3G CDMA
Enabling Mobile Wireless Data
April 2004

Launchpad Applications
BREWapi
BREW Distribution System
gpsOne
CDMA Chipsets
Homeland Security Initiatives
Fleet Management Solutions
CDMA2000 1X
CDMA2000 1xEV-DO
CDMA2000 1xEV-DV
WCDMA/UMTS
Application Solutions
Mobile Processors
Base Station Processors
Radio Processors
CDMA University
Network Optimization
Software Tools
Development Tools
QCTest Tools
Client Software
Digital Cinema
Advanced Security Solutions

Australia • Austria • Belarus • Brazil • Canada • Chile • China • Colombia • Denmark • Dominican Republic • Ecuador • Guatemala • India • Indonesia • Israel • Italy • Japan • Mexico • Moldova • New Zealand • Nicaragua • Panama • Romania • Russia • South Korea • Sweden • Taiwan • Thailand • United Kingdom • United States • Venezuela • Vietnam

QUALCOMM CDMA Technologies
QUALCOMM Technology Licensing
QUALCOMM Wireless and Internet Group
QUALCOMM Strategic Initiatives

Overview of Key Wireless Terms

- **WWAN:** Wireless Wide Area Network
  - Category of technology deployed by cellular operators such as Verizon Wireless
- **1G:** or '1st-Generation', analog cellular (includes AMPS in the U.S.)
- **2G:** or '2nd-Generation', digital cellular (includes cdmaOne, GSM and TDMA technologies)
  - Primarily voice, 9.6 to14.4 kbps circuit switched data, better capacity than analog
- **3G:** or '3rd-Generation', more capacity for voice and high-speed data
  - Requirements: 144 kbps mobile, 384 kbps pedestrian, and/or 2 Mbps fixed environments*
- **3G CDMA:** 3G Code Division Multiple Access
  - Dominant form of 3G. Includes CDMA2000 and WCDMA technologies
- **CDMA2000®:** Family of 3G technologies including:
  - **1X:** efficient 3G voice and data upgrade for CDMA operators. Delivers typical packet data rates from 50 – 90 kbps, peak rates of 153 kbps. Providing service today to over 48 million reported subscribers worldwide**
  - **1xEV-DO:** Optimized for high-speed wireless data. Provides 2.4 Mbps peak rates and typical rates in the hundreds of kbps. Used by over 1.3 million reported subscribers in Korea and other countries**
- **WCDMA:** European version of 3G CDMA designed for new spectrum. Services are just now starting, with rates up to 384 kbps.
- All these wireless technologies operate in **licensed** spectrum

Source: ITU, http://www.itu.int/
****Source: http://www.3GToday.com***

Overview of Key Wireless Terms

- **WLAN:** Wireless Local Area Network
  - Category of cordless technologies for home/office cordless networking, now extended to public “hot spot” offerings
  - Common WLAN terms include Wi-Fi and 802.11
- **Wi-Fi:** or ‘Wireless Fidelity’, a popular name for 802.11 technologies that have passed Wi-Fi interoperability certification testing*
- **802.11:** or IEEE 802.11, is a family of WLAN networking technologies standardized by the IEEE (Institute of Electrical and Electronic Engineers)
  - 802.11b: 11 Mbps peak rates, 2.4 GHz frequency
    - First and most widely used form of Wi-Fi today
  - 802.11a: 54 Mbps, 5 GHz frequency
  - 802.11g: 54 Mbps, 2.4 GHz frequency
- These technologies operate in **unlicensed** spectrum

Source: Wi-Fi Alliance, http://www.wifialliance.com

What is 3G?

The ITU formed the IMT-2000 program to coordinate development of standards to deliver 3G

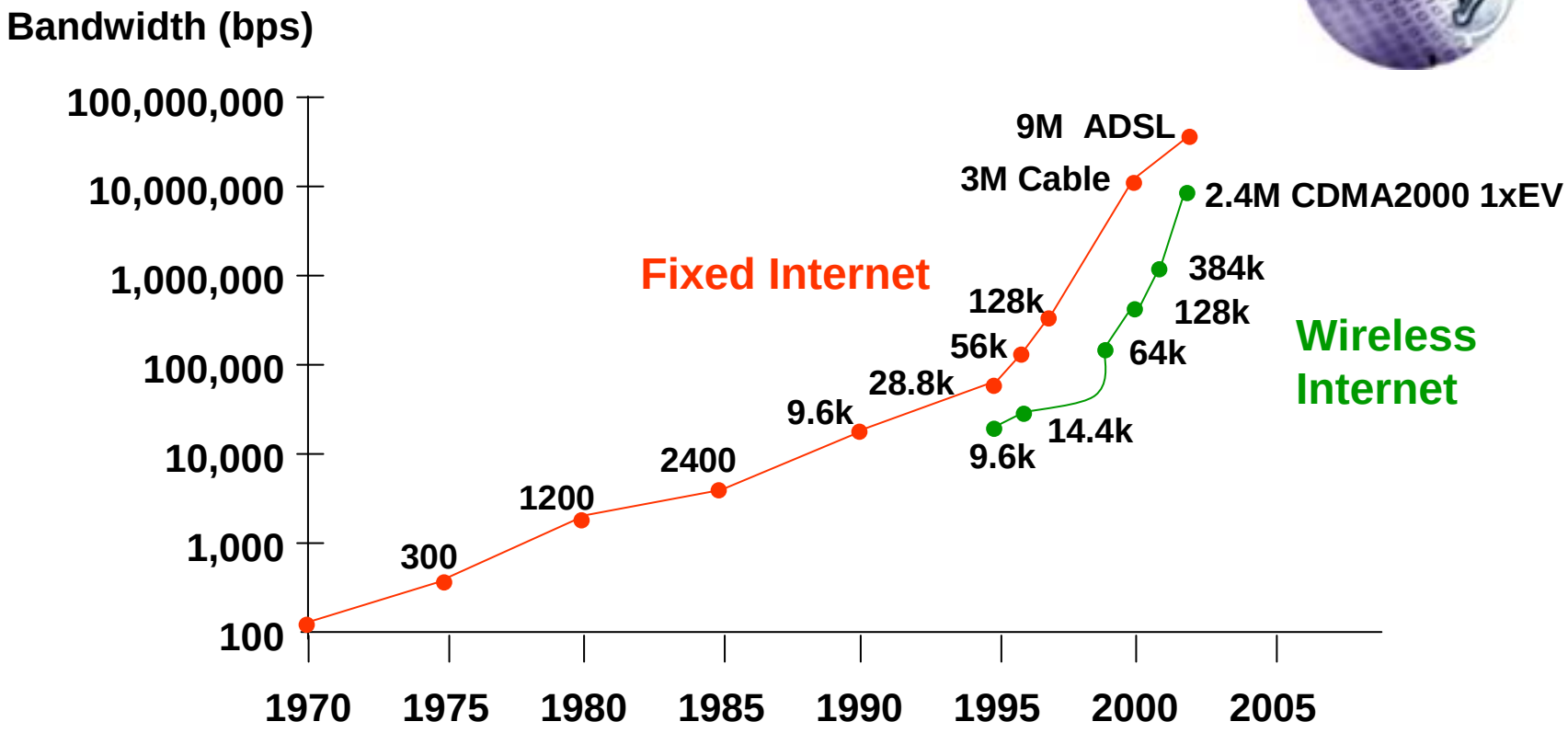
IMT-2000 Terrestrial Radio Interfaces

IMT-2000 CDMA Direct Spread	IMT-2000 CDMA Multi-Carrier	IMT-2000 CDMA TDD	IMT-2000 TDMA Single Carrier	IMT-2000 FDMA/ TDMA
WCDMA (UMTS)	CDMA2000 family	UTRA TDD & TD-SCDMA	UWC-136/ EDGE	DECT

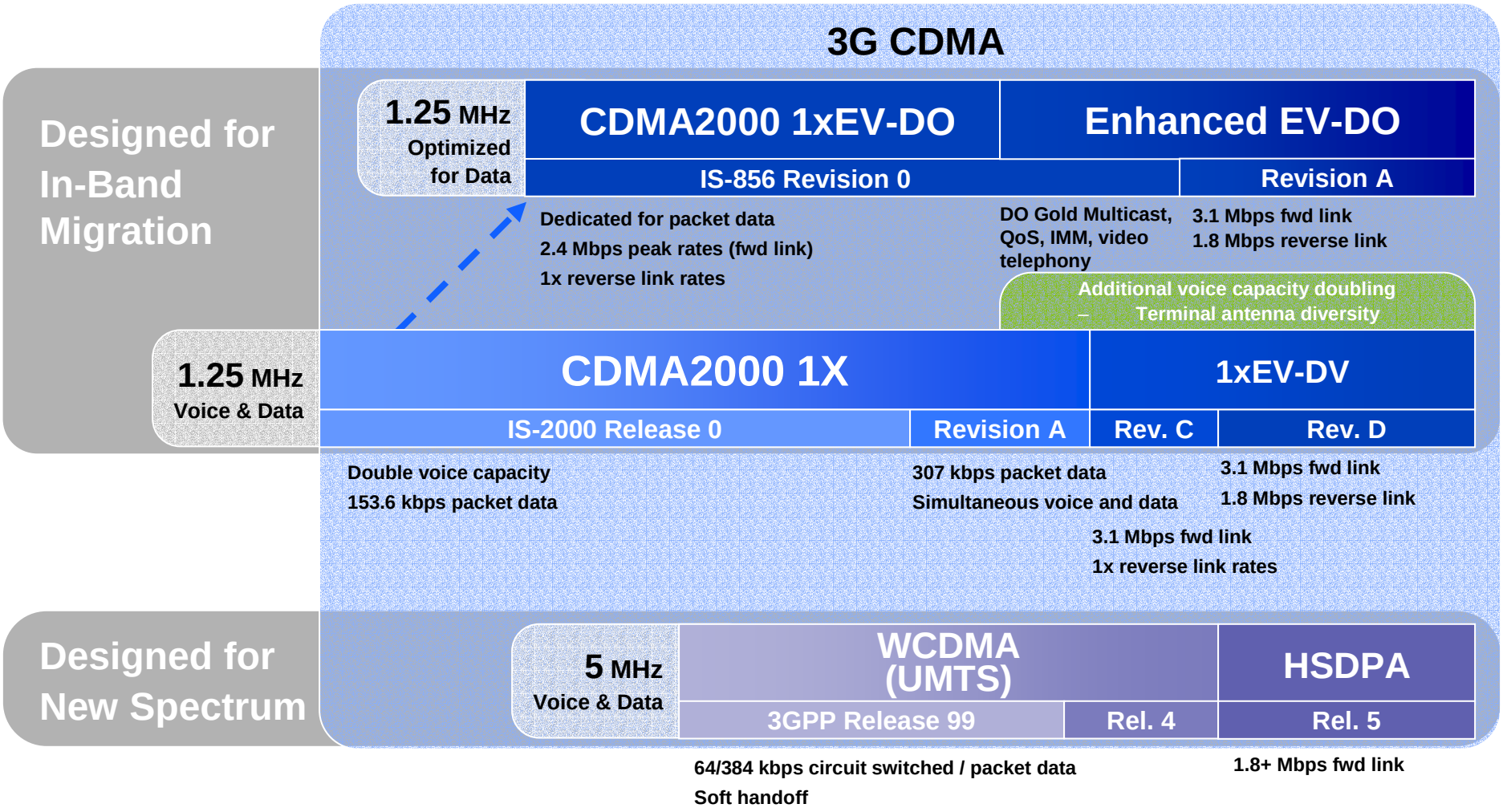
3G CDMA

Although there are five terrestrial standards, most of the attention and energy in the industry has been toward the CDMA standards

Internet Evolution: Bandwidth



3G CDMA Evolution – Today and Tomorrow



2003 CDMA2000 Devices Exceed 1998 Desktop PCs

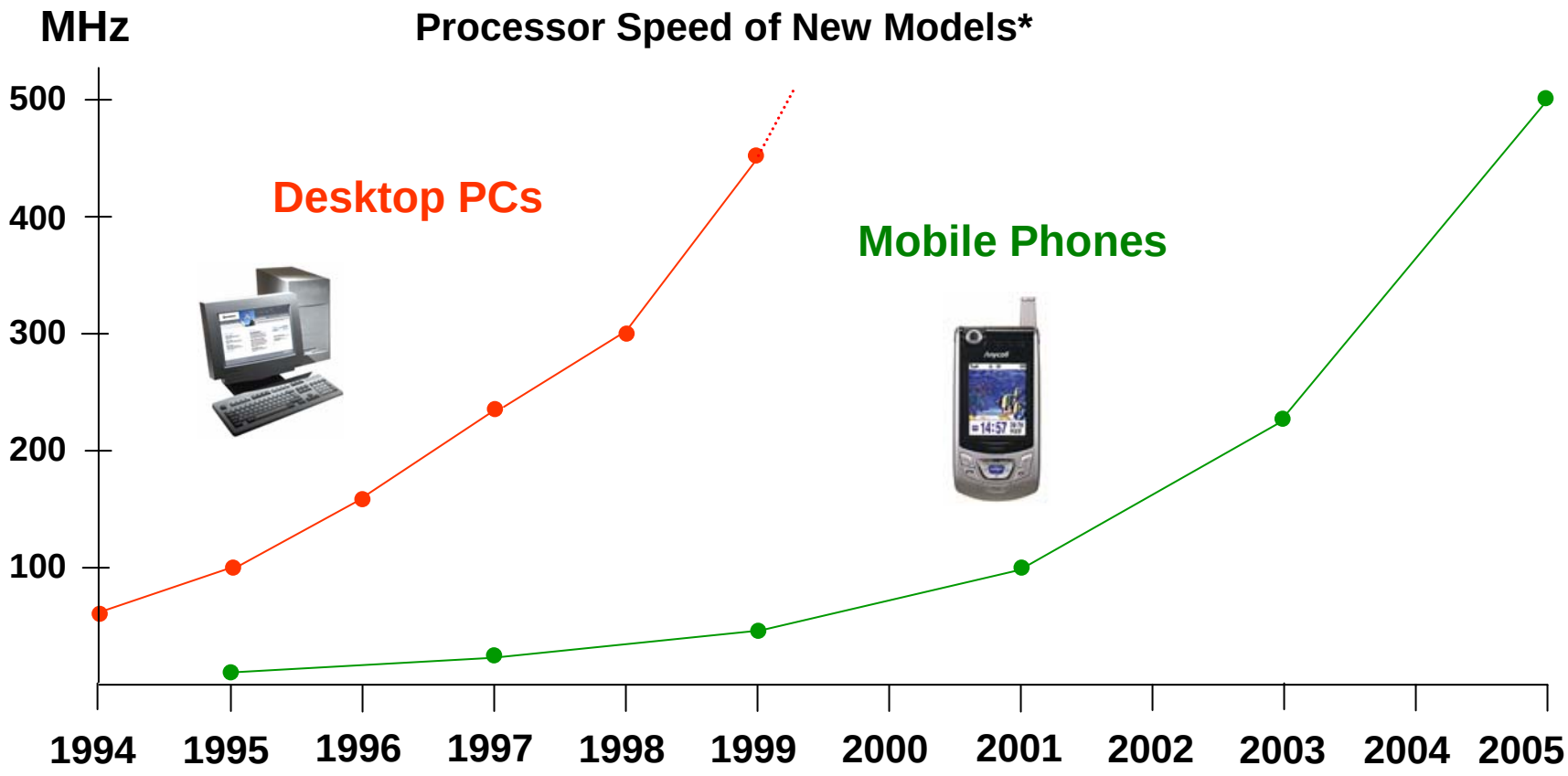
Intel Pentium based desktop computer

- **Date:** Early 1998
- **Processor:** Pentium II
- **Speed:** 233 MHz
- **RAM/Flash:** 16 MB
- **Drive/Storage:** 2.5 GB
- **Display** $1,099 monitor not included

Samsung M400 CDMA2000 1xEV-DO Smartphone

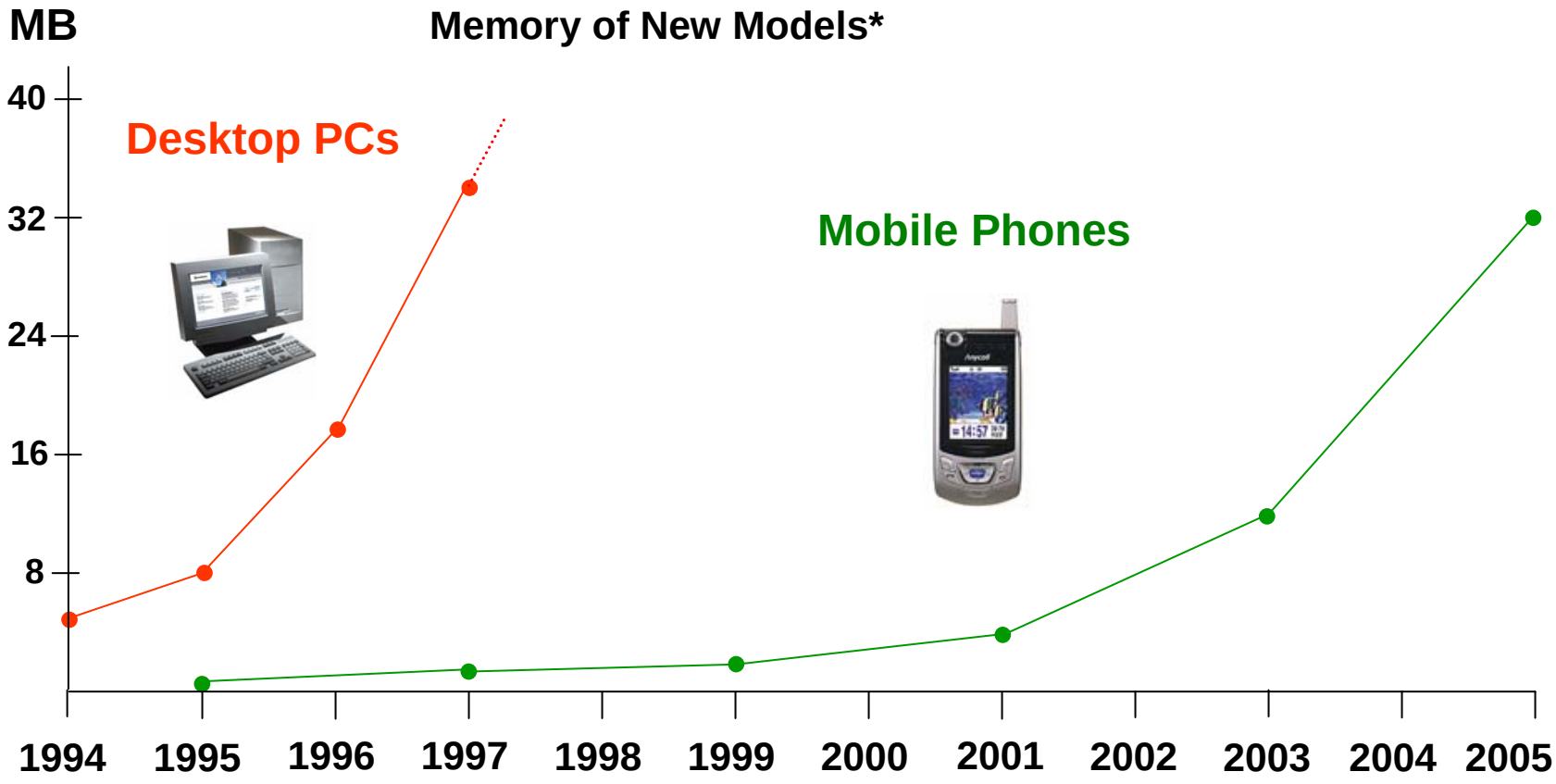
- **Date:** August 2003
- **Processor:** Intel PXA250
- **Speed:** 300 MHz
- **RAM/Flash:** 128 MB
- **Drive/Storage:** SD Card – up to 512 MB
- **Display:** 5” 64K-color LCD

Mobile Phone Processor Power Today Compares to Desktop PCs of the 1990's



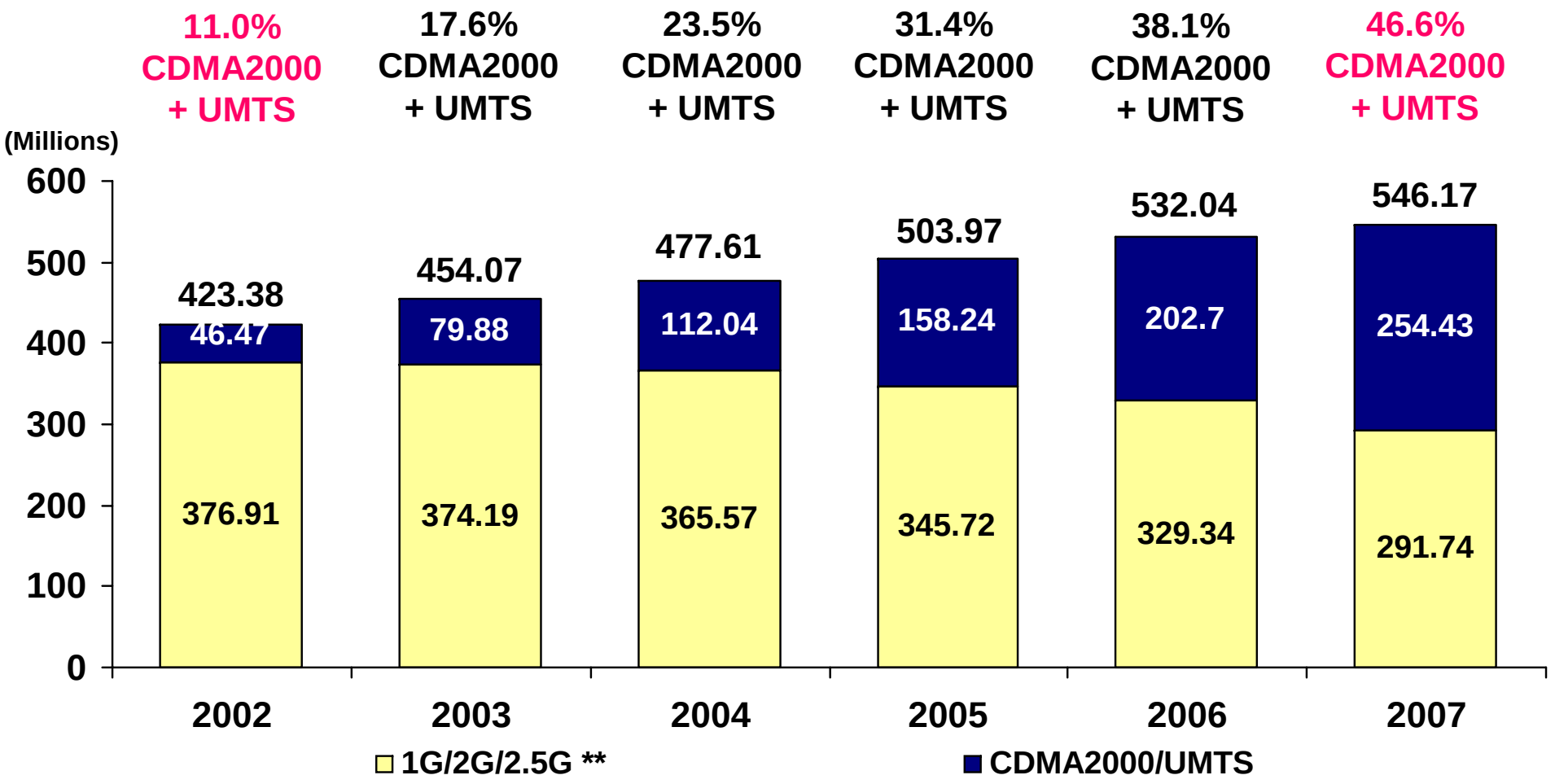
*Source: Gartner Dataquest, November 2003

Mobile Phone Memory Today Compares to Desktop PCs of the 1990's



Source: Gartner Dataquest, November 2003

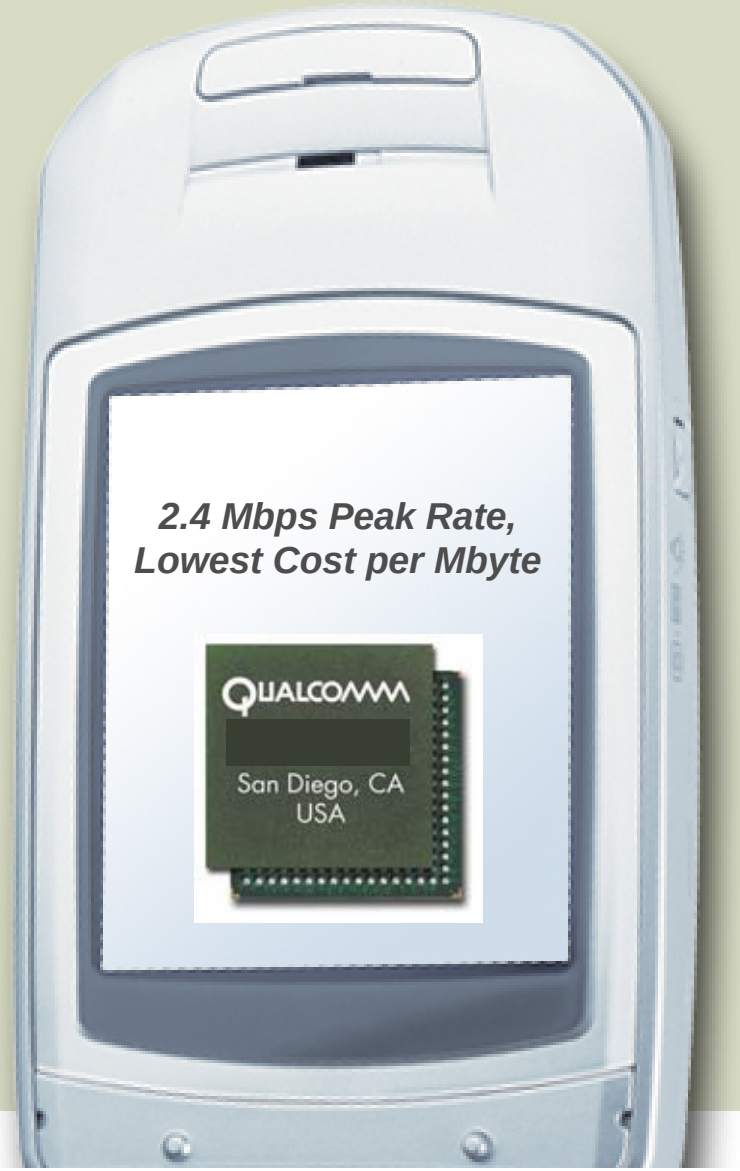
Wireless Handset Sales Growth



** Includes Analog, cdmaOne, GSM/GPRS/EDGE, TDMA, iDEN and PDC

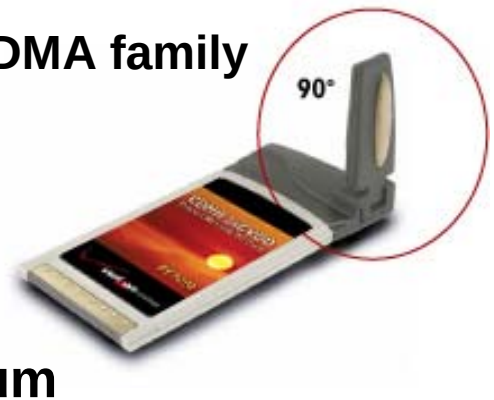
Source: IDC, The Shosteck Group and The Yankee Group (2003)

CDMA2000 1xEV-DO: Affordable Wireless High Speed Data



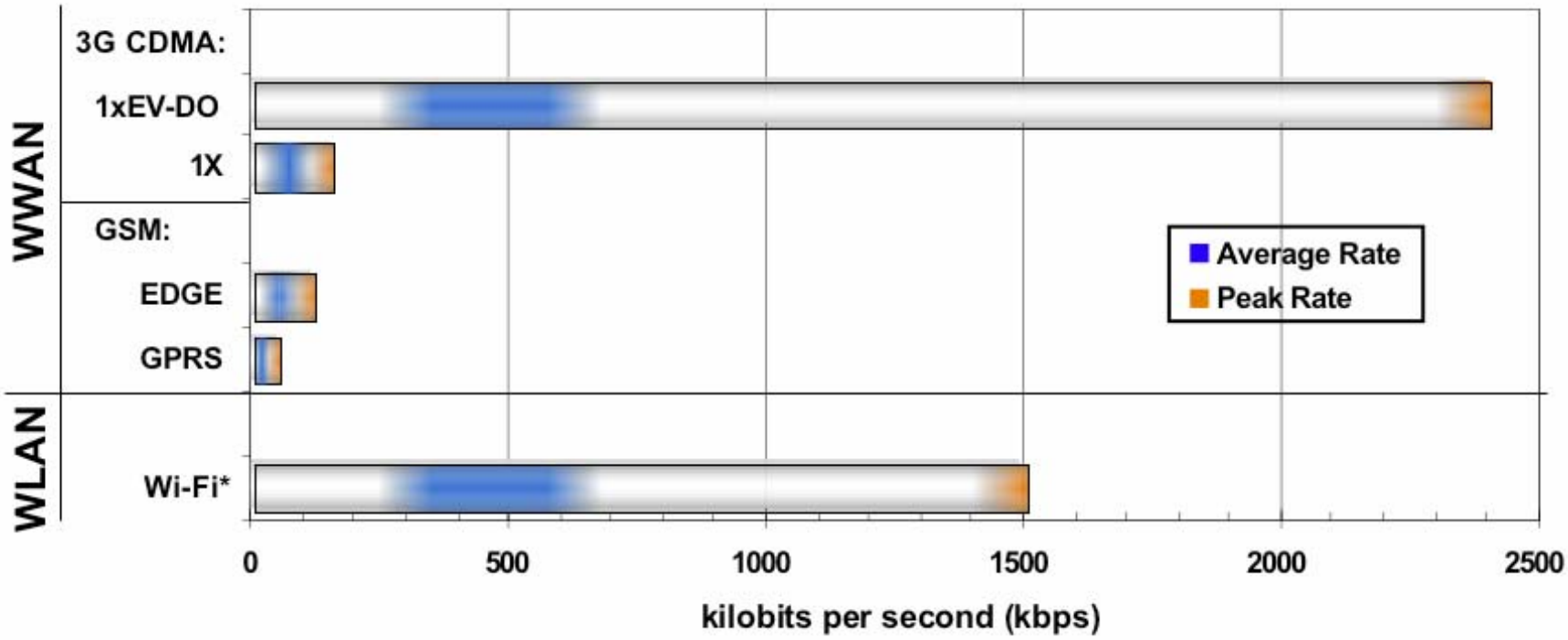
What is CDMA2000 1xEV-DO

- 1xEV-DO – EVolution, Data Optimized
  - Full name is CDMA2000 1xEV-DO - part of the 3G CDMA family
- Delivers data at rates up to 2.4 Mbps
  - Average data rates in the hundreds of kbps
  - Typically 300 kbps – 600 kbps
- Fixed, portable or fully mobile use
  - "Always-on" experience
- Cost-effective for operators, requires little spectrum



- 1xEV-DO is a 3G data evolution for CDMA operators
- Data and voice handoffs with CDMA
- Devices are backward/forward compatible
- Incremental upgrade over current CDMA2000 1X network
- 1xEV-DO works seamlessly with existing, IP-based network infrastructure

Real World Data Rate Comparison



EV-DO Provides Broadband Rates and Wide-Area Coverage

*Public Wi-Fi "hot spot" rates are limited by backhaul throughput. T1, DSL and cable are typical hot spot backhauls.

Operators Expanding Data Services With CDMA2000 1xEV-DO

5 Commercial Operators

verizon wireless

SK Telecom
MOST VALUABLE COMPANY

First in Mobile KTF

KDDI

Launched November 2003

VÉSPER

Over $1 billion EV-DO national rollout over next 2 years

Over 5M EV-DO subscribers as of January 2004

Coming Soon

vivo

biquiTel

TELKOM INDONESIA
(PT Mobile-8)

Pelephone

APBW 亞太行動寬頻電信

Alegro PCS
(Telecsa Ecuador)

ACS Alaska Communications Systems

QUALCOMM 5500 San Diego, CA USA	QUALCOMM 6500 San Diego, CA USA	QUALCOMM 6550 San Diego, CA USA	QUALCOMM 6800 San Diego, CA USA
2.4 Mbps gpsOne ARM 7	2.4 Mbps gpsOne ARM 9	2.4 Mbps Higher resolution video/graphics Camera to 4 megapixel	3.1Mbps Camera to 4 megapixel

Verizon Wireless Going Nationwide With Flat-Rate EV-DO

- **CDMA2000 1XEV-DO deployment to go beyond the current two markets -- San Diego and Washington, D.C.**
- **Offered at $79.99 flat rate, all-u-can eat pricing, 1xEV-DO offers speeds of 300 to 500 kilobits per second, or about 10 times the average dial-up connection speed...**

- **Verizon says it will spend $1 billion over the next two years to launch the EV-DO network... the company's nationwide deployment will be marketed to both consumers and enterprises...**

Source: Verizon Wireless, January 2004

Laptops & Wireless Integration

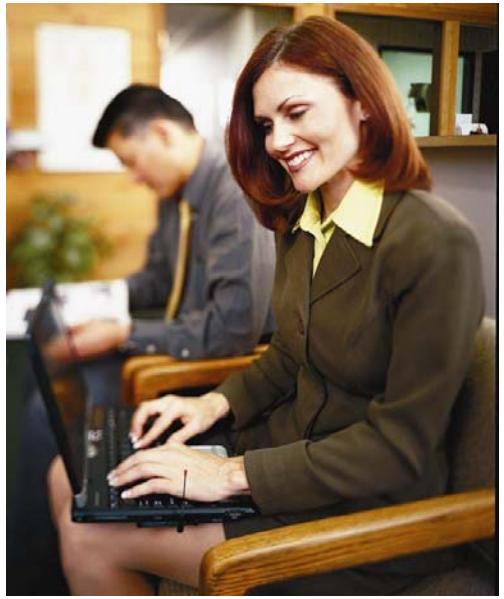
Wireless LAN

- In 2002, <20% of all laptops shipped had an integrated WLAN solution
- By 2006, approximately 95% of all laptops shipped will have WLAN integrated

Source: IDC, July 2003

Wireless WAN

- Products such as the Panasonic Toughbook are currently available with an integrated WWAN solution (enterprise focus)
- Within the next 2 years computer manufacturers will offer mass-market laptops with an integrated WWAN solution
  - QUALCOMM is actively working with laptop manufacturers and the FCC to help bring these products to market
  - PCMCIA WWAN data cards are currently available for consumer/enterprise use



Over 60 1xEV-DO Devices…*commercially introduced*

$600+ range:

$501 - $600:

$401 - $500:

PC Cards from $150:

$301 - $400:

$201 - $300:

$101 - $200:

Source: Retail pricing from South Korea, except when marked (*) which denotes Japanese retail price; PC cards from Korea, Japan, and the United States

Over 50 3G CDMA2000 1xEV-DO Handsets Available Today

South Korea Handset Market: New Models

KTFT KTF-E2000
(MMS)
- **Network: EV-DO**
- **Screen Type: 65K LCD**
- **Sound: 40 poly**
- **Camera: 110K pixels**

Samsung SPH-V3000
(Video-On-Demand)
- **Network: EV-DO**
- **Screen Type: 262K LCD**
- **Sound: 40 poly**
- **Camera: 110K pixels**

Pantech & Curitel PG-1200
(64 Polyphonic)
- **Network: 1X**
- **Screen Type: 65K LCD**
- **Camera: 330K pixels**
- **Add'l Features: GPS, 3D Sound, Dual Speaker**

LG KV-1300
(Camcorder)
- **Network: EV-DO**
- **Screen Type: 260K LCD**
- **Sound: 40 poly**
- **Add'l Features: 1 hour recording time, 64 MB Flash memory**

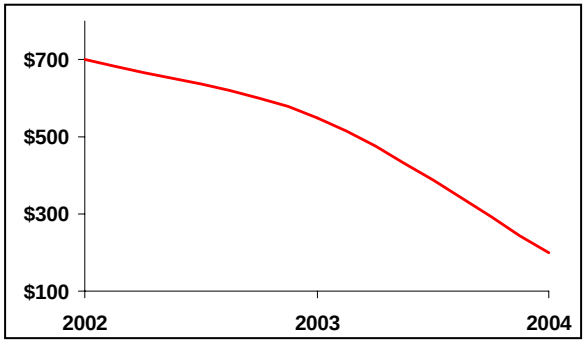
Samsung SCH-V330
(Video Mail)
- **Network: EV-DO**
- **Screen Type: 262K LCD**
- **Sound: 40 poly**
- **Camera: 300K (CMOS)**
- **Add'l Features: GPS, Video Mail**

Samsung SCH-V310
(Video Telephony)
- **Network: EV-DO**
- **Screen Type: 262K LCD**
- **Sound: 40 poly**
- **Camera: 110K pixels**
- **Add'l Features: GPS**

Samsung MITs-M400
(EV-DO PDA)
- **Screen Type: 650K LCD**
- **Camera: 300K pixels**
- **Add'l Features: Internal TV tuner; Pocket PC 2002 Phone Edition**

CDMA2000 1xEV-DO Device Trends

Retail prices have dropped 60% in 2 years: from $700 in January '02 to less than $200 in January '04



- **100 grams or less a standard**
- **Higher-resolution LCD's with tens or hundreds of thousands of colors, new phones incorporate QVGA screens**
- **30 of the 44 devices have cameras, mostly video and new phones have more than a megapixel resolution**
- **Audio and video players for MPEG4, MP3, AAC downloads, many have streaming capability for real-time content delivery**

CDMA2000® 1xEV-DO (1.25 MHz)

FL: 2.4 Mbps
RL: 153 Kbps

1xEV-DO Rel. 0

MSM 5500
MSM 6500
CSM 5500
MSM 6700
CSM 6700

FL: 3.1 Mbps
RL: 1.2 Mbps

1xEV-DO Rev. A

In Standards

- Quality of Service
- Multicast
- Instant Media

What's Next for CDMA2000 1xEV-DO?

Multimedia Services, Increase Data Rates and System Capacity, and Lower Costs

Quality of Service (QOS)
Different levels of priority

Instant Multi-media
Audio and video together

Personal Media
Multiple channels of video/audio

Equalizer
Increase sector capacity 20-60%

Receive Diversity
4X capacity in 1.25 MHz

2x Multicarrier
Two 1xEV-DO carriers simultaneously, doubling data rates

Location-based services (LBS)
High resolution locations

EV-DO Gold Multicast

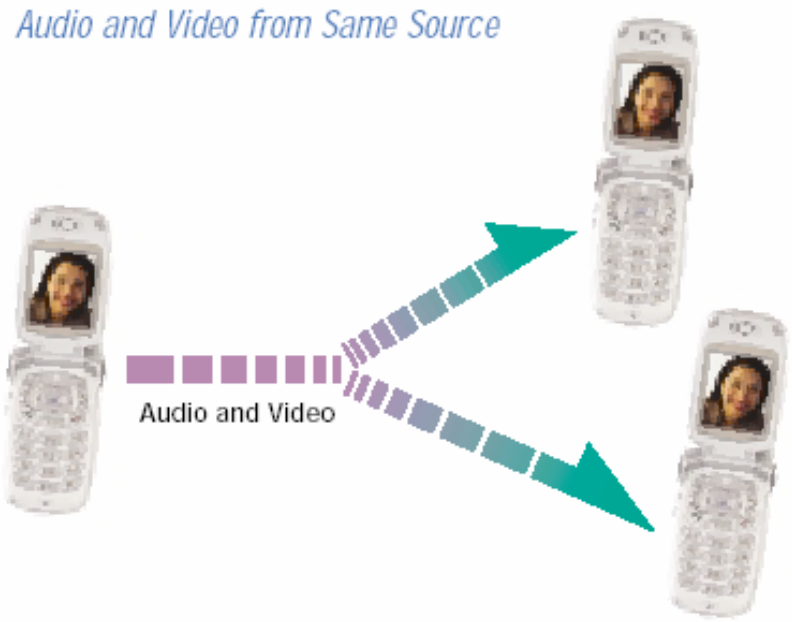
- Each channel may be transmitted at different rates and different BTS' may transmit multiple channels
- No physical layer changes to EV-DO Rev 0
- Software upgrade only, channel cards not affected
- Flexibility in allocating portions of the forward link to EV-DO unicast services vs. Multicast
- Information delivered encrypted over the air
- Standard mechanism leveraged for the device to request specific services and be authenticated

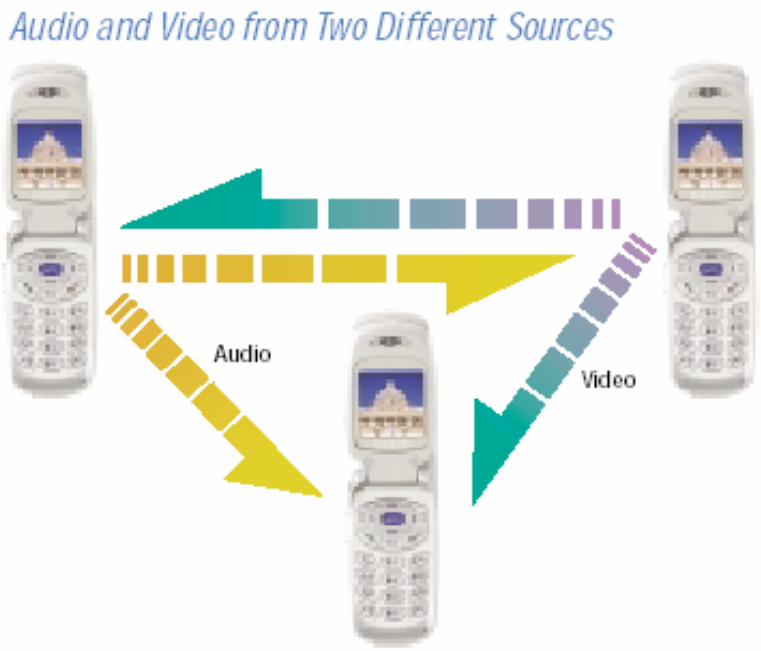
EV-DO Gold Multicast

- Multiple channels of content can be distributed to many users at the same time
- Efficient method to distribute content in a cellular environment
- Users may choose various content based on pricing plans

1xEV-DO Going Forward: Instant Multi-Media (IMM)

- **Combines the best of video conferencing and group services**
- **Everyone in the group receives audio and video from the originator**
- **Both audio and video can come from one user or two different users (separate audio and video floors)**

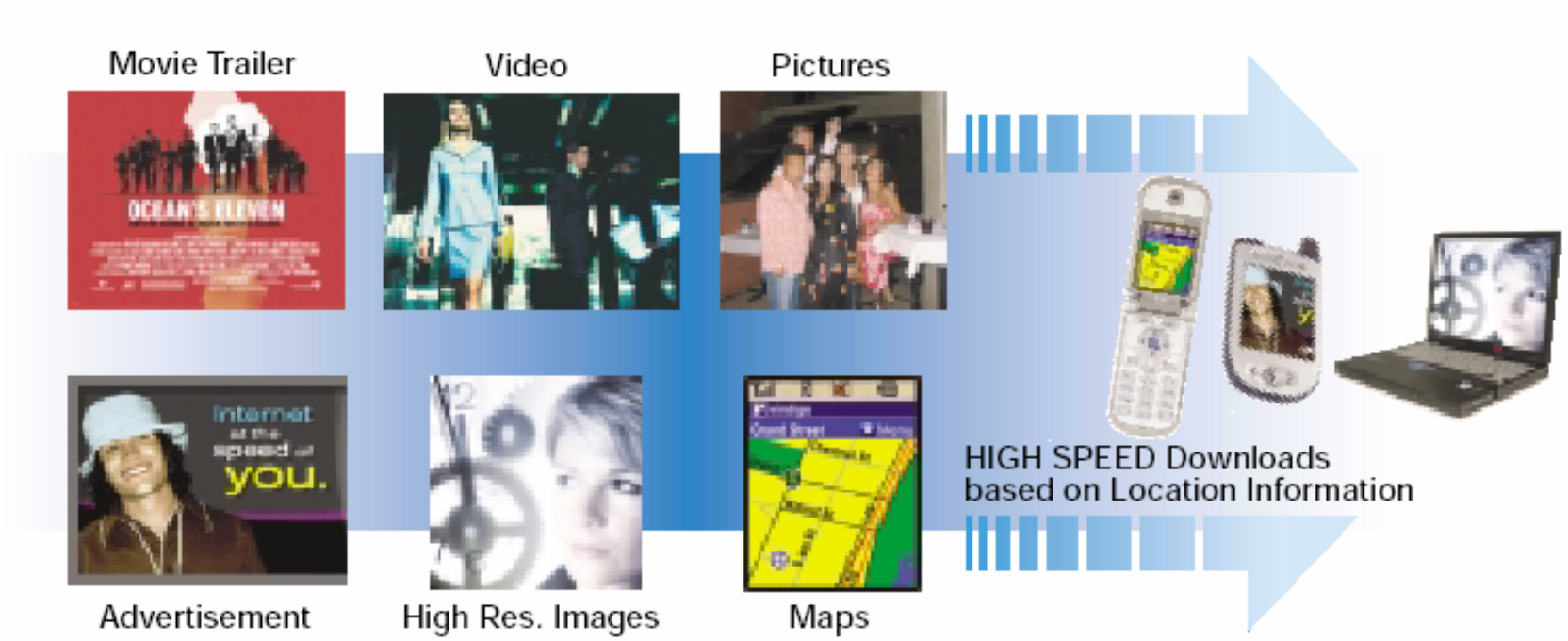




1xEV-DO Going Forward: Rich Location Based Services

Location Based Services over CDMA2000 1xEV-DO

- **Rich multimedia content coupled with location based services**
- **CDMA2000 1xEV-DO fast downloads enable location relevant information with an improved user experience**
- **Location information acquired over CDMA2000 1xEV-DO airlink along with the rich content**



CDMA2000 1xEV-DO Video Telephony (VT)

Simultaneous Voice and Video – High Quality and Efficiency

- **SKT launched July 2003, KTF announced plans to launch 2004**
- **Packet (CDMA2000 1xEV-DO) based VT more efficient and flexible**
  - **Voice and video inherently variable rate**
  - **High throughput for medium QoS Video**
- **CDMA2000 1xEV-DO QoS solution: "Rev0+QoS"**
  - **3GPP2 expect to publish in early 2004**
- **Quality & Capacity Improvements with Rel. A**

"Push to See"

Samsung SCH V310

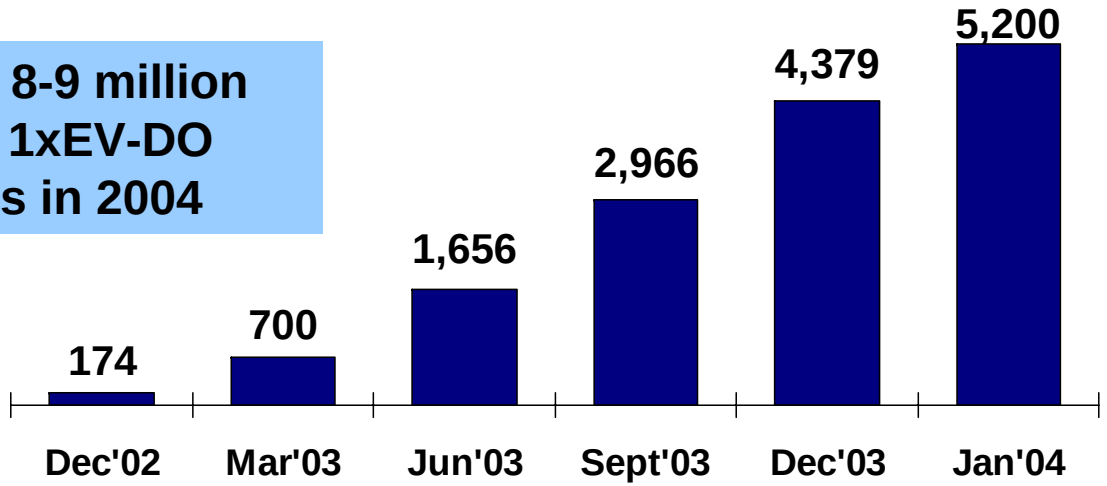
South Korea CDMA Market

Population 49M, Wireless Penetration 69%, CDMA Penetration 100%

- **Number portability**
- **Continued replacement cycle**
- **CDMA2000 1xEV-DO continuing to grow**
- **Limited WCDMA launch, meets MIC licensing terms**

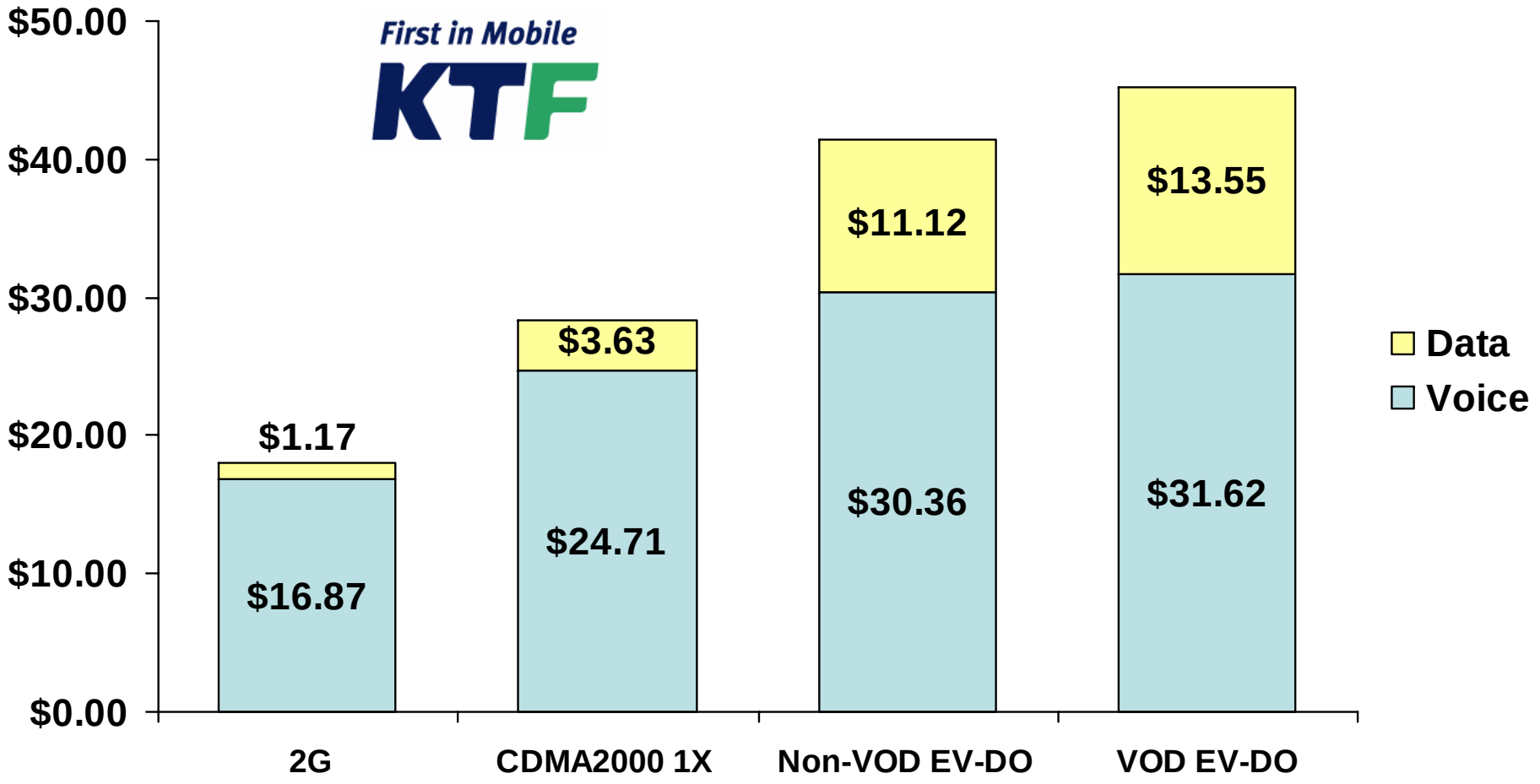
South Korea CDMA2000 1xEV-DO Subscribers (Millions)

SKT expects 8-9 million CDMA2000 1xEV-DO subscribers in 2004



Source: Ministry of Information and Communication, Digital Times, U.S. Census Bureau, EMC January 2004

KTF Monthly Voice and Data ARPU by Device Type Q4'03



Source: KTF Q4'03 Earnings release; net based $1 US=1,168.50 KRW

PDA's – Enabling Mobile Wireless Data

Hitachi SH-G1000

CDMA2000 1X
Commercially Launched – July 2003
Operator(s) - Sprint PCS

SPECIFICATIONS

153 kbps data capable , 238 grams

65K color TFT-LCD, 150 min Talktime
168 hr Standby

Built-in rotating VGA camera
gpsOne enabled
Pocket PC 2002, Phone Edition

SD Card Slot
Voice-activated dialing

Sharp SH2101V
(FOMA)
WCDMA

Samsung MITS
M400

LG Telecom PCD-200

Cellvic mycube
V100

HTC Hutch ICE

PC-EPhone
Cyberbank POZ

Handspring
Treo 600

Audiovox Thera

RIM
BlackBerry 6750

Samsung
SPH-i330 /
MITS M330

G.MATE
YOPY YP3500

Motorola
A920

Samsung
NEXiO
S150

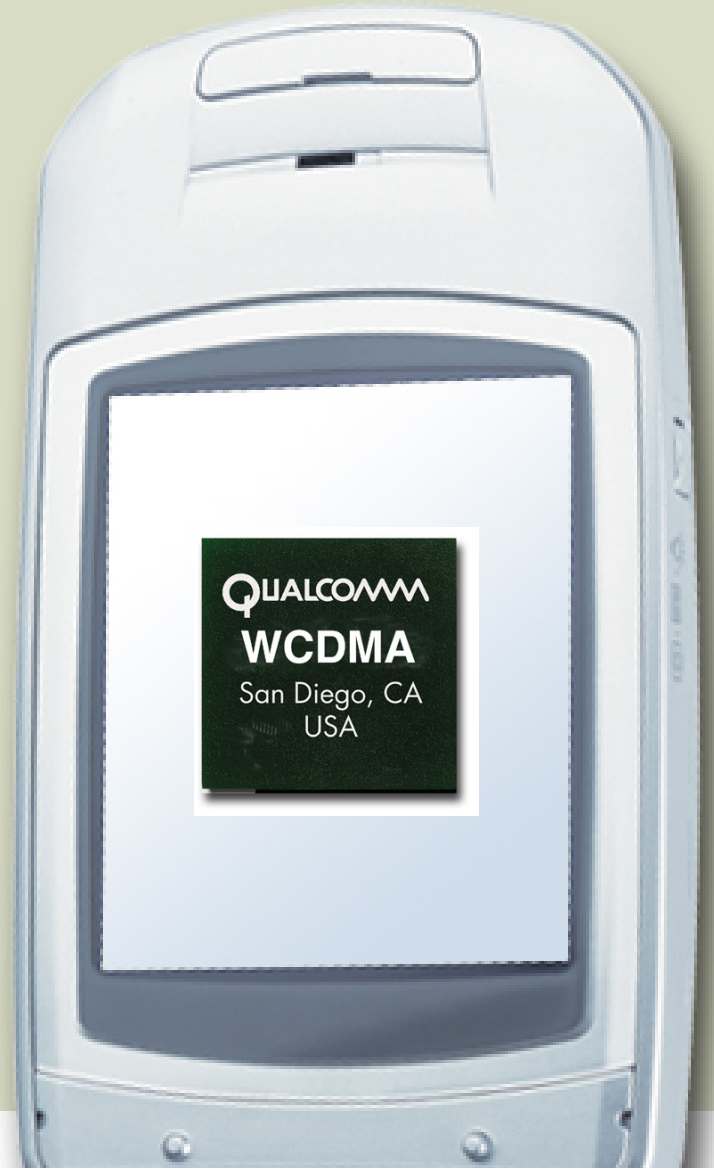
Samsung
SPH-i500

Cellvic XG

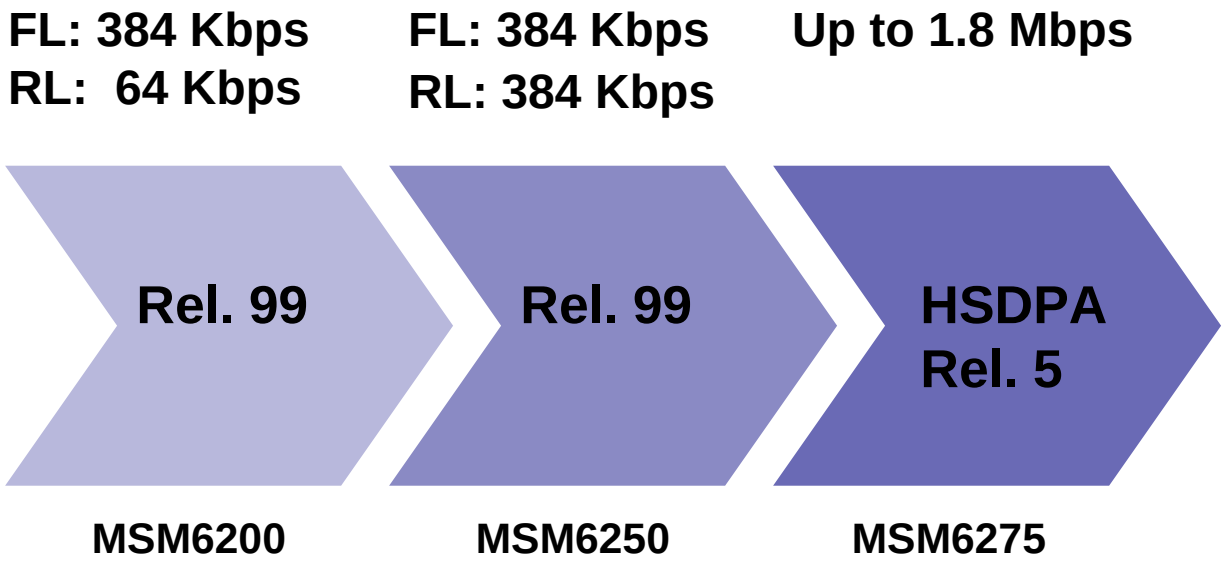
UCSD CyberShuttle - First Bus to Offer 802.11b With CDMA2000® 1xEV-DO Internet Connection

- Riders with a laptop or handheld computer equipped with WLAN connect to access point in the bus, which communicates with the Internet by 3G network
- No extra payment required
- 2.4 Mbps peak, 600–800 KBPS average fully supported bus load of students/faculty
- Popular service

WCDMA (UMTS)

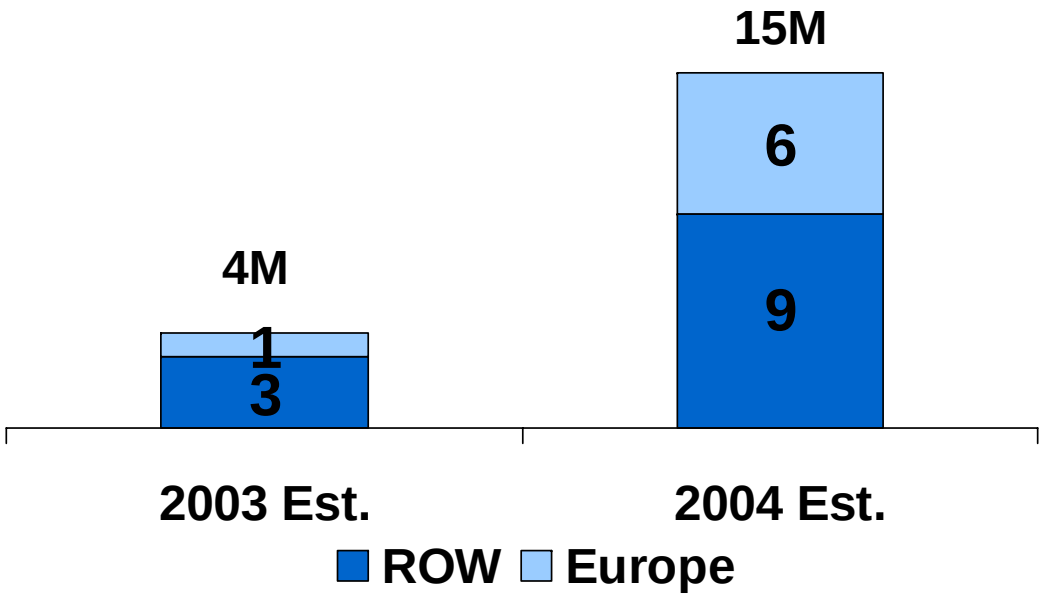


WCDMA (UMTS) Voice & High-Rate Data on Single Wideband Carrier



3G WCDMA is Here Today

QUALCOMM WCDMA Handset Estimate
As of January 21, 2004



2M subs in Japan Jan 2004, FOMA coverage area from 98% to 99% by the end of FY03

Source: DoCoMo Q3'03 Earnings

Signed Over 55 WCDMA (UMTS) License Agreements

Same Royalty Rate by Manufacturer Regardless of Standard

Licensed manufacturers include:

- Agilent
- Alcatel
- DENSO
- Ericsson
- Fujitsu
- Hitachi
- Hyundai
- Kenwood
- Kyocera
- LG Electronics
- Lucent
- Mitsubishi Electric
- Motorola
- NEC
- Nokia
- Nortel Networks
- Panasonic
- Philips
- Samsung
- Sanyo
- Sharp
- Siemens
- Toshiba

Hutchison Whampoa Ltd.

J-PHONE vodafone

FOMA

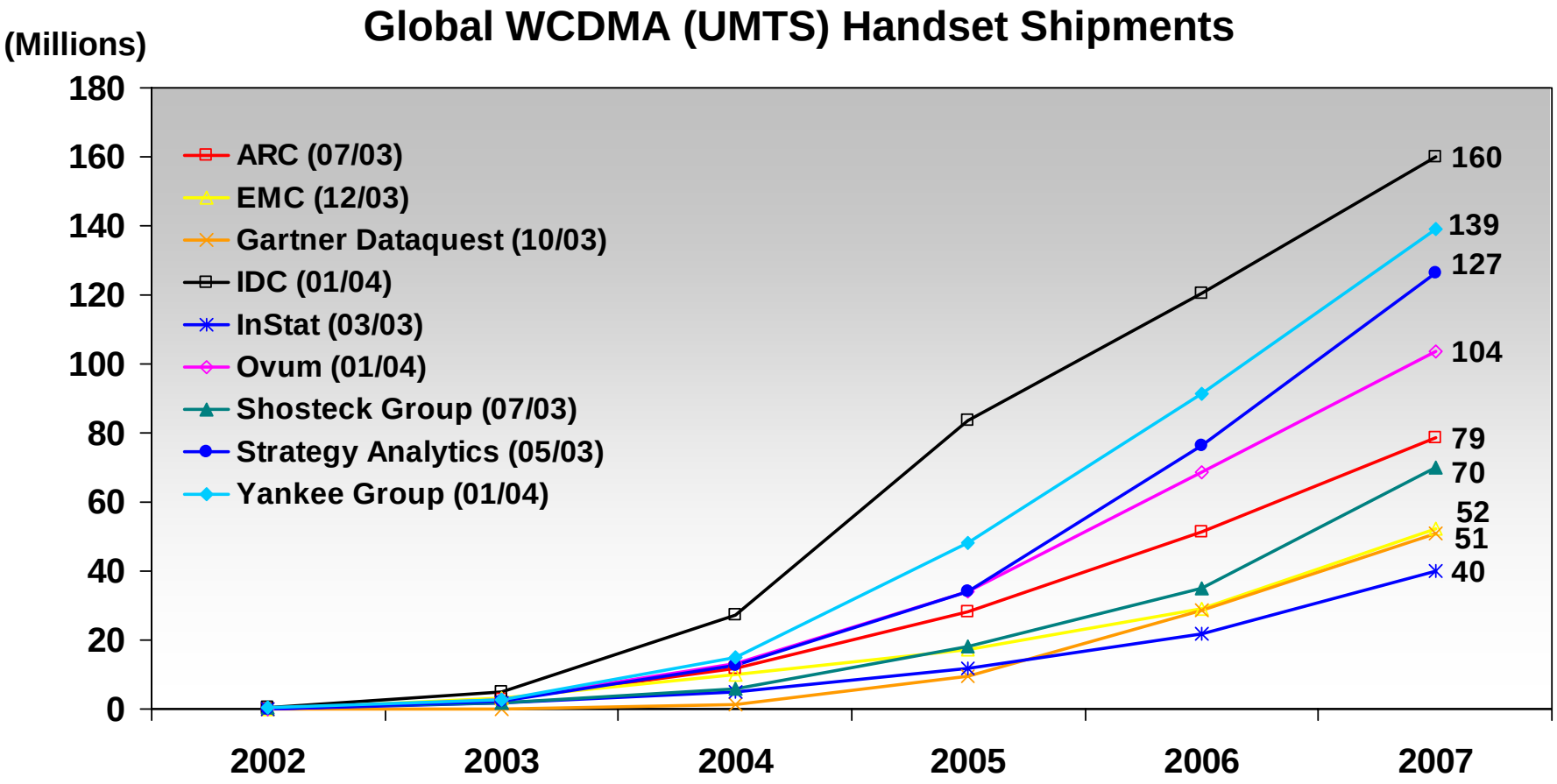
NTT DoCoMo

"We cannot avoid Qualcomm's patents, which are essential to the standards. Everyone has to use them,"

- Adam Gould, Nokia CTO CDMA, Jul 25, 2003

WCDMA (UMTS) – Incremental Growth Opportunity

Increases Chip Market and Royalties



Many Ways QUALCOMM Helps WCDMA Operators

Network testing

WCDMA chips & support 17 customers to date

Sanyo VSA701

Interoperability testing

QUALCOMM test phone

Interacting with operators on feature sets

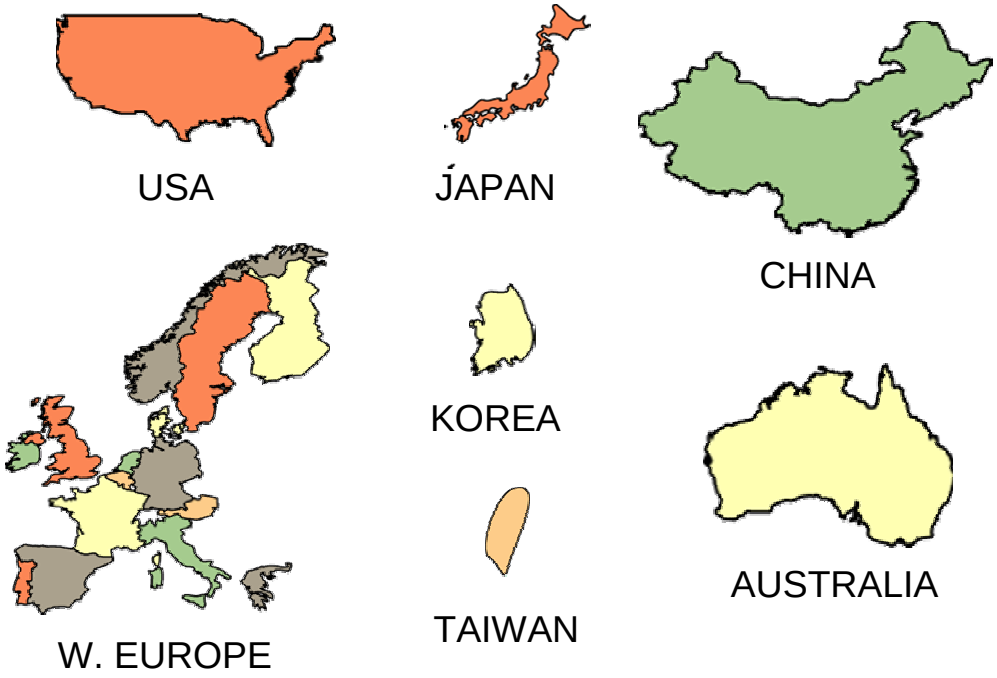
Applications from CDMA transfer immediately to WCDMA

QUALCOMM UMTS TESTING & VERIFICATION PROGRAM

QUALCOMM STATUS TODAY

- **Tested with all 13 WCDMA (UMTS) infra vendors**
- **Test mobiles verified at 2100 MHz & 1900 MHz**
- **GSM/GCF Certified**

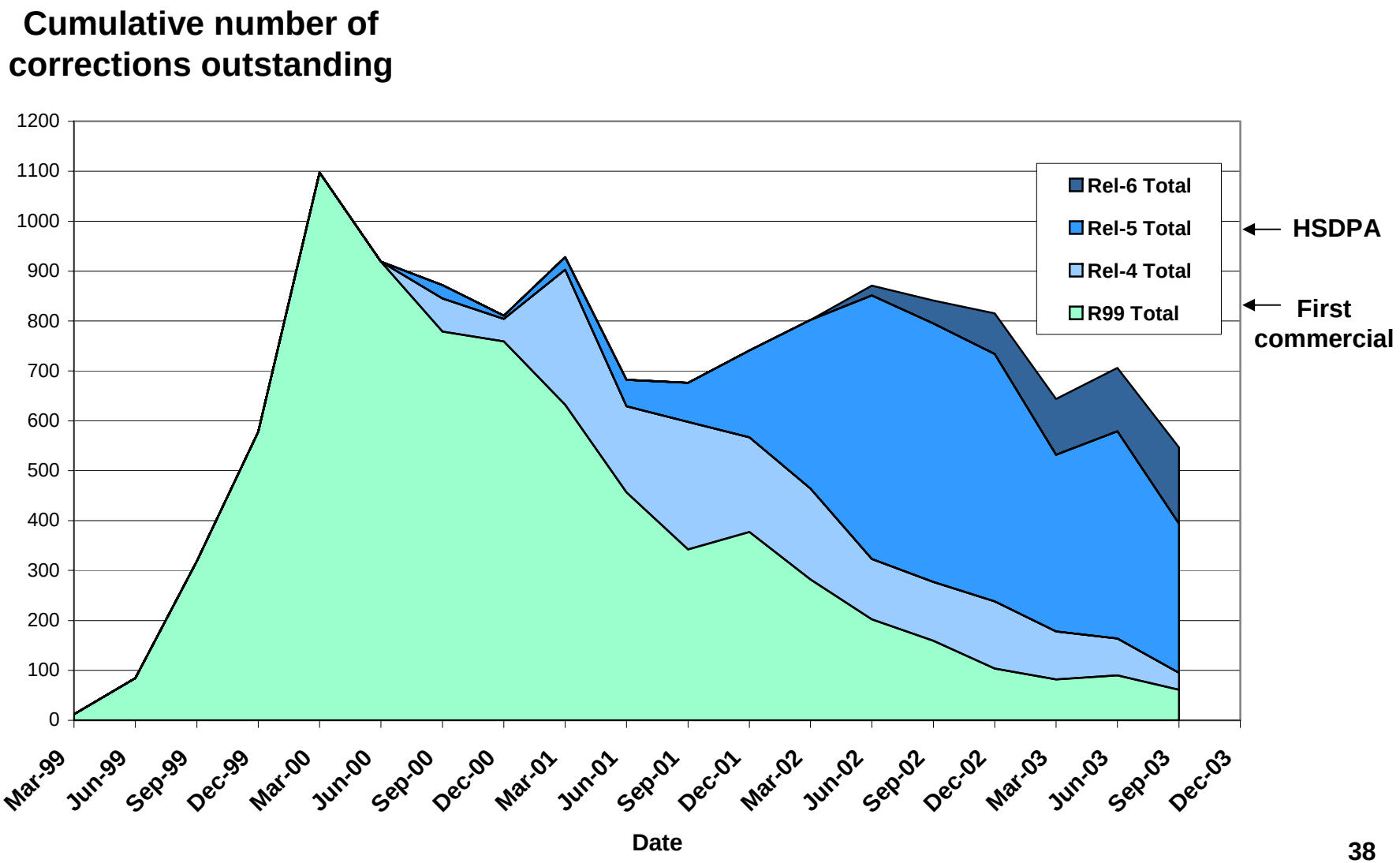
Completed testing with operators and infrastructure vendors around the globe



3GSM™ WORLD CONGRESS 04

2002	*First public WCDMA (UMTS) demonstration*
2003	*First public demonstration of consumer WCDMA (UMTS) devices*
2004	*Demonstration of expanded base of consumer devices*

3GPP Releases and Corrections



QUALCOMM WCDMA (UMTS) Program Supports Mass Market Devices

New 3G Handset Designs to Support a Variety of Multimedia Features

QUALCOMM WCDMA (UMTS) selected by 17 manufacturers

SAMSUNG
LG
TOSHIBA
OPTION WIRELESS TECHNOLOGY
SANYO
NOVATEL WIRELESS
SIERRA WIRELESS HEART OF THE WIRELESS MACHINE™
ZTE
Huawei Technologies
Hisense

QUALCOMM has most established IOT Program

Sony Ericsson
Lucent Technologies
Huawei Technologies
MOTOROLA
NEC
Huawei Technologies
ZTE
NORTEL NETWORKS
UTStarcom
LG
SAMSUNG
NOKIA
SIEMENS
ALCATEL TELECOM

IOT = interoperability testing

Commercially Ready Solutions Enable Mass Market Devices

QUALCOMM
UMTS
San Diego, CA
USA

17 WCDMA/UMTS Partners and Counting…

WCDMA (UMTS) MSM6XXX Series

Market Traction

Existing WCDMA Commercial Solutions

- QUALCOMM 6250 — San Diego, CA USA
- QUALCOMM 6200 — San Diego, CA USA

- 17 Customers
  - High-tier
  - Mid-tier

New….Sampling in 2004

High-Tier

- QUALCOMM 6275 — San Diego, CA USA

- HSDPA, EDGE
- Video playback, streaming, recording & telephony
- MPEG-4 decode for streaming/offline viewing
- MPEG-4 encode for camcorder
- Higher resolution camera capability
- Faster 2D/3D graphics support
- High speed, low power, serial MDDI

- High-tier

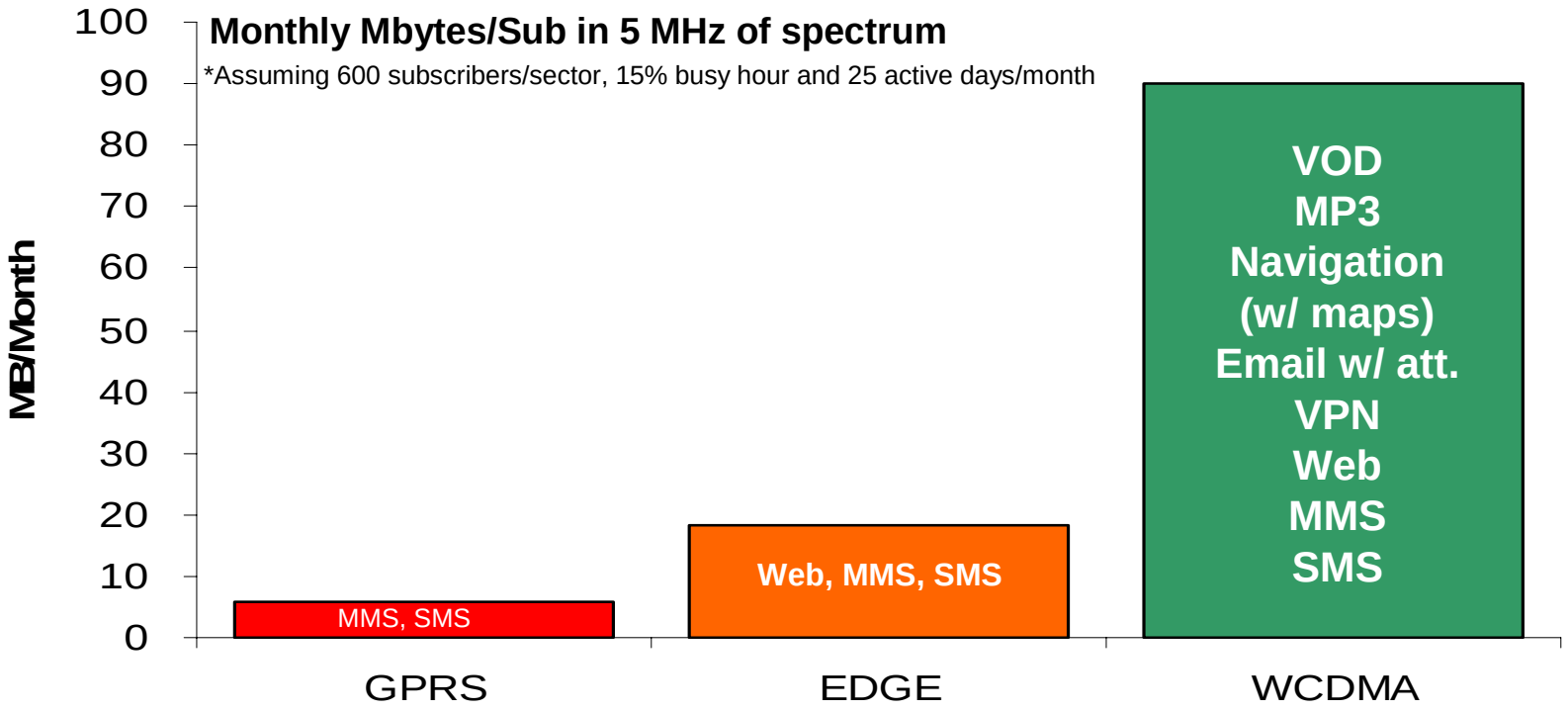
Entry-Tier

- QUALCOMM 6225 — San Diego, CA USA

- Integrated radioOne
- MSM6250 Pin compatibility
- 384 kbps data
- MIDI, MP3 and AAC Audio
- Streaming/downloading of video
- Integrated camera capability

- Entry-level voice and data devices

WCDMA Provides Greater Headroom for 3G Services



WCDMA Delivers Richer Services