



2G and 3G cellular networks: Their impact on today's enterprise mobility solutions...and future mobility strategies



EXECUTIVE SUMMARY

Third generation (3G) cellular networks have arrived... but what does that mean for your enterprise mobility solutions? Do you need to be concerned today with the expense of upgrading your mobile devices to support 3G? If not, when should that migration factor into your IT plans, and how should it affect plans for new and future mobility solutions?

This white paper will help enterprises better understand 2G and 3G technologies and their impact on existing and new WWAN-based mobility solutions.

Background: understanding the key differences in the network generations

To understand what 3G means for your specific business and mobility applications, you'll need a basic understanding of the different networks — and their state of development. The first generation of cellular networks, known as 1G, consisted of analog systems capable of carrying only voice. These first mobile phone systems were in use from the late 1970s through to the 1980s, and were just recently 'retired'.

In the 1990's, the second generation (2G) networks were launched — including GSM, PCS, iDEN, TDMA and CDMA. 2G networks replaced the analog processing of the 1G networks with digital processing, enabling the wireless transmission of voice as well as data. The 2G digital cellular networks expanded on the voice-only services of 1G networks, enabling a variety of new features such as push-to-talk, short messaging service (SMS), conference calling, caller ID, voicemail and simple data applications like email messaging and Web browsing. These networks are still in existence today, providing voice service to the majority of today's cell phone users.

To address the world's 'need for speed', carriers continued to develop 2G networks, giving birth to an interim generation of cellular networks with a significant increase in bandwidth over 2G networks — the 2.5G networks. Where 2G networks typically provide speeds of 10 to 20 Kbps, 2.5G networks deliver data at typical dial-up speeds, from 30 to 90 Kbps¹ — three or more times the effective speed of 2G networks. The throughput of 2.5G networks provides the bandwidth needed to support a wide range of new applications, including faxing, large email messages, efficient Web browsing, maps for real-time navigation and basic multimedia. Today's 2.5G networks represent the most robust network

offering that is also widely available. It is this generation of networks that provides support for many enterprise workers out in the field today, from sales and field service personnel to delivery drivers, postal workers, government inspectors and more.

In addition, further enhancements to 2.5G networks are anticipated in the near future, with a significant increase in speed. These '2.75G' networks include a future upgrade to the EDGE network, dubbed EGPRS², which is projected to double the speed of the 2.5G EDGE network — though operation on this network may require new handsets.²

The 3G networks are the next step in the quest for speed, increasing bandwidth to DSL speeds, with a range of 144 Kbps to 2+ Mbps¹. As a result, 3G can provide support for more demanding multimedia applications, such as video conferencing, Voice-over-IP (VoIP), full motion video and streaming music (for example, to support television programming and satellite radio), while also offering faster Web browsing and faster file downloads.

We're already reaching beyond 3G speeds to 3.5G with HSDPA (High Speed Downlink Packet Access). With speeds up to 14.4 Mbps¹ — four to five times that of most 3G networks — HSDPA provides a substantial increase in bandwidth, providing a dramatic performance improvement for on-demand video, video conferencing, Web browsing and graphics-intensive websites.

One note on 3G networks: while coverage is available today, it is not yet ubiquitous — carriers are still in the process of building out the infrastructure. When 3G subscribers roam out of 3G network coverage, service returns to the 2G/2.5G networks.

4G looms in the future, and includes LTE, UMB and potentially Wi-MAX. 4G networks are defined as networks that will offer speeds from 100 Mbps to 1 Gbps, providing robust performance for the most bandwidth intensive applications, such as high-quality streaming video¹.

1: CNET's Quick Guide: 3G cell phone service; http://reviews.cnet.com/4520-11288_7-5664933-2.html?tag=lnav

2: Press Release; 03/07/08; Nokia Siemens Networks double EDGE data speed; http://www.nokiasiemensnetworks.com/global/Press/Press+releases/news-archive/Nokia_Siemens_Networks_doubles_EDGE_data_speed.htm

The Cellular Network Generations

The following chart provides a high level look of the evolution of the cellular networks. Note that this chart reflects maximum potential data rates; actual user experience is lower. All networks listed in this chart are not deployed as of the release of this paper.

Specifications	Protocol	Maximum Speed	Features
1G analog networks	AMPS	N/A	<ul style="list-style-type: none"> Voice service only (analog) No data service
	DataTAC		
	FDMA		
	Mobitex		
	NMT		
	TACS		
2G	CDMA	Up to 20Kbps	<ul style="list-style-type: none"> Digital voice service Push-to-Talk (PTT) Short Message Service (SMS) Conference calling Caller ID Voice mail Simple data applications such as email and Web browsing
	GSM		
	iDEN		
	PCS		
	TDMA		
2.5G	CDMA2000 1xRTT	Up to 144Kbps (typical 60-80Kbps)	All 2G features plus: <ul style="list-style-type: none"> MMS (Multimedia Message Service) Web browsing Real-time location-based services such as directions Basic multimedia, including support for short audio and video clips, games and images
	GPRS	Up to 114Kbps (30-40Kbps)	
	HSCSD	Up to 64Kbps	
	EDGE	Up to 384Kbps	
	WiDEN	Up to 100Kbps	
2.75G	EGPRS 2	473Kbps (uplink) to 1.2Mbps (downlink) ²	Better performance for all 2/2.5G services
3G (DSL speeds)	CDMA2000 EVDO (data only) Rev 0	Up to 2.4Mbps	Support for all 2G and 2.5G features plus: <ul style="list-style-type: none"> Full motion video Streaming music 3D gaming Faster Web browsing
	CDMA2000 EVDV (simultaneous voice and data)	Up to 2.4Mbps	
	UMTS	Up to 2Mbps	
	WCDMA	Up to 2Mbps	
	CDMA2000/ EVDO-Rev A	Up to 3.1Mbps	
3.5G (cable speeds)	HSDPA	Up to 14.4Mbps	Support for all 2/2.5/3G features plus: <ul style="list-style-type: none"> On-demand video Video conferencing Faster Web browsing (especially graphics intensive sites)
	CDMA2000/ EVDO Rev B	Up to 46Mbps	
4G (wired network- ing equivalent)	WiMAX	100+Mbps	Support for all prior 2G/3G features plus: <ul style="list-style-type: none"> High quality streaming video High quality videoconferencing High quality Voice-over-IP (VoIP)
	UMB	35Mbps	
	LTE	100Mbps	



Reflects evolution of CDMA network



Reflects evolution of GSM network

As new advancements are released, a key value to the customer is that the networks are backward compatible through 2G. For example, a user on the HSDPA network is compatible with all prior generations of the network back to GSM, and CDMA2000/EVDO Rev B is backwards compatible to CDMA.

A practical approach: evaluating the role of 2G and 3G in today's enterprise mobility solutions

The evolution of the cellular networks leaves enterprises to determine how to manage today's mobility solutions as well as future plans. You are likely grappling with questions such as:

- Do we need to be concerned with creating an aggressive plan to migrate to 3G mobile devices today?
- Does it make good business sense to launch new mobility applications on our existing 2/2.5G mobile devices today?
- Does it make good business sense to purchase 2/2.5G mobile devices today, or should I only consider specifying 3G devices for any future mobile device purchases?

While more speed is always welcome, the truth is you may or may not need 3G speed for all of your current — or future — business applications. There may be benefits for continuing to operate some of your applications on 2.5G devices, just as there may be benefits to migrating other applications to 3G devices. Evaluation of a number of considerations can help you determine where and when 3G should factor into your enterprise mobility plans:

Simultaneous voice and data

Do your users need simultaneous voice and data? With most 3G networks, users can maintain a voice connection while simultaneously accessing data. For example, technicians in the field may need to call an engineer back in the office while also viewing a product manual.

Geography

Are your users international 'globe-trotters'? 3G GSM, GPRS, EDGE and HSDPA handsets provide worldwide travelers with always on voice and data connectivity, no matter where they travel (subject to network availability).

Current application performance levels

Are existing applications functioning well today, or are the speed limitations of the 2/2.5G networks already causing application performance issues? If your applications are functioning well today, you may

not need to incur the high capital costs right now to upgrade, which can include purchasing new mobile devices and new cellular data plans. On the other hand, if your applications are pushing the envelope in terms of bandwidth and performance is negatively impacted, you should consider upgrading to 3G mobile devices.

Data usage

How data-intensive are your applications? If your application is performing simpler functions with smaller amounts of data, 2/2.5G networks will be more than adequate. But if larger amounts of data or larger files are routinely transferred or accessed, your application will definitely benefit from the faster speeds of 3G networks.

- **Data 'light' applications**

Are your applications tightly managed, designed to minimize data transfer on a monthly basis? For applications where a bar code or time stamp or other small amounts of data are being transferred, data usage may be less than 1 Mb per month. This type of application is not likely to require 3G speeds, and therefore may be more cost-effective on a 'pay as you go' lower cost cellular service plan rather than a more expensive all-you-can-eat plan. Applications that fall into this category often involve the download of the majority of the data required to the mobile device at the start of the day, minimizing data transfer. Examples of applications with lighter data use can include:

- *Postal and parcel delivery workers*
These workers often download routes and other needed information onto the mobile device before entering the vehicle for the day. Data transmission requirements are then limited to the need for updated navigation information via GPS (for example, traffic and updated maps), the capture of a bar code on a package and the capture of a signature to verify delivery.
- *Field service technicians*
Field service personnel typically download daily work orders (for example, to install or repair equipment) and routes to the mobile device in the morning, again helping to minimize data throughput in the field. Daily data transfer is limited to updated navigational information via GPS, sending updated customer records at the end of a visit that usually include scans of the bar codes of any parts used as well as the customer signature for verification that the job was completed.

- **Data intensive applications**

Alternatively, for applications that are very data-intensive, 3G networks offer the speeds required for peak application performance and cost-effective unlimited data plans. These applications can include:

- Video and other data intensive images that might be critical to the job, such as high-resolution photos, detailed technical diagrams and technical manuals
- Email that includes the routine transfer of sizable attachments
- The need for always-on GPS location-based applications that might be associated with the transmission of graphics intensive files, for example: maps to provide drivers with real-time navigation information; real-time vehicle locationing information for vehicles; and geostamping of images captured in the field for proof of condition and proof of location (for example, in delivery and field service operations).
- The need to regularly send and receive large files, for example, PowerPoint presentations, Word documents and large PDFs

With 3G bandwidth:

- Field service technicians can easily access reference materials to assist in equipment repairs, including large manuals as well as product schematics, in addition to capturing and transmitting photos that document condition.
- First responders in the police and fire department can easily view, capture and transmit photos and video footage.

Connection requirements: always-on or intermittent?

Do your applications require an always-on connection, or do workers collect the data and send at a later time or whenever they are in the network coverage area? For example, a driver delivering perishables and other food-related items to a grocery store will collect information in the store while offline — perhaps scanning the bar codes on the items delivered, noting any exceptions to the

order (for damaged product or order changes on site), and collecting a signature to verify delivery and authorize billing. The information is not posted into the database until the record is complete and all information is recorded — so the user does not need to be connected at all times. Other use cases do require an always-on connection. Management needs a constant connection to email, corporate contact directories and more. Some drivers require real-time traffic and other navigation information. Additionally, enterprises may want to track vehicles to increase route efficiency to improve driver productivity, reduce fuel costs and enable efficient dynamic routing changes throughout the day.

Network coverage issues

Be sure to check coverage in all the areas where your workers will be traveling. 3G networks are still in the build-out phase — while the service is available in many large cities, coverage in suburban and rural areas is potentially spotty. Wherever coverage is not available, service will revert to the 2/2.5G networks in the area if present.

If 3G service is not yet available in a majority of the travel area (for example, along a delivery route), and if your application is dependent upon the higher 3G speeds, performance can be an issue when the service reverts to the 2/2.5G networks throughout the business day. In addition, depending on your carrier, there may be additional roaming charges for services provided on the 2/2.5G networks.

Battery life

If you have workers that require battery power for a full day without recharging — for example, field service technicians or field sales personnel who spend the day outside the four walls — you already have a battery management program to ensure that fully charged batteries are available at the start of a shift or workday. At present, the 3G networks create a larger drain on the battery — you will likely need to maintain a larger battery pool, and workers that are out in the field the entire workday may need to carry multiple batteries. If your present and future-planned applications do not require the bandwidth and speed of 3G networks, you can elect to continue to standardize on 2G mobile devices to avoid the additional capital and operational costs associated with purchasing and managing a larger battery pool.

Device cost

Mobile devices that are 3G enabled are more expensive than devices that operate on the 2G based networks. The delta is dependent upon the type of device you are purchasing, and can easily amount to hundreds of dollars. If your existing and near future-planned applications are not data-intensive and do not require 3G speeds, you may not need to incur the large additional capital expenditure at this time. In this instance, you could elect to wait until your business applications are more advanced and require 3G speeds to support a heavier data load.

State of the networks: are 2/2.5G networks in danger of near-term obsolescence?

As 3G networks gain more visibility and near build-out, enterprises justifiably are concerned about properly planning enterprise mobility applications around the lifecycle of the present 2/2.5G networks. Concerns include the need to determine a timely migration schedule for existing 2/2.5G mobility applications, and ensuring that new purchases of 2/2.5G mobile devices will not require upgrade to 3G in the near term.

While no one can say with any certainty when 2/2.5G networks will reach the end of their lifecycle, industry indicators point to the co-existence of these two generations well into the future. While today's world is a mixture of 2/2.5G and 3G networks, the heavy majority of subscribers are on 2G-based networks — and predicted to remain so for a number of years:

- Today: In 2007, total global cell phone subscribers numbered 2.3 billion³, with 351 million of those subscribers on 3G³ — approximately 15 percent.
- In 2012: According to In-Stat, 2/2.5G based technologies will still account for over 70 percent of the worldwide cellular subscriber base in 2012⁴.

The slow movement towards applications that truly require 3G speeds and a subscriber base willing to pay for that speed will likely affect the pace of the build-out of the 3G network — and the ability for carriers to offer ubiquitous 3G coverage. In addition, the EV-DO 3G cellular network handles data only — the 2/2.5G networks are required in order to provide

voice support until the network technology evolves to support simultaneous voice and data services. As a result, 2/2.5G networks will continue to co-exist alongside 3G networks to ensure pervasive wireless connectivity until 3G networks become omnipresent.

Summary: how to navigate the near term

Today, you are likely grappling with questions such as:

- Do we need to be concerned with creating an aggressive plan to migrate to 3G mobile devices today?
- Does it make good business sense to launch new mobility applications on existing 2/2.5G mobile devices today?
- Does it make good business sense to purchase 2/2.5G mobile devices today?

The cellular networks will evolve to an 'all 3G' world — ultimately you will need to upgrade your mobile devices from 2/2.5G to 3G networks. But 2/2.5G networks will continue to co-exist alongside 3G networks for some time to come. As a result, if applications are working well today on 2G-based devices, there is no need to undertake a forklift upgrade to 3G devices in the very near future. Enterprises can more fully reap the value of current investments while keeping a careful eye on the buildout and coverage for 3G networks.

Should you refrain from launching new mobility applications on existing 2/2.5G mobile devices? No — the applications you develop for 2/2.5G devices can be cost-effectively ported to 3G devices with similar operating systems.

New mobility applications that require heavy data transmission and/or global coverage are best suited for 3G devices — though enterprises need to factor in 3G network coverage areas and the impact on application performance when only 2/2.5G services are available.

The 'stickiest' question arises when your applications do not require 3G network speeds at present. Should you purchase 3G devices for future proofing, or

3: Plunkett's Wireless, Wi-Fi, RFID & Cellular Industry Almanac 2008; Plunkett Research, Ltd.; Copyright@2007; www.plunkettresearch.com

4: In-Stat Adds Tracker Service on 3G and 4G Deployments Worldwide; In-Stat - March 14, 2008; <http://analystnews.tekрати.com/firmnews/10192/>

can you consider 2/2.5G devices? To answer that question you'll need to consider a number of factors. Today's enterprise mobile computers have a life expectancy of roughly five to seven years — likely the timeframe when migration to 3G devices will become critical, even for applications that run satisfactorily on 2G-based networks. If budget is an issue, 2/2.5G devices can provide some savings and a lower total cost of ownership in the near term, though they will likely need upgrading toward the end of their lifecycle. However, before purchasing 2/2.5G devices, you need to examine your long term mobility application plans. Will you need 3G speeds to deploy future planned applications? To answer this question, consider your existing application requirements as well as the new trend towards the

development of applications that utilize more data intensive profiles — in particular, the greater use of hosted web-based delivery models that operate more effectively on 3G networks. If your applications are less data intensive and the 2/2.5G networks can provide good application performance, you can consider investing in today's 2/2.5G mobile devices, since those networks will remain in existence for years to come.

For more information on Motorola 2/2.5G and 3G enterprise mobility solutions, please visit us on the Web at www.motorola.com/mc75 (for 3.5G) and www.motorola.com/mc70 (for 2.5G) or access our global directory at www.motorola.com/enterprise/contactus

About Motorola Enterprise Mobility Solutions

Motorola enterprise mobility solutions provide employees with on-the-spot access to the voice and data services required to maximize productivity, availability and customer service. We offer the strength of an industry leader and the power of tested and proven end-to-end solutions — with the reliability, security, manageability and superior uptime that mission critical applications demand. Our planning services can help ensure your mobile asset management solution is designed from the ground up for maximum success, factoring in ease-of-use and user adoption rates as well as wireless connectivity requirements. Our wide range of mobile computing devices is designed to handle the rigors of all day every day use in the field — from rugged or EDA integrated voice and data handheld mobile computers to vehicle-mount workstations and notebook computers. Our devices aren't just tough on the outside — they're tough on the inside, packed with processing power and Motorola-only features that provide outstanding application performance and pervasive wireless connectivity. True inside-outside mobility enables the same device to connect to a private or public wide area network when workers are outside the four walls, and seamlessly switch to an available wireless LAN upon return to the office for the delivery of more cost-effective in-building voice and data services. Our world-class business partners provide best-in-class applications that integrate easily with the existing workflows of your agency to minimize disruption of day-to-day business procedures. Our post-deployment services minimize downtime, helping to keep your field mobility solution running at peak performance every day of the year. And our management solutions bring a new level of simplicity to the management of mobility solutions, enabling you to easily stage, update, monitor and troubleshoot your mobile devices in the field from a single centralized location.



MOTOROLA

motorola.com

Part number WP-3G. Printed in USA 06/08. MOTOROLA and the Stylized M Logo and SYMBOL and the SYMBOL Logo are registered in the US Patent & Trademark Office. All other product or service names are the property of their respective owners. ©2008 Motorola, Inc. All rights reserved. For system, product or services availability and specific information within your country, please contact your local Motorola office or Business Partner. Specifications are subject to change without notice.