



Wireless for universal telecoms access

by William Hearmon FSAIEE, chairman, African CDMA Forum

Basic mobile telephony has done a wonderful job of empowering Africa. A subsistence farmer growing a larger crop can now negotiate a price for his tomatoes before picking them and going to market. Information is power and the middle-man can be kept in his place without holding the poor farmer to ransom because of his ability to make a phone call on his prepaid mobile phone.

Of the 800-million inhabitants in Africa approximately 600-million are subsistence farmers. They want to improve their lot. Ubiquitous coverage with 3G networks will do a lot to give the New Partnership for Africa's Development a kick start. Then the farmer will be able to "surf" the web on his mobile phone at a lower cost to see how better to grow his tomatoes; improve crop yields and produce better cattle. Next generation wireless technologies offer a tremendous opportunity for providing access to global telecommunications at a profit to the operators. The African CDMA Forum (ACF) is an African trade association serving Africa's CDMA fixed and mobile member community by promoting, protecting and enhancing their interests and investments. For further details on the ACF and how to join see www.3gafrica.org. This website gives links to the technologies discussed in this paper.

The 3G standard

3G stands for third-generation wireless technology and networks. It is based on the International Telecommunication Union (ITU) initiative for a single global wireless standard called International Mobile Telecommunications-2000 (IMT-2000). This concept of a single standard evolved into a family of five 3G wireless standards. Of those five, the most widely accepted are CDMA2000, WCDMA (UMTS) and TD-SCDMA. According to the ITU and IMT-2000, a wireless standard must meet minimum bit-rate requirements to be considered 3G:

- 2 Mbps in fixed or in-building environments
- 384 kbps in pedestrian or urban environments
- 144 kbps in wide area mobile environments
- Variable data rates in large geographic area systems (satellite)

In addition to providing faster bit rates and greater capacity over previous-generation technologies, 3G standards excel by effectively:

- Delivering mobile data
- Offering greater network capacity
- Operating with existing second-generation technologies
- Enabling rich data applications such as VoIP, video telephony, mobile multimedia, interactive gaming and more.

A brief history of 3G

First generation wireless, or 1G, refers to analogue networks introduced in the mid-1980s. Examples include advanced mobile phone service (AMPS) used in North America and total access communications system (TACS) used in the UK. In South Africa we had the C450 mobile system run by Telkom which was relatively expensive and took ten years to achieve ten thousand

According to the ITU and IMT-2000, a wireless standard must meet minimum bit-rate requirements to be considered 3G

subscribers. Most 1G technologies and systems were country or region-specific and thus offered limited coverage. As mobile communications grew in popularity, networks often became overloaded, resulting in busy signals and dropped calls. The solution was second-generation wireless, or 2G, which emerged in the early 1990s. 2G technologies were digital and offered the much-needed capacity that 1G analogue systems did not afford. Several technologies were widely used:

- GSM was and still is popular in Europe and Asia Pacific, and Latin America
- TDMA was used in the Americas and is still used in Latin America
- CDMA IS-95 or cdmaOne was used primarily in the Americas and Asia Pacific

However, these 2G technologies are incompatible

with each other. Thus, mobile service subscribers were still often limited to using their phones in a single country or region. In an effort to standardise future digital wireless communications and make global roaming with a single handset possible, the ITU established a single standard for wireless networks in 1999. Called IMT-2000, which is commonly referred to today as 3G, the initiative set forth the requirements (mentioned above) for the third generation of wireless networks.

Where is 3G today in Africa?

Today, wideband CDMA (WCDMA) and CDMA2000 are by far the dominant standards in terms of current commercial services, operator deployment plans and vendor support. In the ACF website one may see via the selection of maps available where the deployments in various frequency bands are taking place. Nigeria has 39 licensed operating companies in the CDMA2000 1X-EV-DO 800 MHz band alone. Tanzania has just licensed four. MTN and UTL in Uganda have been operating CDMA2000 WLL systems for a while now. Mauritius and South Africa have had WCDMA networks for more than a year. Movitel in Angola is the largest mobile operator in Africa with CDMA2000. Every one of the 48 countries in sub-Saharan Africa are licensing and deploying CDMA systems in the next year.

Launched commercially by wireless operators in 2000, CDMA2000 1X was the world's first operational 3G technology, capable of transmitting data faster than most dial-up services. Today, more than 210-million people enjoy the benefits of CDMA2000 1X, which provides enhanced data capacity compared with all 2G technologies.

Also known as universal mobile telecommunications system (UMTS), WCDMA is the 3G standard chosen by most GSM/GPRS wireless network operators wanting to evolve their systems to 3G network technology. WCDMA offers enhanced voice and data capacity and peak data rates faster than most dial-up

services and average rates consistently greater than global system for mobile communications/general packet radio service (GSM/GPRS) and enhanced data for GSM evolution (EDGE). As of February 2006, more than 51-million subscribers were using WCDMA for their mobile voice and data needs.

What does 3G offer Africans and who benefits from it?

3G wireless services enable consumers and professionals to experience excellent voice quality as well as a wide array of compelling data services, including:

- Mobile internet connectivity
- Mobile e-mail
- Multimedia services, such as digital photos and movies taken by and shared via wireless handsets
- Wireless application downloading
- Video-on-demand and short-format Clipcast content
- Real-time multiplayer gaming
- Enhanced emergency and location-based services
- Low-latency push-to-talk and push-to-video message services

For consumers, 3G quite simply means a more rewarding wireless experience – high-quality, low-cost voice, and fun and useful data services whenever they want them, whenever they need them and wherever they have mobile phone service. The small farmer and rural business entrepreneur in Africa can empower himself by linking into the 3G networks emanating from his cities.

CDMA 2000 systems in 850 MHz have a cell area of 2712 km² and in 450 MHz a cell area of 7521 km². The relative range is 29,4 km and 48,9 km respectively. With WCDMA this is severely reduced due to the high frequency with a cell area of only 312 km². In South Africa Vodacom and MTN have only rolled out their WCDMA coverage in very limited urban areas. For them it was an expensive “forklift migration” due to the fact that GSM air interface is totally incompatible with WCDMA. Not so for countries and operators that originally went for CDMA 2000 networks. The systems are forward and backward compatible. So for new operators in Africa the system of choice is CDMA 2000 with a frequency in 850 MHz for its range and the fact that 95% of handsets are manufactured in this band. Lehman Brothers estimates that the total cost of building and operating a CDMA 2000 network to serve a million users at 850 MHz is 31 - 38 % of the cost for the same WCDMA network.

In South Africa the second network operator and five of the seven under-serviced area licences have selected CDMA 2000 1xEV-DO Rev. A in 850 MHz as their technology of choice. See below what the properties of such systems will have for their new users. Enterprises can leverage 3G's advanced data capabilities to gain critical competitive advantages such as increased productivity, streamlined processes, improved customer service

and enhanced communications. Workforces, farmers, transporters and entrepreneurs can essentially work from anywhere at anytime. Phones coming out of China even have built-in barcode scanners. 3G technology also benefits the other participants in the wireless value chain. Wireless network operators are able to capitalise on increased voice capacity, greater network efficiency, lower costs per user served, increased average revenue per user and greater service differentiation. Device manufacturers can leverage the enhanced capabilities of 3G networks to sell premium wireless devices in volume. Finally, 3G technology's data capabilities open up an enormous world of opportunity for application developers and content providers.

What's next?

The future of 3G is impressive - in fact, it's already here.

CDMA2000 1xEV-DO

Launched in 2002, CDMA2000 1xEV-DO is a data-optimised evolution of the CDMA2000 standard, capable of delivering peak forward link data rates of 2,4 Mbps, or rates comparable to wired broadband. By dividing radio spectrum into separate voice and data channels, EV-DO, which uses a 1,25 MHz data channel, improves network efficiency and eliminates the chance that an increase in voice traffic would cause data speeds to drop.

CDMA2000 1xEV-DO Rev. A

EV-DO Rev. A is a significant evolutionary step in the CDMA2000 1xEV-DO progression. Expected to launch in 2006, EV-DO Rev. A provides a peak forward link data rate of 3,1 Mbps and a peak reverse link rate of 1,8 Mbps.

In addition, EV-DO Rev. A incorporates comprehensive improvements to the air link that reduce call set up times, decrease transmission delays and enable greater service control. These enhancements, combined with the increased data rates, enable network operators using EV-DO Rev. A to offer richer, more interactive applications and services such as wireline-quality VoIP, low-latency push-to-talk, online gaming, video on demand and video messaging, as well as the ability to upload large data files. EV-DO Rev. A also features Platinum multicast. Offering three times more capacity than Gold multicast, platinum multicast provides even greater network efficiency and reduces the cost of rich media content delivery to a large subscriber base when coupled with a content delivery system solution such as the MediaFLO media distribution system. Platinum multicast's multi-tone modulation enhancement uses CDMA and OFDM waveforms on the forward link to multimedia handsets, while continuing to use CDMA for forward and reverse links on unicast services.

With its additional speed and capacity, Platinum multicast enables operators to deliver live content such as breaking news, traffic, sports and weather. Furthermore, it offers operators greater flexibility - depending on network needs, operators can

choose to deliver more channels of content or fewer channels of content in higher resolution.

EV-DO Rev. B

EV-DO Rev. B, a further development on the CDMA2000 roadmap beyond Rev. A, offers multi-channel capabilities, which allow network operators to aggregate multiple 1,25 MHz channels simultaneously and increase data rates dramatically. The first implementation of Rev. B will support up to 9,3 Mbps on the forward link and 5,4 Mbps on the reverse link (the standard, at its theoretical limit and aggregating 20 MHz of spectrum, allows up to 75 Mbps on the forward link and 27 Mbps on the reverse link) One of the chief advantages of Rev. B is that it puts the control for scaling bandwidth into the network operators' hands, allowing operators to tailor their systems to the spectrum they have available. Rev. B's flexibility will enable significant capacity and performance improvements, while protecting CDMA2000 operators' current investments in networks and devices. Furthermore, it will allow more of operators' spectrum to be used for IP-based services, including mobile broadband data, wireline-quality VoIP and multicast traffic in a manner that results in lower operator costs through greater efficiencies.

HSDPA/HSUPA

HSDPA (high-speed downlink packet access) is an evolution of WCDMA, optimised for packet-switched data applications. HSDPA provides impressive enhancements over WCDMA on the downlink (also referred to as the forward link) - promising 14,4 Mbps peak data rates - resulting in a better end-user experience. Subscribers with HSDPA service are able to receive emails with large attachments, surf the web or download multimedia or text files faster than ever.

For operators, HSDPA offers a three- to five-fold capacity increase over WCDMA, which translates into significantly more data users and lower cost per bit. At the conclusion of January 2006, there were more than 50 other HSDPA networks planned or in deployment and nine announced trials around the world. On 3 April 2006, the first HSDPA network was launched in South Africa by Vodacom. HSDPA will be followed by another evolution still in standards development. Just as EV-DO Rev. A greatly improves the uplink of 1xEV-DO, high-speed uplink packet access (HSUPA) extends the benefits of HSDPA to the uplink (also referred to as the reverse link). HSUPA will support up to 5,76 Mbps peak rates, further improving the end user experience. HSUPA will provide end users with a DSL-like experience and enable lower latency services such as voice over IP, multiplayer interactive gaming, push-to-talk and more. The first HSUPA deployments are expected in 2007. Moving forward, both CDMA2000 and WCDMA will continue to evolve with the goal to increase network capacity, improve data rates and enhance system performance. These are impressive systems that will improve the lives of all who live in Africa.

Contact William Hearmon,
hearmon@dynacom.co.za □