Wireless Broadband Access with CDMA2000

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CDMA Development Group

The CDMA Development Group (CDG), founded in December 1993, is an international consortium of companies who have joined together to lead the adoption and evolution of 3G CDMA wireless systems around the world.

The CDG is comprised of CDMA service providers and manufacturers, application developers and content providers.

CDG's Mission:

To lead the rapid evolution and deployment of 3G CDMA-based systems, based on open standards and encompassing all core architectures, to meet the needs of markets around the world.

More info: www.cdg.org

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Why the Emerging Markets

Nokia's Jorma Ollila 3/06

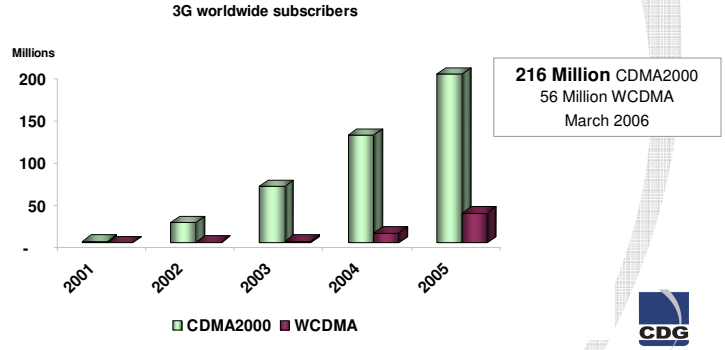
80 percent of the next 1 billion wireless subscriber users will be from the Emerging Markets.

The Emerging Markets have very low penetration rates and the battle is still 2G, GSM vs. CDMA for voice and some data.

The New Emerging Markets (Southeast Asia, Russia, Middle East and Africa) have the largest CDMA opportunities with abundant 450 MHz spectrum available.

CDMA2000 is the Leading 3G Technology

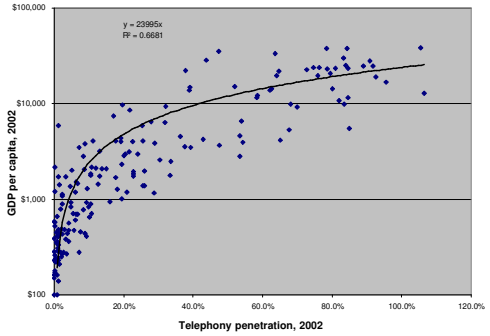
- **155 operators in 69 countries on six continents, including developing countries** (www.cdg.org, June 2006)
- **216 million or 10% of all wireless subscribers use CDMA2000® today** (www.3gtoday.com, March 2006)
- **There will be nearly 500 million CDMA2000 subscribers serving 20% of total users in 2009***

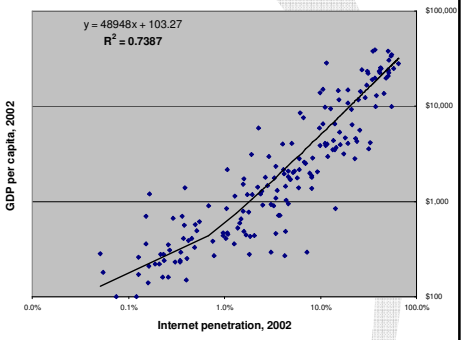


*Source: The Yankee Group, June 2005

The Value of Improving Connectivity

It's not just about voice …. It's about voice and data





For each 1% increase in Mobile penetration, GDP per capita goes up by US$240

For each 1% increase in Internet penetration, GDP per capita goes up by US$593

Although mobile voice communications are bridging the digital divide, regulatory and spectrum policy should continue to encourage the penetration of mobile broadband data connectivity

Source: Michael Minges, TMG Telcom, and ITU World Telecommunications Database Statistics, 2003.

3G CDMA – Satisfying the Demand for Wireless Voice and Broadband Data Today!

- Toll-quality Voice communications (equal or better than landline)
- Broadband Data transmissions (multiples greater than ISDN speeds)
- Secure transmissions (including DRM, anti-spam, fraud control, etc.)
- Excellent coverage (with in-building, multimode and robust hand-off services)
- Commercial-grade infrastructure (switching, billing, authentication, etc.)
- Thousands of applications (multimedia, multicasting, messaging, etc.)
- Low cost per minute, megabyte or message (due to spectral efficiency)
- More than 200 million paying subscribers worldwide and growing (~4M/mo)!
- Commercially available devices (more than 940 devices from 50 vendors)
  - Small and attractive form factors
  - Data-enabled devices based on IEEE (TCP/IP) standards
  - WWAN connectivity embedded into laptops
  - Operating systems based on "open" execution environment standards
  - Low battery power consumption

CDMA Evolution: Key Success Factors

Backwards Compatibility

- Rapid commercialization and deployment.
- Investment protection.
- Transparency for the end-users.
- Seamless service evolution building on top of existing 3GPP2 IMS Core and feature transparency.

Flexibility

- Requires small amount of spectrum, 1.25 MHz, and evolving in the future to scale up to 20 MHz with Rev B and Rev C in the future.
- Supports existing multiple frequency bands ranging from 450 MHz to 2100 MHz and can support future ranges such as 1700 MHz.
- Solid evolution path towards OFDM/MIMO.

Handset Availability

- 956 CDMA2000 1X Devices and 280 EV-DO Devices (www.cdg.org).
- These include embedded devices in laptops, PCMCIA cards and PDA's, thereby delivering the seamless broadband experience to users of any and all devices.
- Handsets are available at all price points, i.e., low, mid, and high-tier.
  - In the low-end category, 3G CDMA handsets are being sold as low as US$50 with a service contract.

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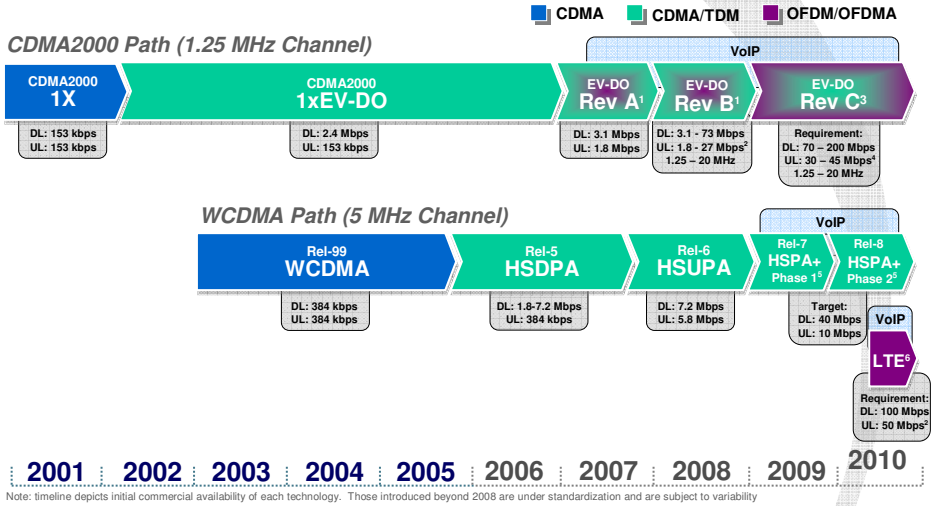
CDMA Time-to-Market Leadership

Commercial Introduction to Market



Note: timeline depicts initial commercial availability of each technology. Those introduced beyond 2008 are under standardization and are subject to variability

[1] EV-DO Rev A and Rev B incorporate OFDM for multicasting
[2] Data rates of 73 Mbps for the DL and 27 Mbps for the UL are based on a 2 x 20 MHz allocation
[3] May have multiple modes, with at least one mode being backwards compatible with EV-DO (all versions); will likely utilize CDMA/OFDM or a combination of OFDMA and CDMA; MIMO/SDMA; leverages EV-DO protocol stack
[4] Data rate dependant on level of mobility. Higher end of data rates ranges are based on a 2 x 20 MHz allocation
[5] Release 7 and Release 8 introduce enhancements such as MIMO and VoIP
[6] Utilizes OFDMA on the DL and SC-FDMA on the UL; MIMO

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EV-DO Rev A:

Higher Rates, Lower Latency and Higher Spectral Efficiency

New peak rates for better user experience

- 3.1 Mbps peak data rate on forward link.
- 1.8 Mbps peak data rate on reverse link.

Higher Spectral efficiency

- Increased rate quantization on both forward and reverse link enables more efficient use of air link resources.
- 1.2 times Rel 0 forward link sector capacity.
- 3.4 times Rel 0 reverse link sector capacity.

Reduced latency and optimized QoS enables delay sensitive applications

- Support for delay sensitive applications such as Push to Talk, Video Telephony, Instant Multi-Media (IMM), VoIP and low-delay gaming.

DO Platinum Multicast

- 1.5 Mbps capacity with > 98% coverage.
- Configurable based on market needs.

Backward compatibility

- Continued support for existing Rel 0 devices.

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EV-DO Rev B:

Scalable Bandwidth for Higher Performance

Rev B aggregates multiple EV-DO channels for higher performance

- Gradual upgrades to existing Rev A networks will support all-IP applications at broadband rates.
- Allows deployment in “hot-zones” with high data demand.

Higher peak data rates

- Aggregate carriers for linear gains in peak rates.
  - 2 RFs – 6.2 Mbps, 3 RFs – 9.3 Mbps
- Likely configuration of 5 MHz (standard supports up 20 MHz).

Increased bandwidth

- Support for wider bandwidth to address portable data and visual centric devices.
- Existing applications supported at higher rates.

Network flexibility

- Allocation of bandwidth for new devices depends on application needs and network availability.

Higher capacity

- Improved spectral efficiency on both FL and RL due to Multi-carrier TX.

Backward compatibility

- Co-existence of Rev A and B devices in the same network.

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EV-DO Rev C:
Next-Generation Multimedia

System Requirements:

- Highly scalable, backward-compatible evolution modes of the EV-DO Rev B standard.
- Higher Peak Data Rates and System Capacity.
  - Target peak data rates range from 70 Mbps to 200 Mbps, depending on mobility, for the FL and 30 Mbps to 45 Mbps for the RL
- Higher spectral efficiency (e.g., hot spots).
- Lower delay (10 msec latency).
- Higher mobility (up to 350 km/h).
- Enhanced VoIP capacity and user experience.
- Support for bandwidth allocations up to 20 MHz in 1.25 MHz blocks.
- Support flexible spectrum allocation options including possible operation on non-contiguous carriers.
- Minimize control and signaling overhead.
- Decrease terminal power consumption and improve battery life.

3G CDMA for the Middle East and Africa

A large opportunity exists to increase voice & broadband penetration

Majority of voice telephony will continue to be serviced by 2G GSM

3G CDMA will serve key market segments over a single technology platform:

- Low Cost Voice Telephony:
  - Spectral efficiency and capacity of 3G CDMA networks supports lower voice tariffs.
  - Spectral efficiency leads to reduced costs per subscriber (Notable example: India).
  - Satisfies Universal Service Obligations for “under-serviced” areas and rural deployments.
- Broadband Data:
  - High-speed, secure and cost-effective Internet connectivity.
  - Available wherever wide area coverage exists: urban, suburban, rural and in-buildings.
- Multimedia Services:
  - 3G CDMA networks support multicasting, multimedia streaming and on demand services.

CDMA2000 Snapshot of the MENA Region

Middle East			
• Saudi Arabia	CDMA2000 1X WLL	450 MHz	Deploying
• Yemen	CDMA2000 1X WLL	800 MHz	Commercial
• Oman	CDMA2000 1X / EV-DO	450 MHz	Deploying
• Kuwait	CDMA2000 1X WLL	800 Mhz	Commercial
North Africa			
• Algeria	CDMA2000 1X WLL	1900 MHz	Commercial
• Morocco	CDMA2000 1X WLL	800 MHz	Deploying
• Egypt	CDMA2000 1X WLL	800 MHz	Commercial
• Tunisia	CDMA2000 1X WLL	1900 MHz	Commercial

First Commercial EV-DO Network on African Continent

Starcomms of Nigeria was the first operator in the African continent to commercially launch EV-DO.

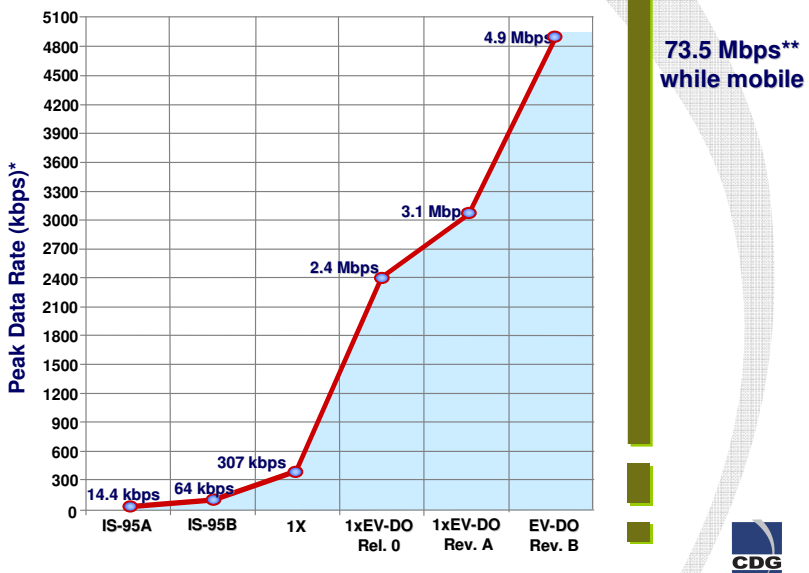
The NCC recently introduced four Unified Licenses into the market; operators Starcomms and Prest Cable and Satellite TV Systems (Prestel) are the first of four unified licensees to pay their fees to the Nigerian Communications Commission (NCC).

Under the Nigerian unified licensing regime, operators are allowed to offer a portfolio of services including local, long-distance and international voice telephony services, mobile and internet access services, on a national or local basis.

- Starcomms initially offered CDMA2000 WLL services; with the Unified License, they will begin offering fully mobile services on their CDMA network.

3G CDMA Broadband Connectivity

CDMA2000 EV-DO is delivering the highest broadband rates



* *Forward link in a mobile environment using 1.25 MHz of spectrum*
** *Using 20 MHz of spectrum*

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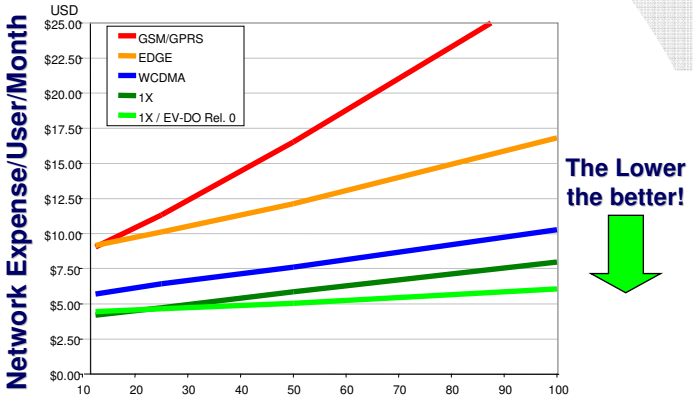
3G CDMA Enables Lowers Tariffs

CDMA2000 1X and EV-DO enable the lowest cost per bit and Erlang

Combined Voice and Data Network Expense
(500 Minutes of Use)



Operators Prefer Network Technologies that are Affordable and Evolutionary

Source: The Economics of Wireless Data, http://www.qualcomm.com/main/whitepapers/WirelessMobileData.pdf
Assumptions: On demand Traffic: a) 15% of traffic demand occurs at the busy hour, b) 7,600 kbps / sq km at busy hour, c) 5 MHz
Multicast Traffic: a) 2,000 subscribers / cell, b) 30 live streaming minutes / day at 128 kbps data rate, c) 1.25 MHz

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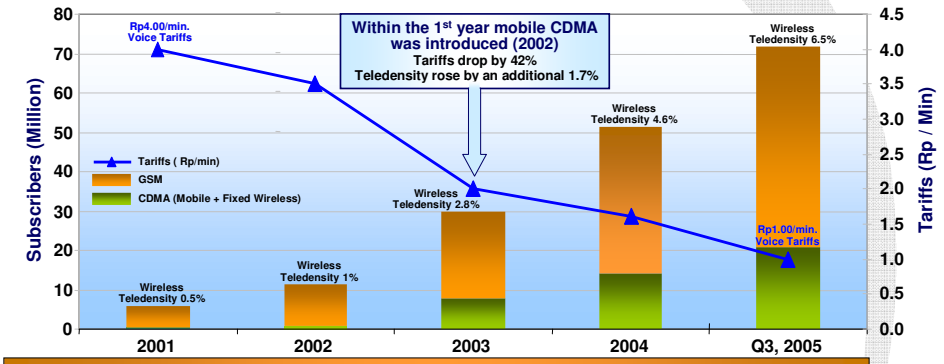
Impact of 3G CDMA on India

CDMA created a competitive landscape that made wireless affordable



	2001	2002	2003	2004	Q3, 2005
GSM Networks:	39	64	71	79	84
CDMA Networks:	5	14	25	34	44

Wireless Growth Since Introduction of Mobile CDMA (2002-2005)		
Tariffs Decrease	75%	
Teledensity Increase	6%	
Subscriber Growth (CAGR)	205% (CDMA)	74% (GSM)

Sources: CDG, TelecomWatch, AUSPI, COAI and TRAI, October 2005

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3G CDMA Capacity Advantage

Mobile Operators are able to profit from lower tariffs

Greater spectral efficiency leads to greater capacity

- Greater call capacity can lead to lower tariffs for voice service
- Greater data throughput can lead to reduced data tariffs

Mobile Voice

Bharat Sanchar Nigam Ltd.
India

Free incoming calls,
$0.008 per minute (outgoing)

Lowest
Mobile Voice Tariff
in the world

Mobile Data

Sprint

After a free 3-month trial period,
an unlimited data plan for cell phones
at $10 a month

Lowest
Mobile Data Tariff
in the world

Affordable and evolutionary 3G CDMA networks are driving tariffs lower

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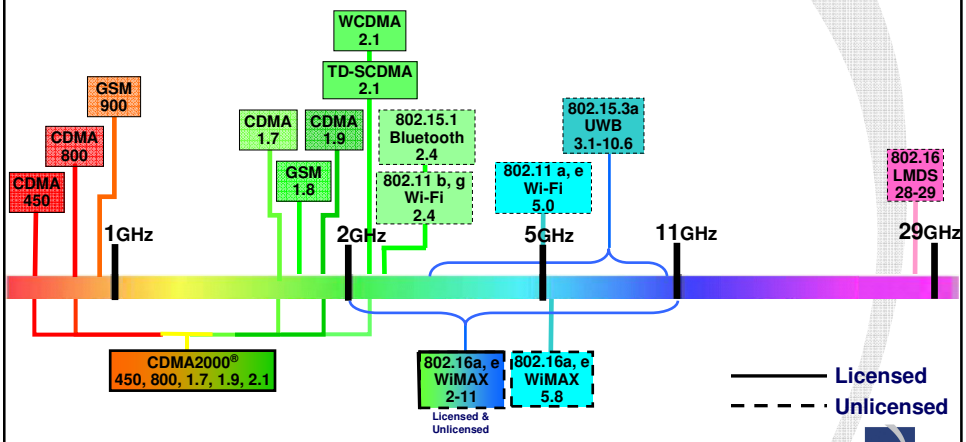
Spectrum Allocations

To deploy 3G requires the allocation of the appropriate spectrum

Providing affordable coverage is crucial in wireless telecommunications

The warmer (lower) frequencies are best!



Licensed Spectrum vs. Unlicensed Spectrum

The use of unlicensed spectrum creates interference issues

Benefits of Lower Frequencies

Wireless signals travel farther at lower frequencies, thus a cell site at 450 MHz or 850 MHz covers more geography than one at 1900 MHz or 2100 MHz.

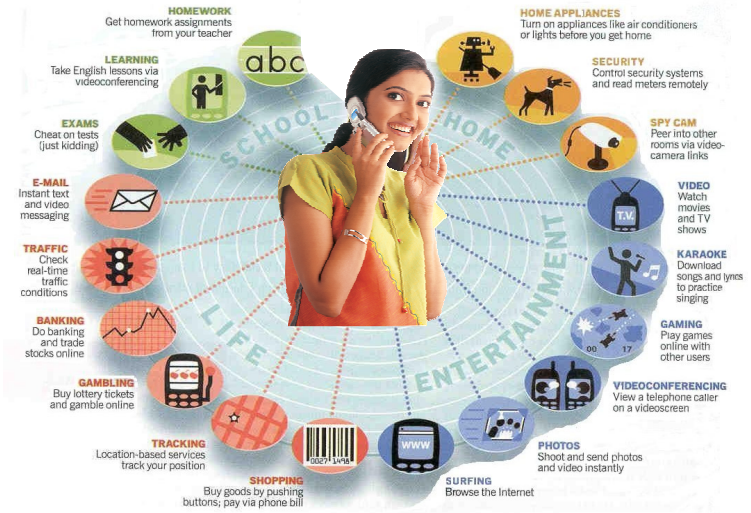
Due to these favorable propagation characteristics of lower frequencies and their associated coverage benefits, there may be significant cost advantages associated with deploying a wireless system in lower bands.

Frequency (MHz)	Cell Radius (km)	Cell Area (km2)	Relative Cell Count
450	48.9	7521	1
850	29.4	2712	2.8
950	26.9	2269	3.3
1800	14.0	618	12.2
1900	13.3	553	13.6
2500	10.0	312	24.1

Coverage Comparison of an IMT-2000 System at Various Frequency Ranges
Source: "Coverage Comparison of IMT-2000 Systems at Various Frequency Ranges, Including 450", ITU, Radio Telecommunication Study Group, June 11, 2002

3G is Fulfilling the Demand for Mobile Services

Serving a large number of personalized mobile data services



Source: "Broadband Wonderland", Fortune Magazine, September 20, 2004

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3G is Fulfilling Universal Service Obligations

Connecting citizens to voice and Internet services

In **India**, Reliance will meet universal service obligations by providing 3G service to 48,310 villages that don't have public phone facilities[1]

In **India**, Shyam Telecom has equipped a fleet of around 200 self-employed rickshaw drivers with a mobile calling office, including fax[2]

In the **Dominican Republic**, Tricom deployed over 1,700 public pay phones in underserved rural areas. These phones will eventually be used for high-speed Internet access[3]

In **Brazil**, Anatel and Lucent provided universal broadband (800kbps @ 45km) access with 3G

In **Ecuador**, Edumasters installed 3G kiosks at several public schools to provide free Internet access. Panama is next[4]

In **Chile**, BellSouth provided 3G broadband access to 667 schools nationwide[5]

Rainbow Chalta Firta PCO

1. http://www.thehindubusinessline.com/2004/09/20/stories/2004092002090100.htm
2. http://www.hellorainbow.com/aboutus.asp
3. BNAmericas.com, "GEC-Tel, Tricom Partner for wireless Network – Dominican Republic, November 20th, 2004
4. http://projetoscd.isat.com.br
5. www.edumasters.net
6. http://www.subtel.cl/servlet/page?_pageid=57&_dad=portal30&_schema=PORTAL30&p_language=e, Sept. 3, 2003

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3G is Fulfilling Public Safety Initiatives

Protecting and saving lives

In the **U.S.**, 3G carriers offer E911 services with accurate (5-30m) position location capabilities[1]

In **Japan**, SECOM launched a nationwide location-based security service[2]

In **China**, Unicom donated 150 kid tracker devices to the Beijing School of the Blind[3]

In **Korea**, SK Telecom and the National Police Agency introduced a Missing Children Service[4]

In **Canada**, the Ontario Police quickly access vital information (including fingerprint IDs) and respond to emergencies instantly with position location dispatch[5]

In **Florida**, the Broward County Sheriff's Office uses 3G for child protection services[5]

1. www.fcc.gov/911/enhanced/
2. www.secom.co.jp
3. www.chinaunicom.com.hk
4. www.cnn.com, Friday October 1st, 2004
5. CDMA A-List Award Winners

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Conclusion

The Future is both voice telephony penetration and Internet connectivity.

- The Middle East and Africa need *both* to accelerate economic growth. **The Emerging Markets are both voice and data.**

The CDMA2000 evolution path is clear, forwards and backwards.

The Emerging Markets are mobile and wireless local loop.

The Emerging Markets need affordable handsets and devices, not cheap ones.

The allocation of the "warmer (lower) radio frequencies" provides the best geographic coverage and network economic solution.

- The 800 MHz and 450 MHz frequency allocations are the most valuable in this context.

The CDG is here to support you.

Thank you.

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