile and stationary wireless networks, and was motivated by the belief that basing all types of wireless services on a single standard would allow users to get by carrying only one device and benefitting vendors who could develop components that were usable in various devices and technologies. It hasn't quite worked out that way for various reasons, including the fact that fixed wireless systems work at their optimum at much higher frequencies than mobile systems.

Today, what constitutes 3G is open to some debate. The ITU has set the following benchmarks which all 3G systems are supposed to meet: in highly mobile situations, such as when a user is in a car, transmission is targeted at 144kbps; in low mobility situations, such as a pedestrian en route, the transmission speed is to reach 384kbps; and in a stationary, untethered situation, the target speed is 2Mbps. This makes 3G, at least in theory, much, much faster than 2G -- 10, 20, even 100 times faster.

These speeds were not chosen from virtual outer space. The 144kbps is the same speed as a B-rate ISDN line which can be deployed over ordinary phone lines and is widely used in some European countries. 384kbps corresponds to an H-rate ISDN line, often used for video conferencing and was considered the minimum speed needed for picture quality similar to that of television. 2Mbps is the same as the speed of a European P-rate ISDN line, which is usually a

fiber optic cable carrying up to 30 separate phone lines.

Another defining characteristic of 3G is that it is packet-switched. This technology sends bits of information, whether voice, text or data, as packets which share the pipeline with packets from other calls or connections. This sharing of channels is more efficient than having dedicated, one-user-at-a-time channels, as happens with a circuit-switched network. Efficiency is increased two to eight times. The concept is similar to Digital Subscriber Line or DSL connections, where you can be transmitting or receiving data and talking on the phone at the same time on the same line.

Why bother with 3G? Its promised benefits include:

- . Permitting use of high-speed applications, which are not now possible
- . Full graphic Web browsing
- . Increased capacity available to cellular operators
- . Supporting Internet Protocol or IP, and real-time video
- . Voice quality equal that of fixed-line service
- . Voicemail and e-mail eventually integrated through computerized voice recognition
- . E-mail that includes attachments
- . Always-on service
- . Such functions as collaborative working and games become possible
- . Multimedia, including high-definition video and CD-quality audio on demand
- . Location-based applications

Computer Reseller News on December 10, 2001, reported, and I quote, 3G opens up a huge raft of new application areas which can be exploited for business purposes. It will offer always-on connectivity at speeds up to 2Mbps, making the integration of voice, data and video a realistic option for mobile users, end quote.

Charles Levine, president of Sprint PCS, gave a keynote speech in June 2001 at the 3G World Congress held in Hong Kong. There he cited some statistics on what business customers want and receive from 3G. The top five functions business customers want are: company e-mail, intranet access, electronic newsletters, order status, and network applications. What business customers will get, he noted, includes e-mail with attachments, high speed intranet and Internet access, video and audio streaming, digital imaging and on-demand conferencing.

Mike believes that while there a variety of benefits from 3G, it's basic benefit is quite straight forward:

WALTERS: The true difference between what we have today and third generation is not so much the introduction of new applications and capabilities, the difference is capacity. What we're doing now is we're expanding the capability of what we can do on a wireless connection.
END WALTERS

Getting to 3G, though, isn't a non-stop flight from 2G, but involves some layovers, which the industry, not with great imagination, calls 2.5G. One thing both 2.5G and 3G have in common is they are packet-switched networks.

Wireless carriers are taking one of two paths to get to 3G. One is based on GSM and is called Wideband CDMA or WCDMA. In Europe, this standard is called UMTS for Universal Mobile Telecommunications System. The second is CDMA based and is called CDMA2000. WCDMA and CDMA2000 are true 3G technologies. Generally, the path carriers are taking to 3G depends on where they are today in 2G. Those using GSM are migrating to 3G via the WCDMA route, while those using CDMA are heading towards CDMA2000. Users of TDMA are generally moving towards WCDMA.

However, rather than going straight to 3G, carriers are stopping off at 2.5G. TDMA carriers on their way to WCDMA have a way station at General Packet Radio Service, or GPRS, which is already available through AT&T. Observers say the speed of GPRS is between 20Kbps and 40Kbps which, not surprisingly, is faster than 2G but slower than 3G. Like a supercharger on a car engine, GPRS can get a boost up to between 64Kbps and 100Kbps via another interim technology known as Enhanced Data Rates for Global Evolution or EDGE. Remember that 3G has a maximum of speed of 2Mbps, at least in theory.

One of the reasons for these stopovers is that WCDMA requires considerably more spectrum than 2G. Europe has set aside spectrum for 3G. So excited were the carriers by 3G's prospects that they spent upwards of \$100 billion for licenses for this spectrum, with about half that just for spectrum in Germany. There is now some buyer's remorse, and observers are wondering if the carriers will ever earn back the money they've committed to buying spectrum. In the U.S., the FCC has not yet mandated any spectrum specifically for 3G.

Another reason for the existence of 2.5G is that operators can use software upgrades and not have to invest as much as with 3G, says one analyst.

The route to CDMA2000 is likely to be a bit easier than to WCDMA because of the spectrum issue. CDMA2000 doesn't need as much spectrum as WCDMA. In fact, WCDMA is a real spectrum hog. Its 5MHz spectrum requirement is four times that of CDMA2000's 1.25MHz and 25 times that of GSM, the standard now widely used around the world. Nextel is aiming towards CDMA2000, in part, because of its more efficient use of spectrum.

The journey from CDMA to CDMA2000 has a stop called CDMA2000 1XRTT. One analyst says 1XRTT is likely to give a user speed of 50Kbps to 60Kbps. That's a bit faster than WCDMA's intermediate step, GPRS, but not quite as fast as EDGE. Because it is faster than GPRS, some claim that CDMA2000 is 3G, while GPRS is merely 2.5G. Neither are true 3G, at least if you define 3G as having the speeds specified by the ITU. CDMA2000 will really not be at true 3G speeds until it reaches a technology called CDMA2000 1XEVD0. This has a top speed of 2.4Mbps (that's actually more than the specified 3G top speed of 2Mbps), but will transmit only data at this speed. 1XRTT technology will still be relied on to carry voice.

Levine of Sprint PCS, in his presentation to the 3G World Congress, gave the following capital cost figures for upgrading 2G to 3G. Using numbers supplied by Sprint PCS, the cost to CDMA users to upgrade to 3G is less than 10 percent of the cost of 2G network. Using figures supplied by the Yankee Group, he says that upgrading from TDMA and GSM to GPRS will be 28 percent

of the cost of the 2G network, while an EDGE upgrade will equal 51 percent of 2G costs and WCDMA will be 90 percent of the cost of 2G.

Timetable

The timetable for deployment of 3G is less than clear, which is putting it mildly. Telefonica of Spain initially expected to launch a WCDMA-based UMTS system in 2001, only to announce in February of that year that, as quoted by Ovum, mobile handsets of sufficient quality are unlikely to be widely available before 2003, end quote. Britain's Vodafone in November 2001 said that it would wait until early 2003 before full commercial rollout of 3G, citing fears that dual-mode handsets able to handle calls from 2G and 3G networks would not be available in sufficient numbers. South Korea is often cited as the first place 3G has been deployed (it happened in 2001), but its services only go up to 144Kbps. That meets the minimum speed of 3G, but not its full potential.

In late October 2001, Cingular Wireless of the U.S. announced what it calls 3G, which it defines as the EDGE technology. Writing for NewsFactor Network, Jay Wrolstad says, and I quote, the always-on packet data technology offers data transmission speeds of up to 384Kbps, which Cingular said is fast enough to support full-motion video and other 3G services, such as high-speed Internet access, end quote.

Confused? Cingular is saying that EDGE, with a top speed of 384Kbps is 3G because it can support full-motion video and high-speed Internet access, yet the ITU says 3G is supposed to have a top speed of 2Mkps, over five times faster than what Cingular is offering.

Not only that, but the speeds promised by 3G may be more smoke-and-mirrors than reality, at least initially. *Computerworld* magazine in April 2001 reported that though the carriers were boasting they'd have raw speeds for 3G networks starting at 144Kbps in year 2001, and will reach 2Mbps to 3Mbps in the 2004 time frame, tests were proving otherwise. On its 144Kbps service, Verizon found that throughput averaged on 50Kbps. The magazine warned its readers that users should expect speeds of 50 to 70Kbps on 144Kbps networks, and 500 to 600Kbps on 2.4Mbps networks. These are speeds about one-fourth to one-half of those promised. Why the difference? It seems that the promised speeds are achieved under only optimum conditions. Distance from a cell tower, the type of application and network load all affect speeds, too. Plus, the top speeds will only be obtained by fixed not mobile users.

It's no wonder that 3G has gotten a bad rap. It has been promised since 1992. Its initial implementation date was 2000, and yet it hasn't reached the market. Speeds, at least initially, will likely be nowhere near those promised -- though still considerably faster than 2G. Add to this the fact that market players are making claims for having 3G for technology that doesn't fully even meet the specifications of 3G. It's no wonder there's much user skepticism and confusion.

In the May 7, 2001 issue of *Information Week*, Matthew G. Nelson wrote, and I quote, exactly when 3G will emerge as a viable wireless networking option is in question and depends on several factors. Its biggest champions -- the telecommunications and wireless carriers -- have put the brakes on deployment for a number of reasons, including unresolved standards, delayed

spectrum auctions, and skepticism that the carriers won't recoup the hundreds of million of dollars it'll take to build a nationwide 3G wireless infrastructure.

He continues by saying that, according to analysts, the best-case scenario is that 3G services will become available in 2004 -- three years behind schedule. In 2000, he notes, industry experts were predicting these services would hit the market by the end of 2001. It didn't happen. Nelson quotes Bob Egan, vice president and research director for mobile wireless at Gartner as saying, and I quote, for 3G to see momentum, at least 50 percent of the population has to have access to 75 percent of the services, and at least 5 percent of the market has to have the handsets. By that definition, 3G won't be available until 2004 to 2005 at the earliest, end quote.

That said, 3G is coming, there's not much question about it. When and in what form is a bit ambiguous at this time, but not its eventual deployment. As for a strategy regarding 3G, IT managers have to sit and wait. Of course, they can't do anything until the technology is available to them, and 3G is not likely to be widely deployed until 2004 at the earliest. For many, it will make more sense to invest in 2G and 2.5G now, and gain the benefits of mobile communications and, in the case of 2.5G, relatively high bandwidth. Then wait until the 3G technology matures and carriers are able to deliver what 3G promises.

Here's Mike's recommendation to IT managers:

WALTERS: 3G isn't going to happen overnight. The best you can do is not get caught off guard. Being informed is the biggest thing you can do right now, and see how the technology -- and the market -- evolves.

END WALTERS

Dave Molta, writing in *Network Computing* in December 2001, commented, and I quote, wireless networking is a lot like rocket science. Both are sexy. Both depend on the magic of physics. Both have the profound potential to change the world in which we live. If pressed to identify the key difference, we'd probably say that rocket science is a little easier to get right.