



November 14, 2006

**Innovation, Technology and
Spectrum Policy Mini-Conference
George Mason University
School of Law**

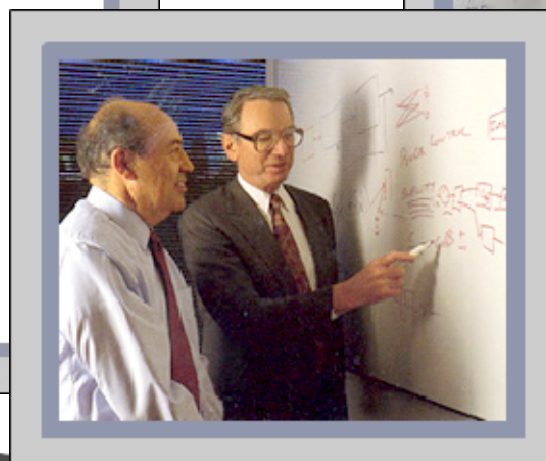
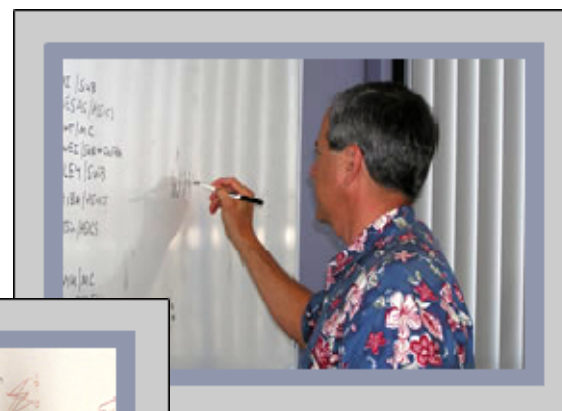


LINKABIT – Founded October, 1968

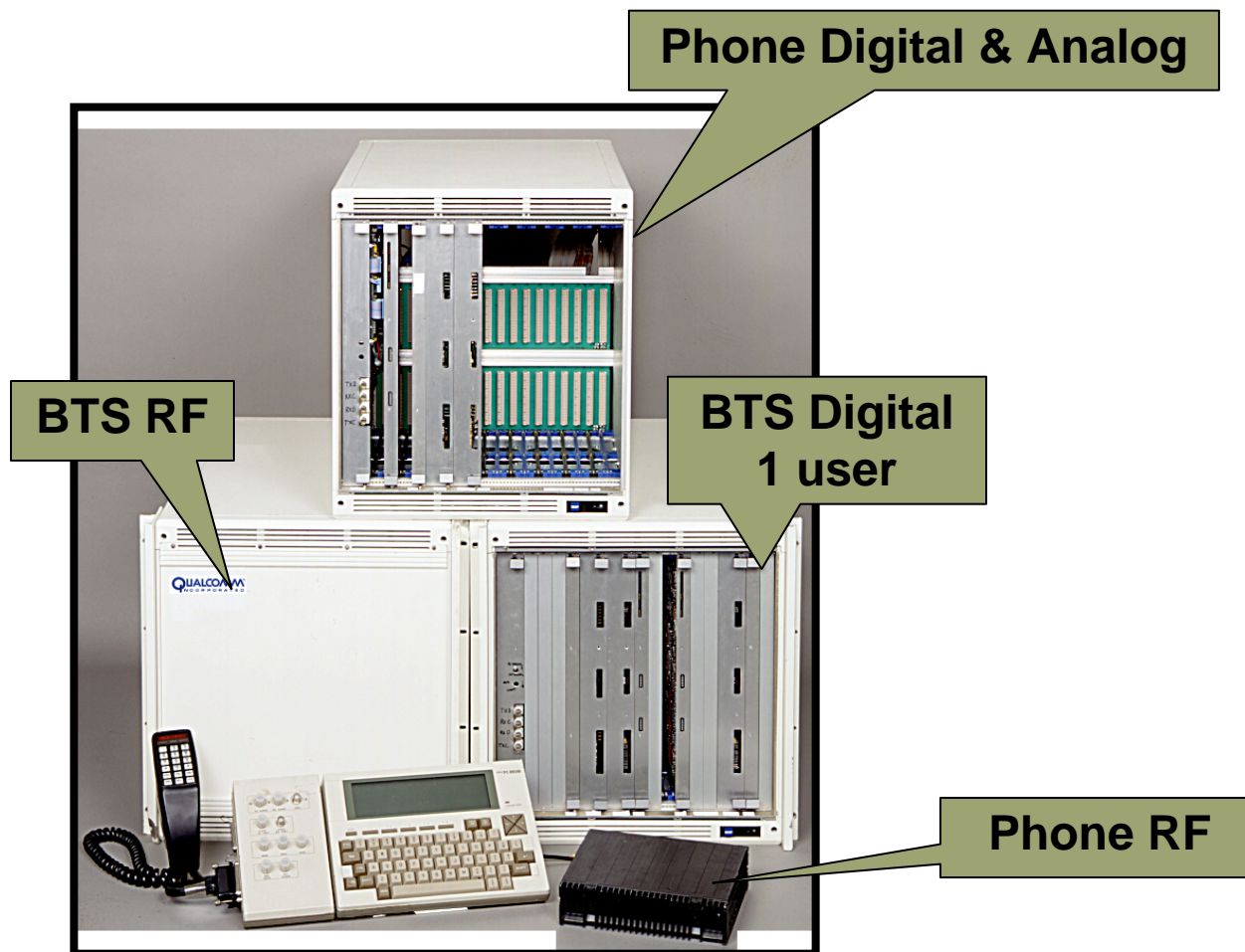
QUALCOMM - Founded July 1, 1985

For Both Companies - No Products at Start

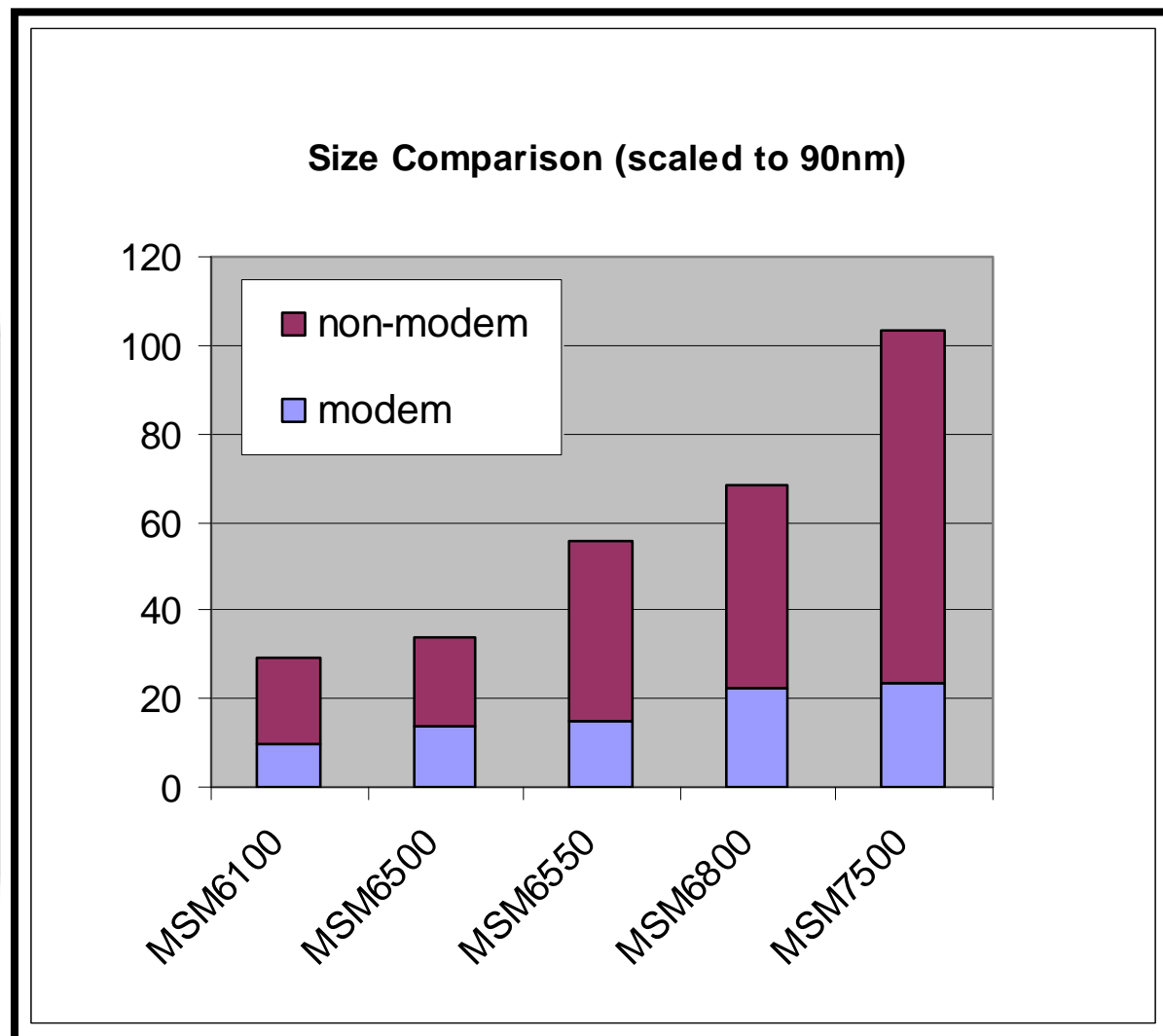
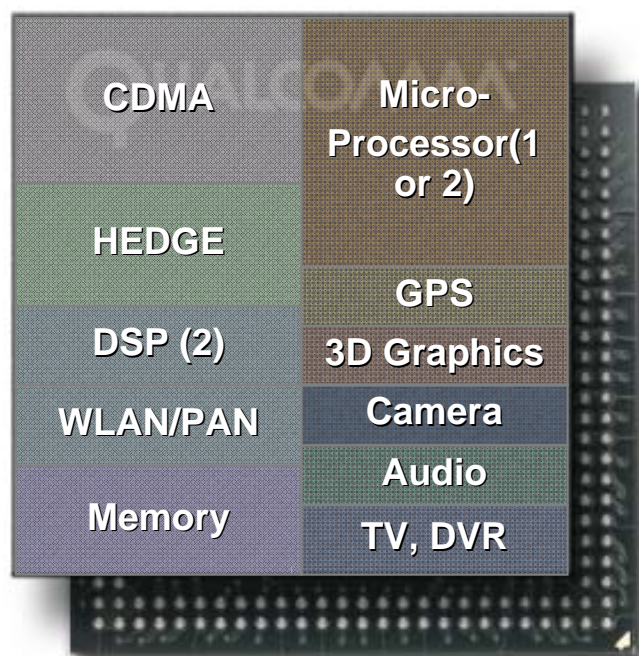
Strategy – Innovation: Digital & Wireless Communications & Applications



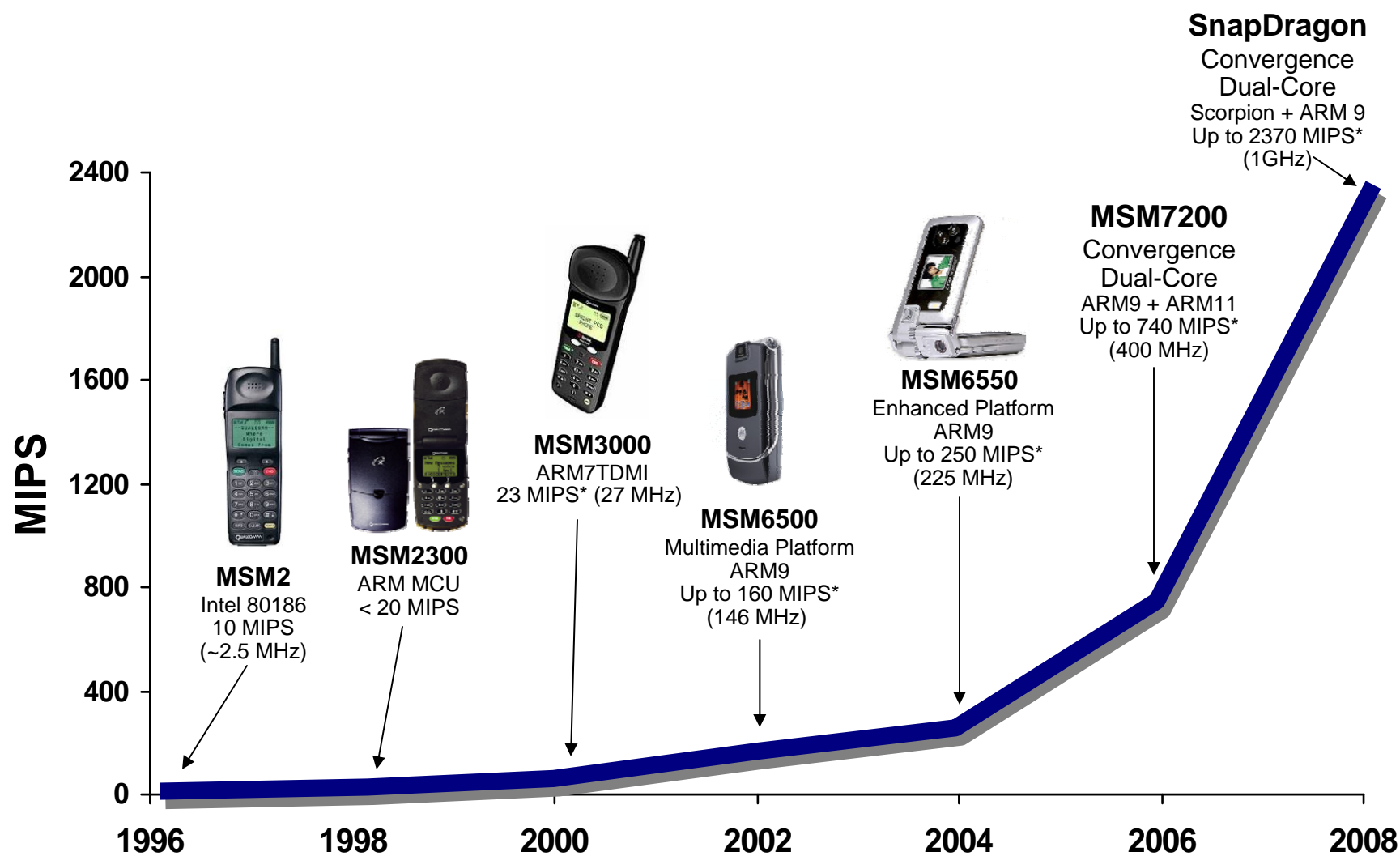
November 1989 – First CDMA Demonstration Two Base Stations (BTS) & “Mobile” Phone



Nov. 1991: 3 Separate Chips Required for 2G CDMA Modem 2006: 1 Chip Supports Multimode 3G/2G Modem & Much More

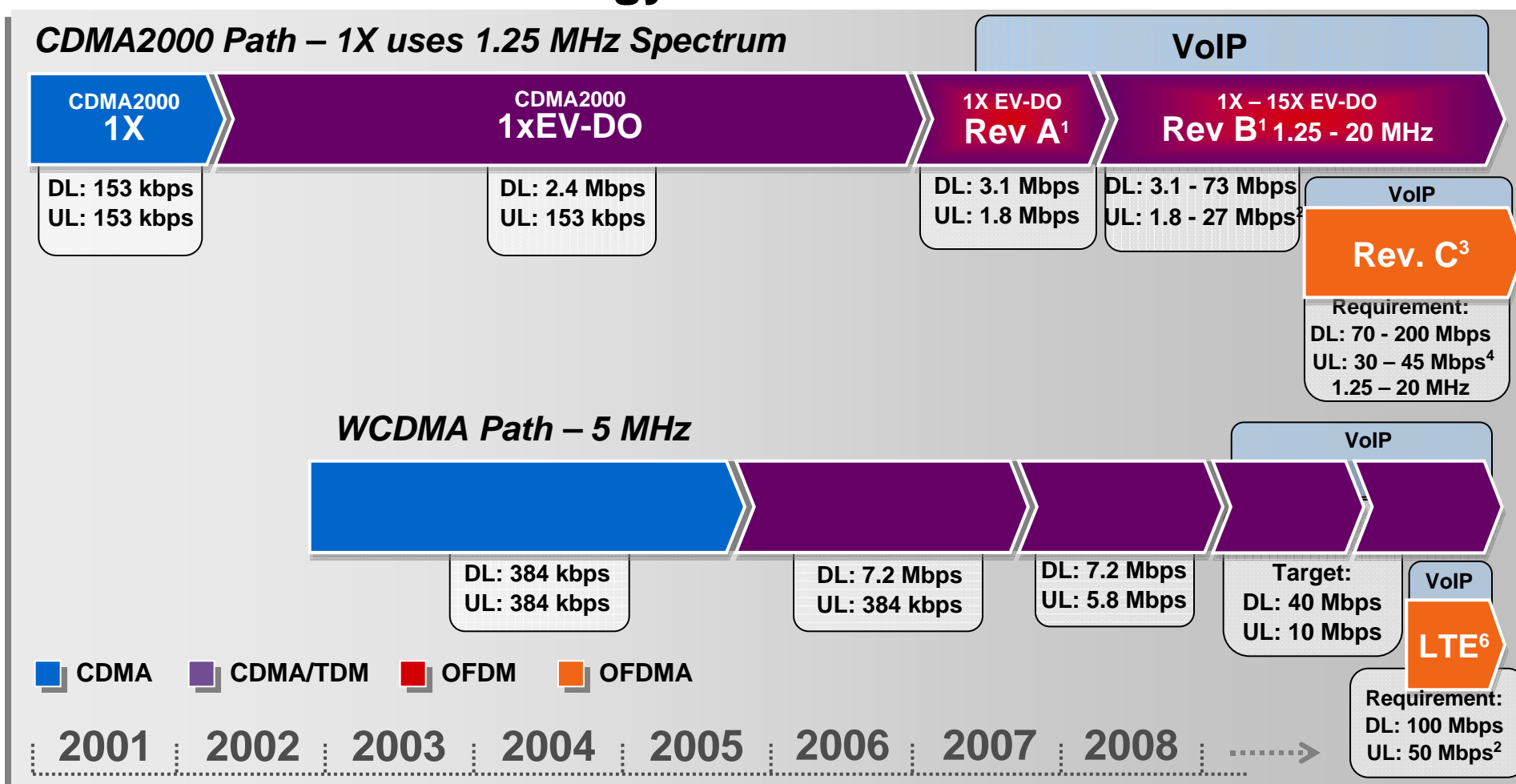


Mobile Processing Power – Changing the Mobile Device



* Dhrystone 2.1

3G Broadband Technology Evolution



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 figures are based on a 2 x 20 MHz allocation

³ Will likely have multiple modes supporting FDD and TDD operation and utilizing a combination of OFDMA and CDMA; MIMO/SDMA; leverages EV-DO protocol stack

⁴ Data rate dependant on level of mobility. Data rates of 73 Mbps for the DL and 27 Mbps for the UL figures 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

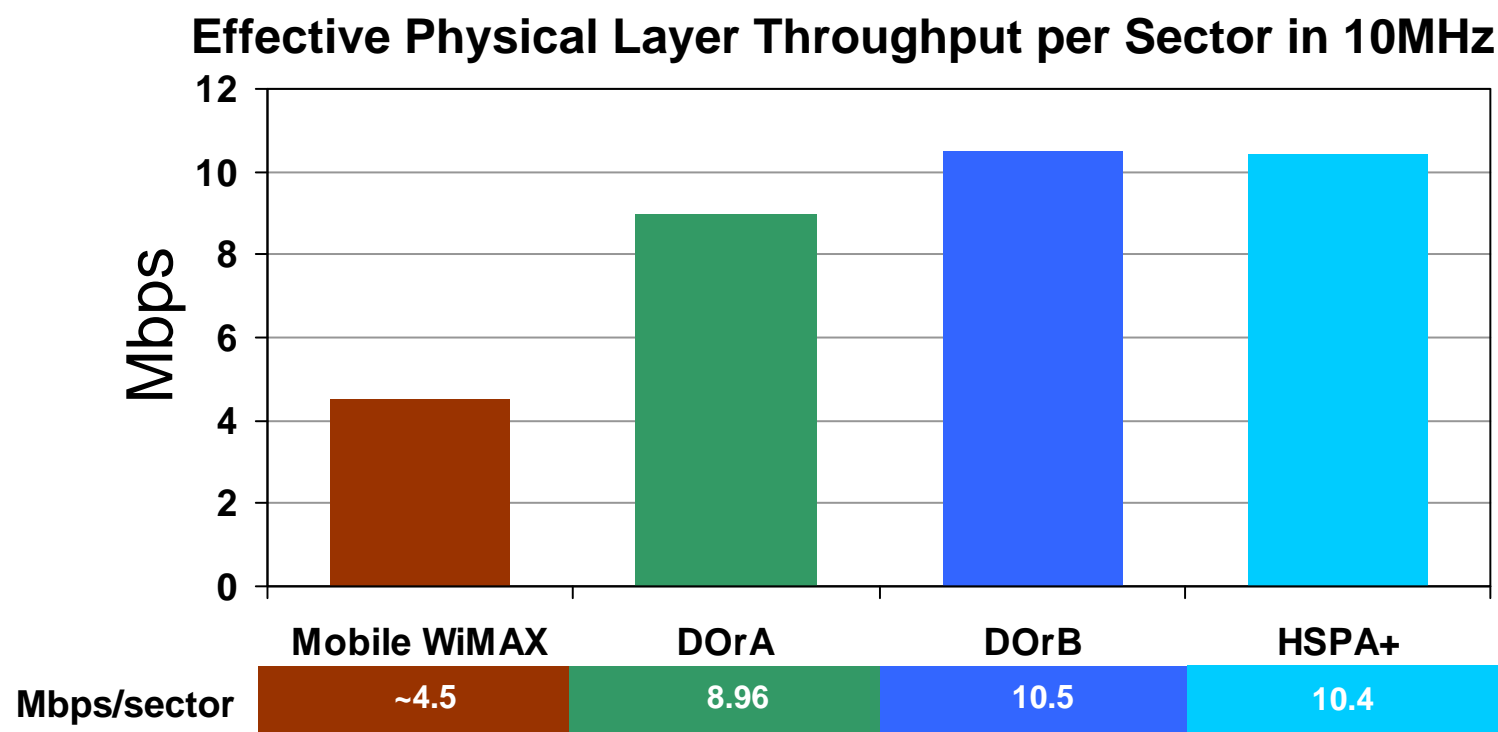
3G Offers Many Embedded Solutions Today

| September 2005 | September 2006 |
|------------------------|----------------|
| 0 | 74 |
| Commercial Notebooks | |
| 0 | 10 |
| Notebook manufacturers | |
| 0 | 11 |
| 3G Embedded Carriers | |



Today's 3G Technologies Outperform Mobile WiMAX

Forward Link Sector Throughput Comparison



Simulation assumptions:

SIMO Full Buffer, physical layer performance

3GPP2 frame work

DV channel model mix

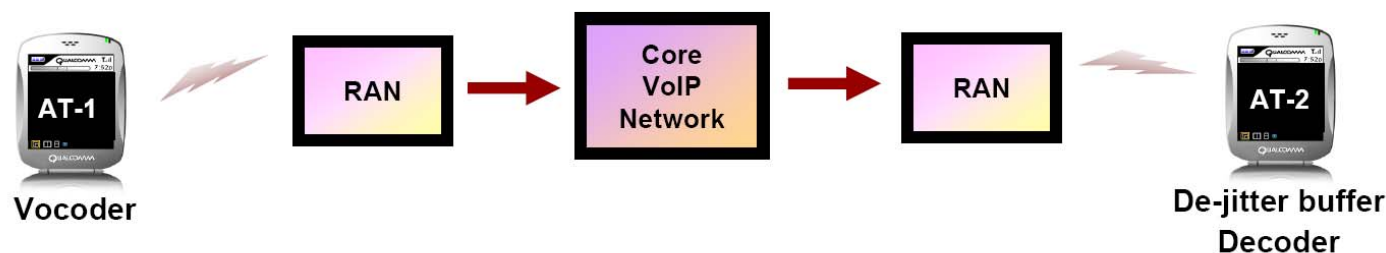
Equalizer gain simulated for DOrA, DOrB and HSPA+

10MHz TDD 2:1 carrier for Mobile WiMAX, scaled to 10MHz effective Forward Link

5MHz FDD carrier for HSPA+ , 2 carriers in 2x10MHz. 1.25MHz FDD carrier for DOrA and DOrB, 7 carriers in 2x10MHz

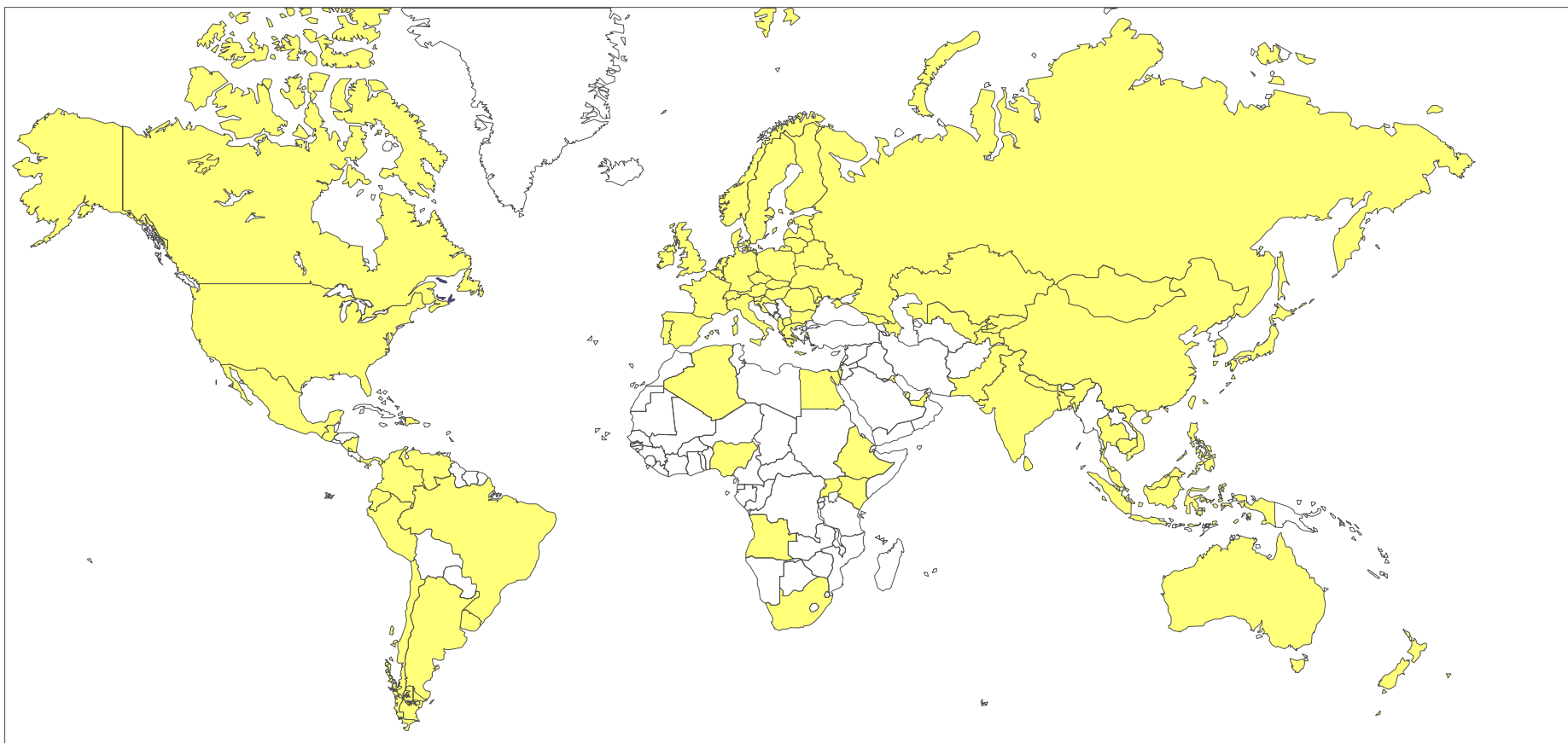
Wireless Voice over Internet Protocol (VoIP) Packet-Switched Voice on EV-DO Rev A, Later on HSPA+

- DOrA VoIP Tested in Loaded Wide Area Network
- Result: **60 to 70** High Quality VoIP calls per Sector in 1.25 MHz
- **30-35 times more efficient than 1G Analog**
- Advanced techniques ensure quality comparable or better than circuit-switched voice services
 - Utilize Quality of Service (QoS), advanced hand-off algorithms, mobile Rx diversity, Equalizer, and other enhancements



Low-Latency Enables Fast-Response Push-to-Talk & Push-to-Media Networks

1 Billion People Estimated To Have Access to Over 118 3G Mobile Broadband Networks by End of Calendar 2006



50 Million Mobile Broadband Subscribers Estimated by End 2006

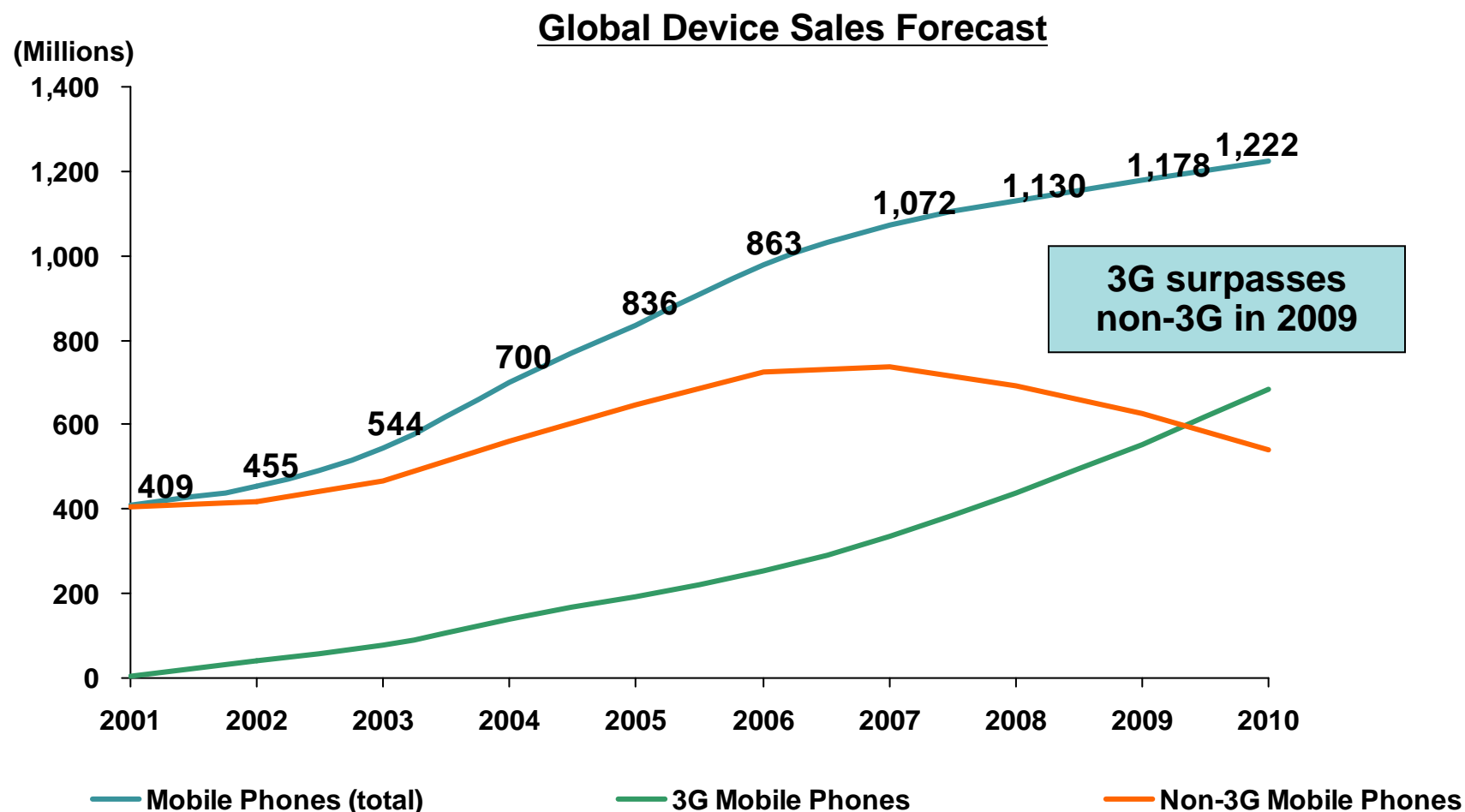
EV-DO: 51 Commercial Operators

HSDPA: 25 Commercial Operators

*Source: 3Gtoday.com as of November 2006: 1xEV-DO: 51 operators and HSDPA: 25 operators. 1 billion refers to combined estimated POPs coverage.

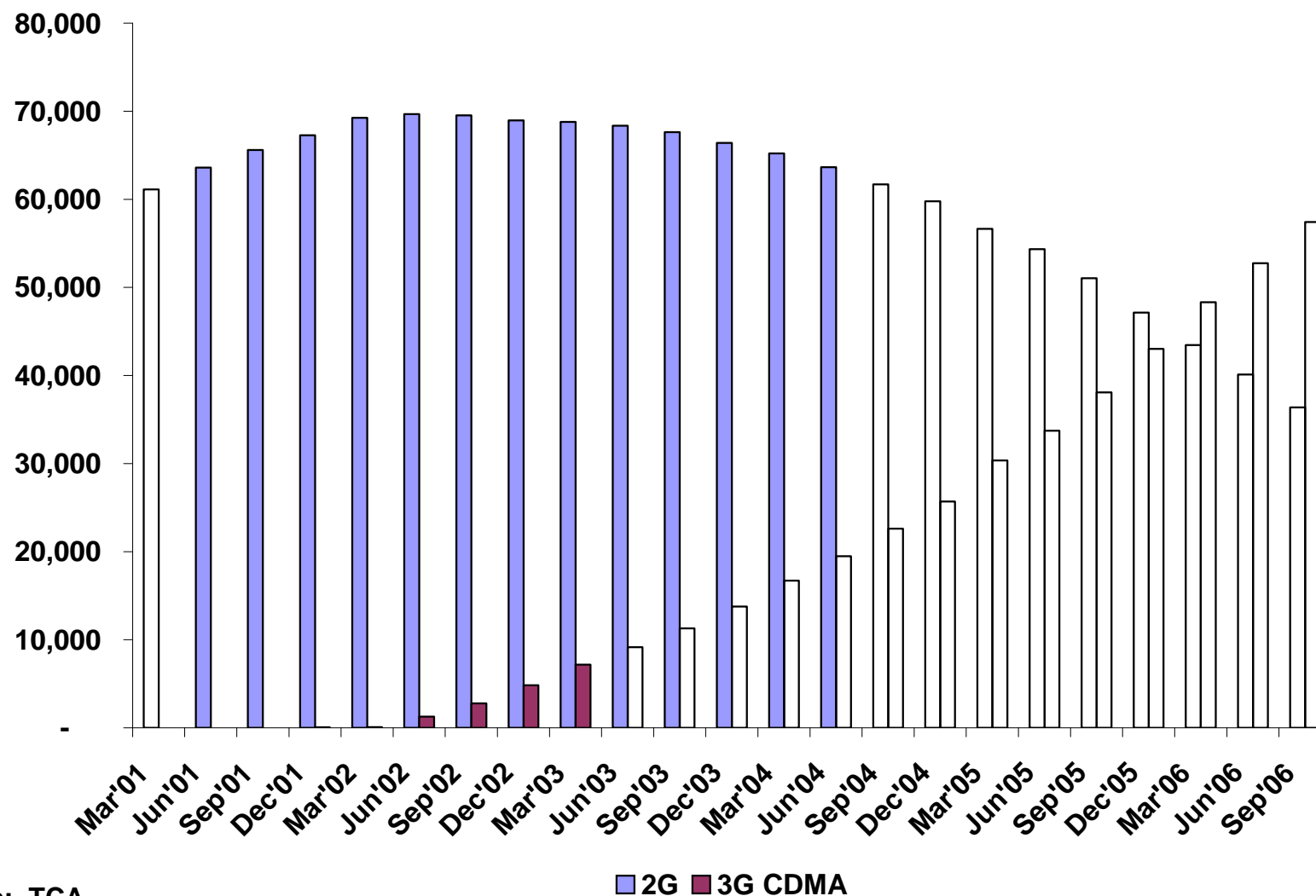
3G Shipments to Surpass All Others Before 2010

Increasing Network and Device Capabilities at Reduced Costs

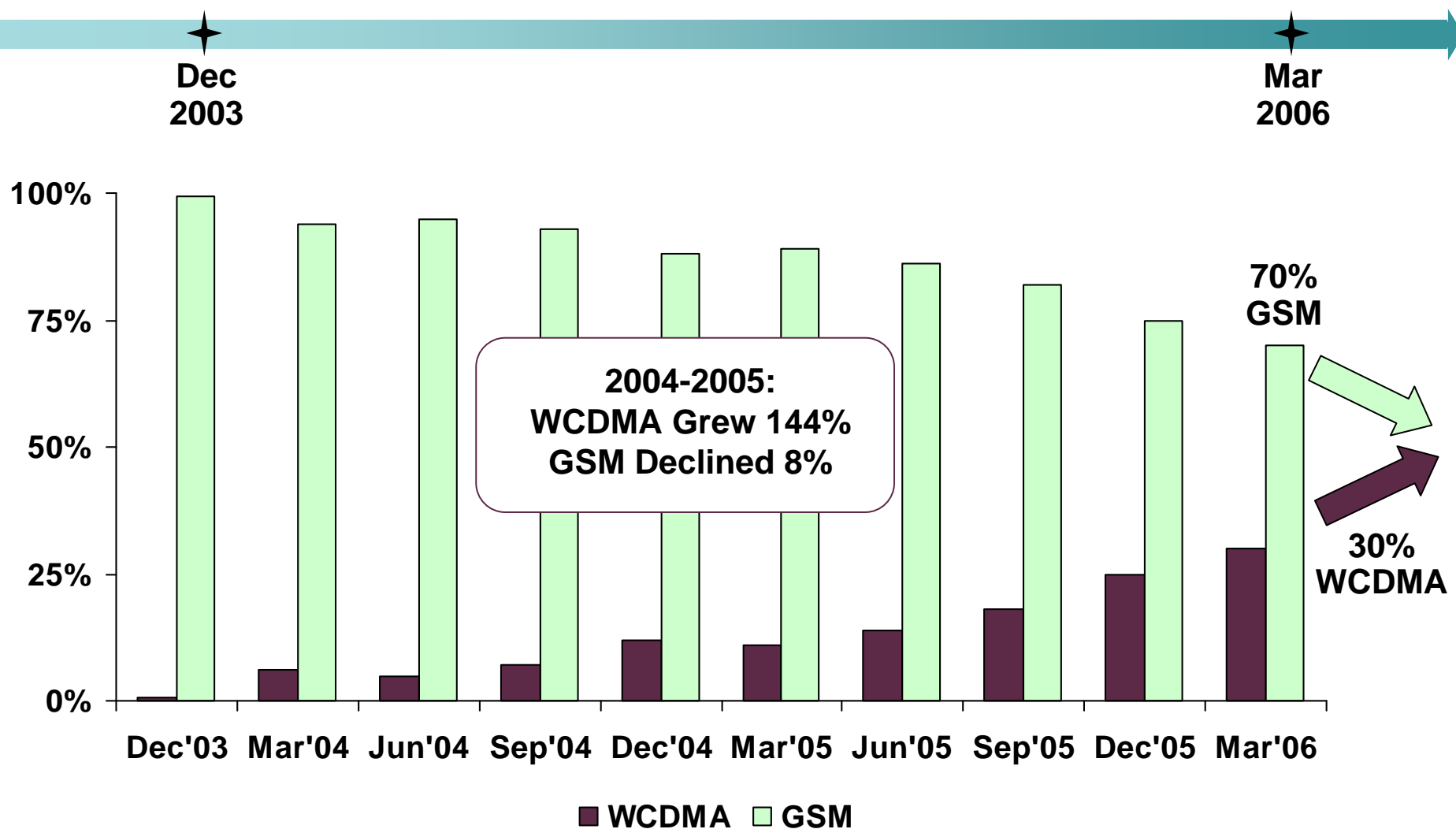


Source: Average of Strategy Analytics (Sep 2006) and Yankee Group (Aug 2006) handset forecasts

2G to 3G Migration in Japan

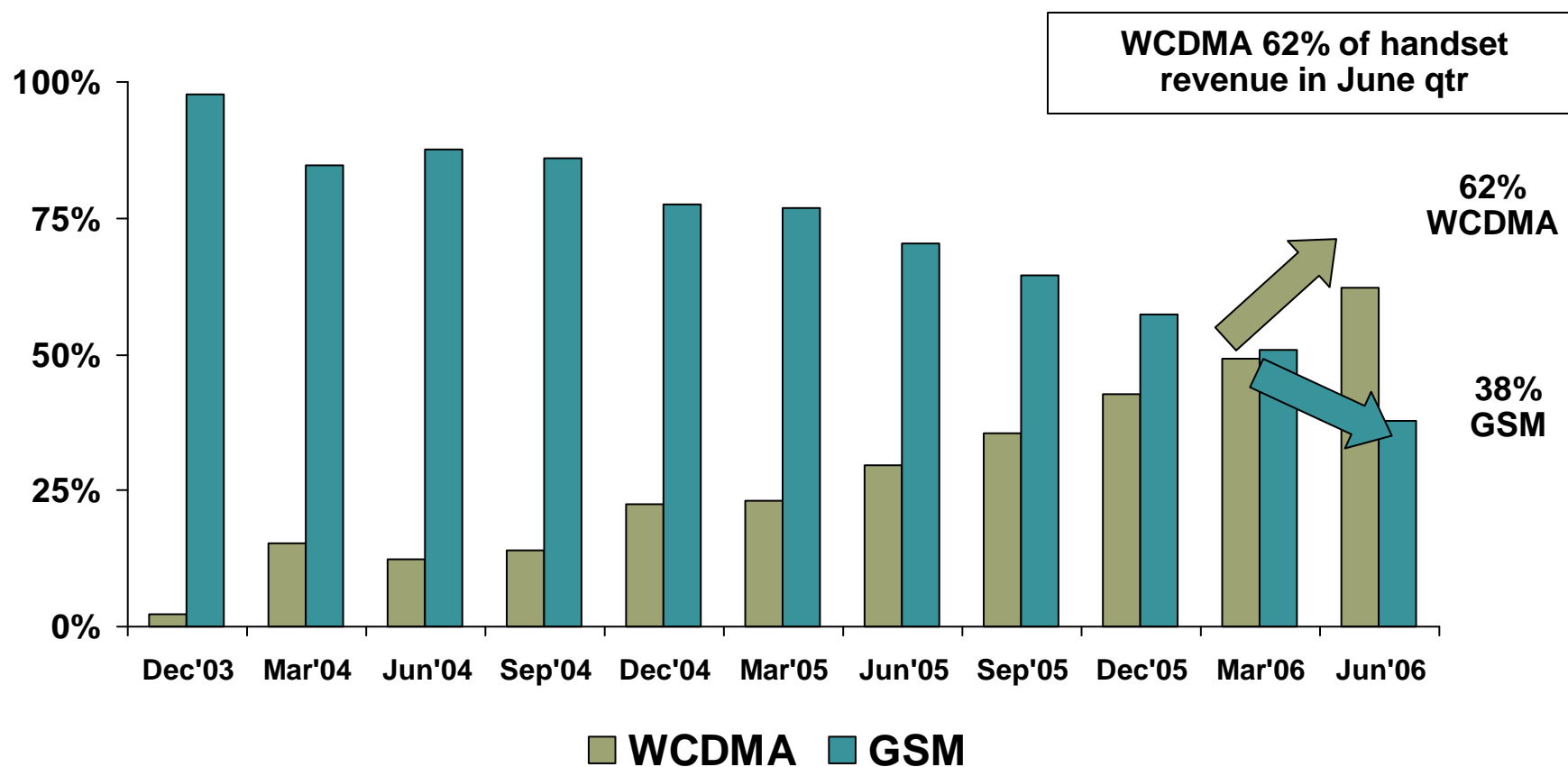


Source: TCA

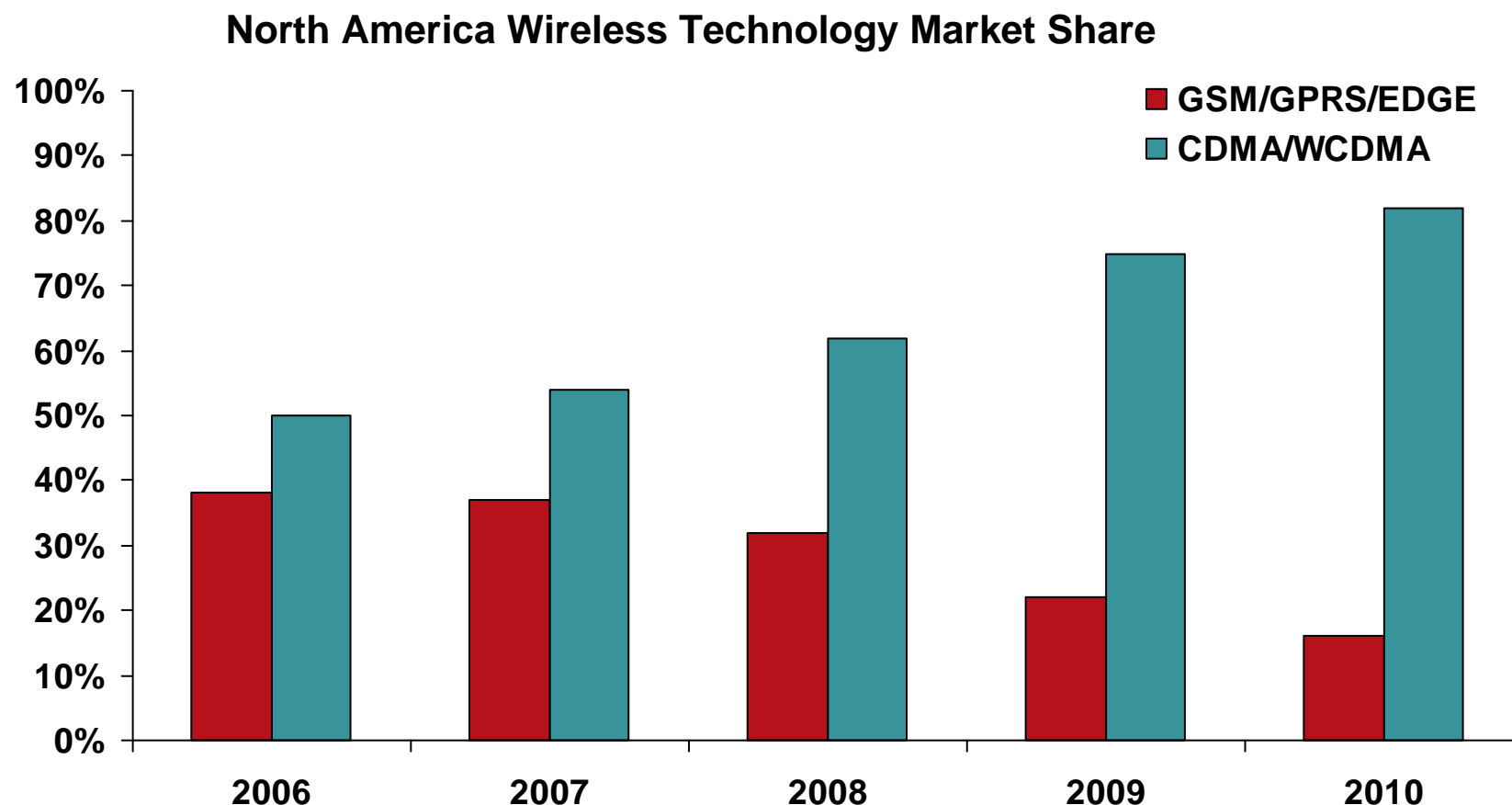


WCDMA and GSM % of Handset Shipments in W. Europe

WCDMA Handset Revenue Higher Than GSM in Western Europe



CDMA and WCDMA Subscribers Accelerate in North America



* "Other" includes AMPS, cdmaOne, iDEN and TDMA

Source: Average of Strategy Analytics (January 2006) and Yankee Group (March 2006) subscriber forecasts

Licensed Spectrum: Rapid Increase of 3G Wireless Broadband

- **Verizon Wireless** EV-DO network is available to 150 million people in more than 170 cities in the U.S. today. Services enabled by this network include “Broadband Access,” “V-CAST,” “Get-it-Now,” and “VZ Navigator.”
- **Cingular’s** HSDPA network is available to 35 million people in 52 communities and is expanding to all major markets by the end of this year. Services enabled by this network include “Cingular eBay Wireless,” “Broadband Connect,” and “HBO Mobile.”
- **Sprint Nextel** has launched EV-DO Rev A in First Markets; coverage to reach more than 40M people by end of year . Services enabled by this network include “Sprint TV,” “Sprint Mobile Broadband,” “Sprint Precision Locator”, and Nextel-style Push-to-Talk in 08.
- **All Carriers** Next Generation Network Technologies (EV-DO and HSDPA) are available in counties containing 63% and 20% of the U.S. population, respectively. 1

Convergence of Consumer Electronics & Cellphones



Location-Based Services Rapidly Expanding

Today, gpsOne®
enables:

Nearly **200 million**
handsets

50 carrier
deployments

40 handset
manufacturers



Points of
Interest



Peer to Peer



Commerce



Security



Gaming



E911 Services



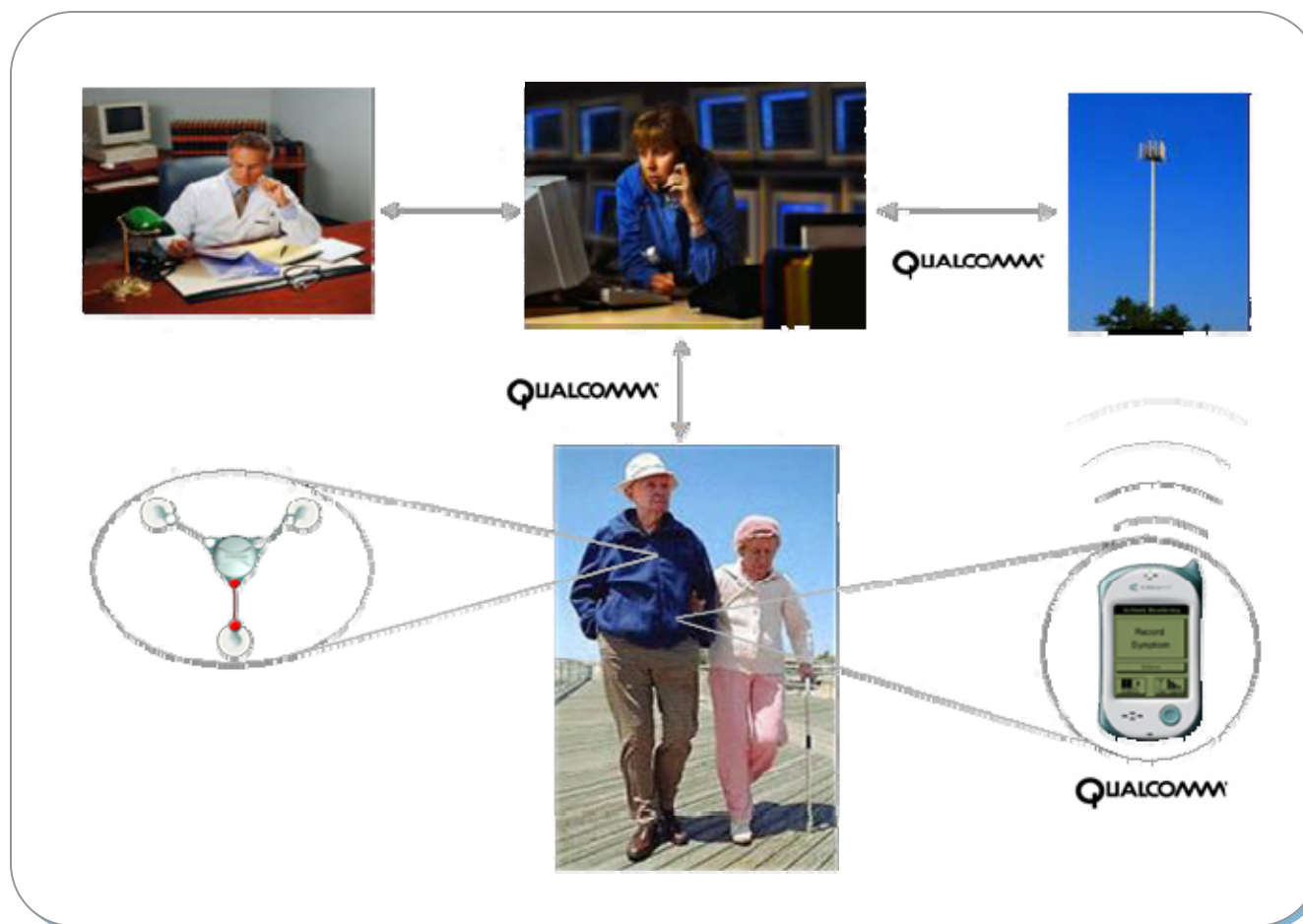
Diabetes Phone:

- In May 2004, LG and HealthPia introduced a World's First Diabetes Phone in Korea under KTF wireless service.
- More than 700 customers are currently using the Diabetes Phone in Korea with a high satisfaction

Glucometer cell phone & service for managing diabetes remotely



CardioNet: Cardiac Monitoring Service -- *Enabled by QUALCOMM's Wireless Network Management Services*



Downloading Applications to Very Low End Phones in India

- TATA among Top-10 for BREW download revenue
- Application download doubled between May and June 2006, 2/3rd contributed by Kyocera Prisma
- 80% of new BREW users on CDMA Prisma in June 2006



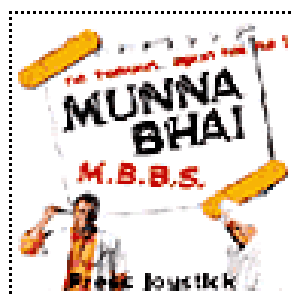
Wallpaper Download



Games Download



Ring Tone Download



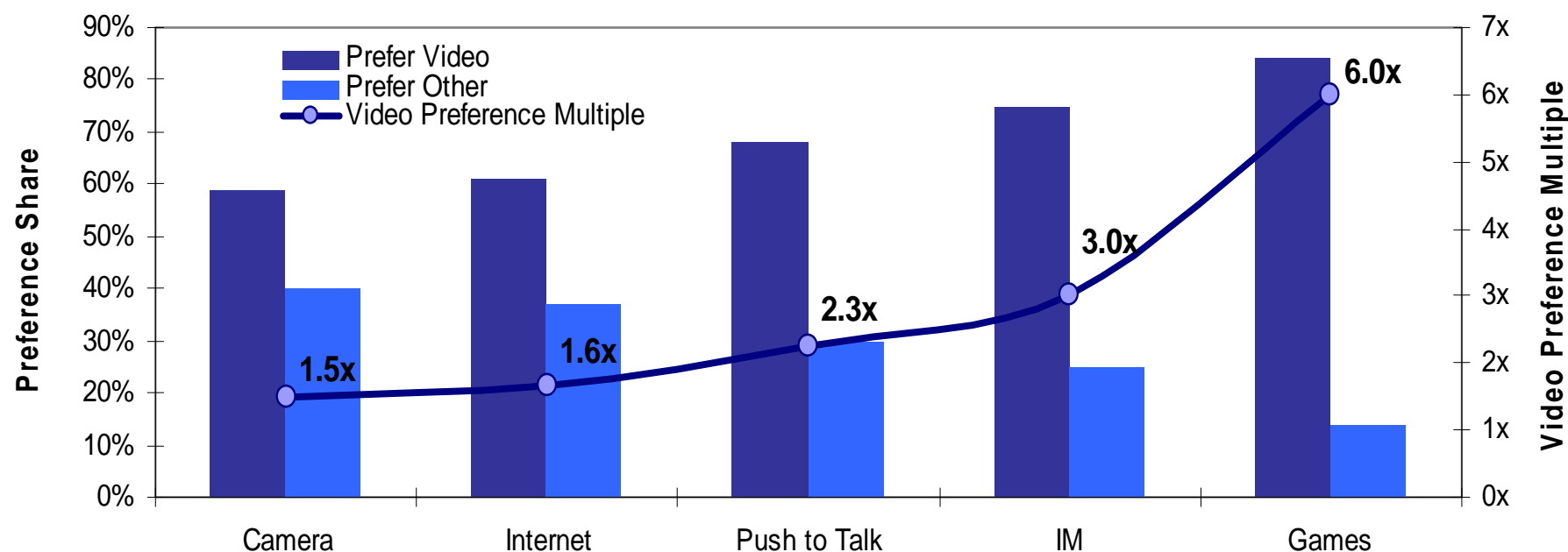
**Go Mobile.
Go Colour.**
Just **Rs. 999/-**



KYOCERA PRISMA

- Large Colour Display
- Speakerphone
- Polyphonic ringtones

Interest in Video Outstrips Other Cell Phone Features



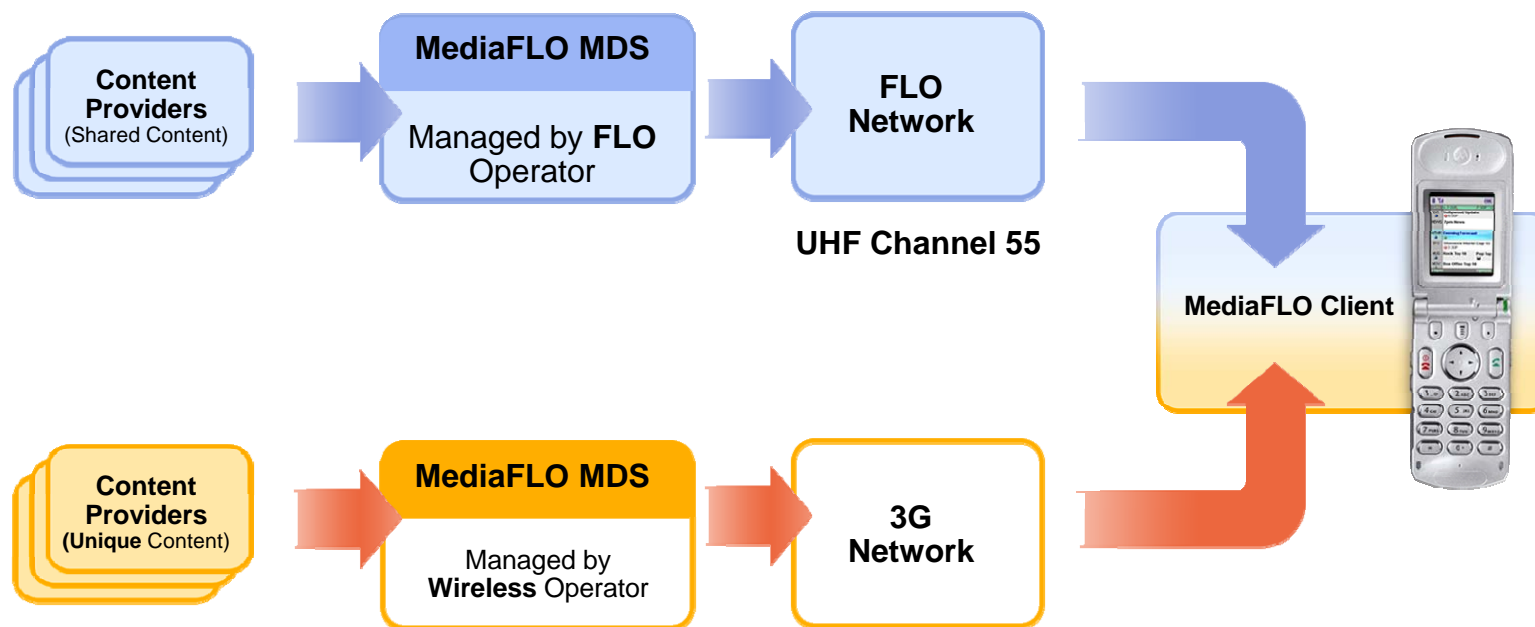
Video functionality second only to voice

- 1.5 to 1 preference for video services over camera phone
- 2.3 to 1 preference for video services over push-to-talk

MediaFLO - Integrated Service Across Multiple Networks

Low Cost Multiple Channels to Mobile Device

Non-real-time clip-casting → OFDM FLO network



VOD Services & Authentication ↔ WCDMA or CDMA2000 3G network

MediaFLO - Superior User Experience and Economics

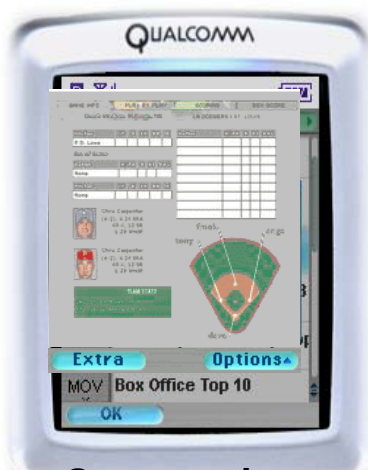
- Over 25 real-time TV channels and streaming audio channels
- Including Clipcast™ content and numerous IP datacast services
- QVGA resolution at up to 30 fps
- 1-2 second channel changing time
- Optimized power consumption



Networks: Richer Information Distribution Possibilities



Video / Audio



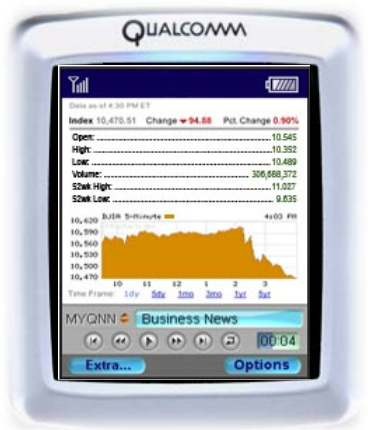
Gamecasting



Data Channels / RSS



Weather

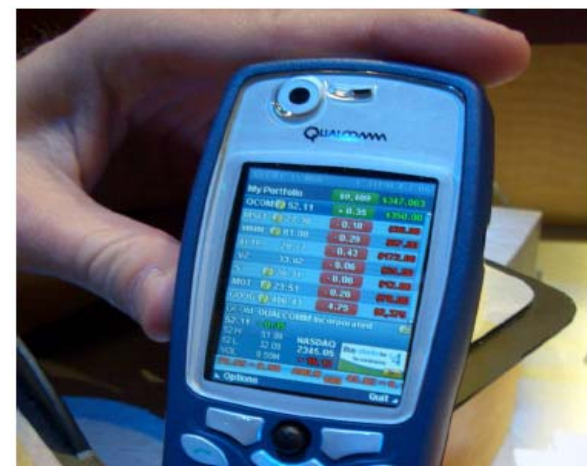


Stock Ticker

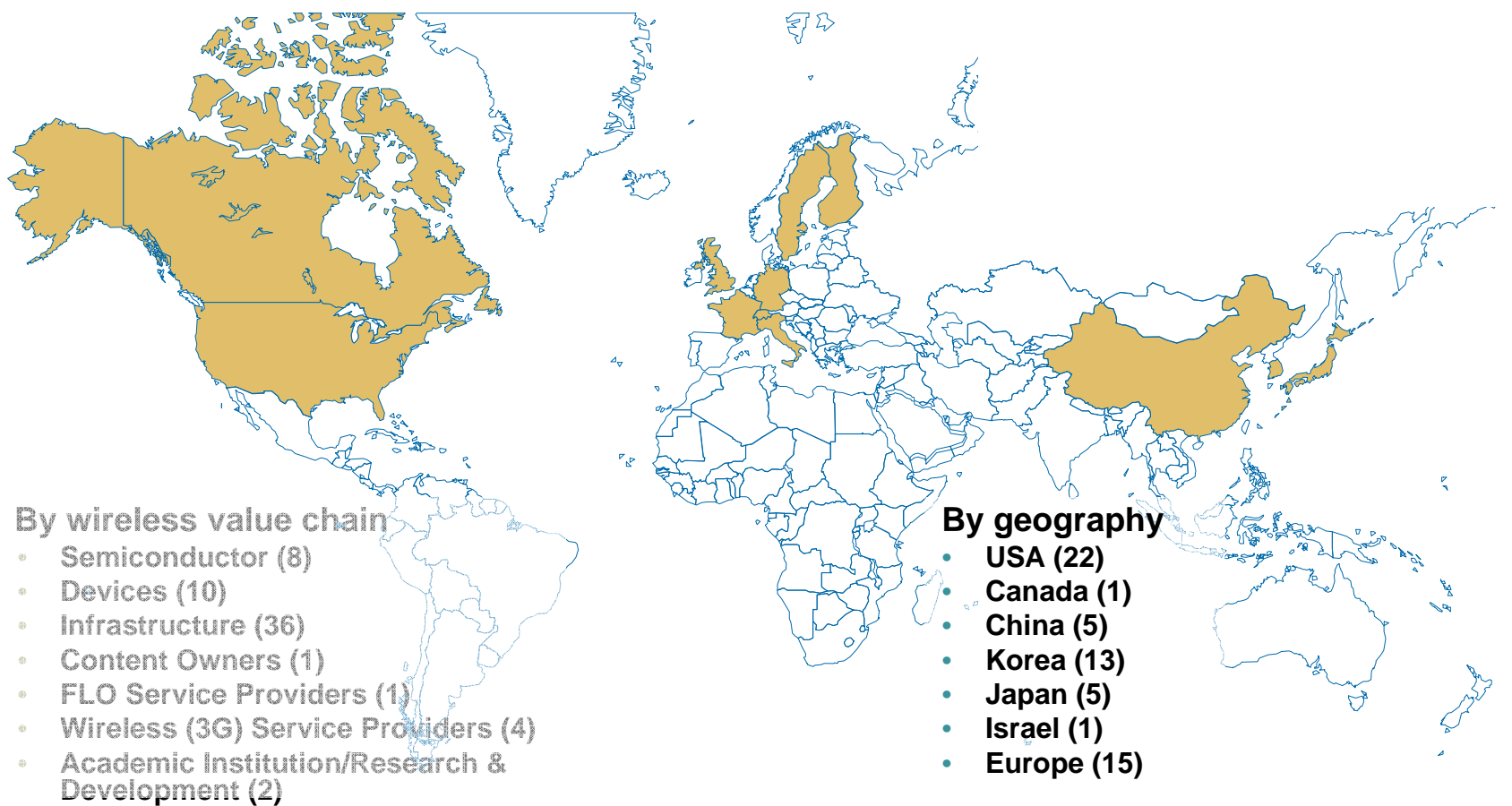


Traffic

Live Stock Quotes & Game Stats



FLO Now a Standard: Published as TIA-1099 with Support of Global FLO Forum



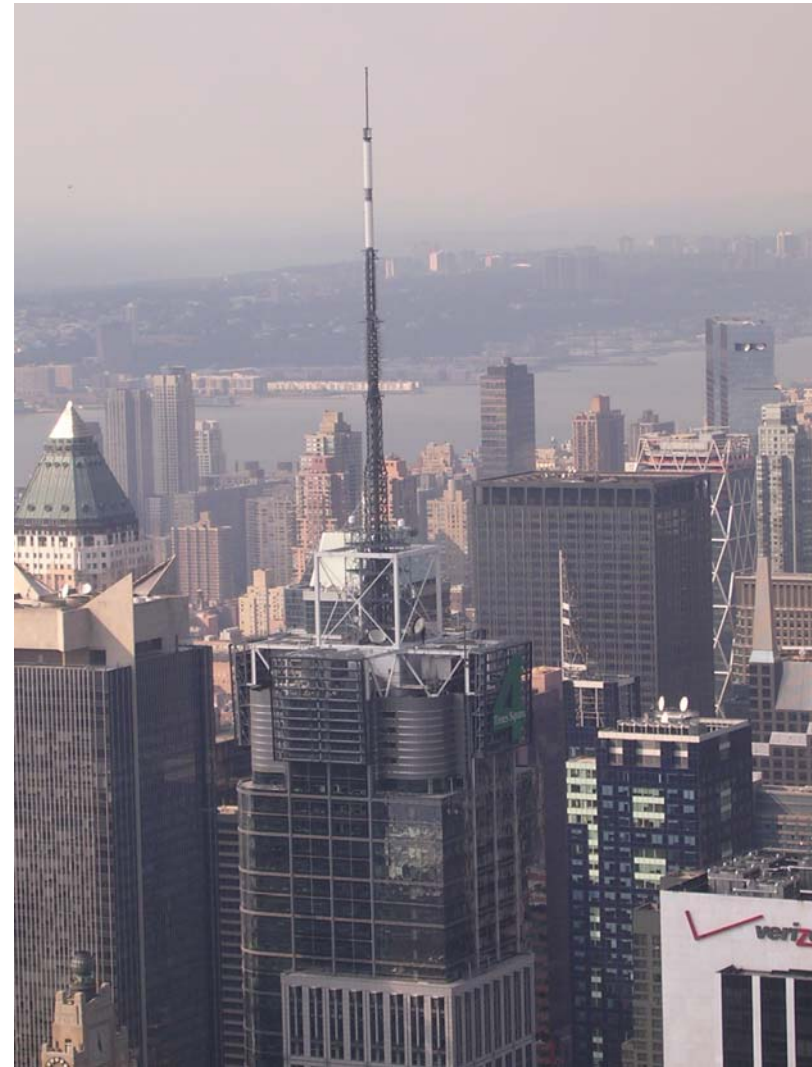
**62 members from 12 countries -
Representing all levels of the value chain**

MediaFLO USA Preparing for Launch, 1Q 2007

MediaFLO Network Operations Center (NOC) – San Diego, CA



4 Times Square, New York City



MediaFLO OEM Phones Shown at CTIA Show, March 2006



Licensed Spectrum for Wide Area Networks

- **Interference More Easily Managed**
 - Identification and elimination of interference sources easier when the operator of the interfering systems is known
 - Licensees have strong incentives to promote efficient use of spectrum
- **Investment Encouraged**
 - Certainty provided by an exclusive license attracts private capital
 - Without certainty, infrastructure investment will lag
 - Wireless carriers have invested \$199B in their networks and are continuing to upgrade to achieve higher speeds and expanded service offerings

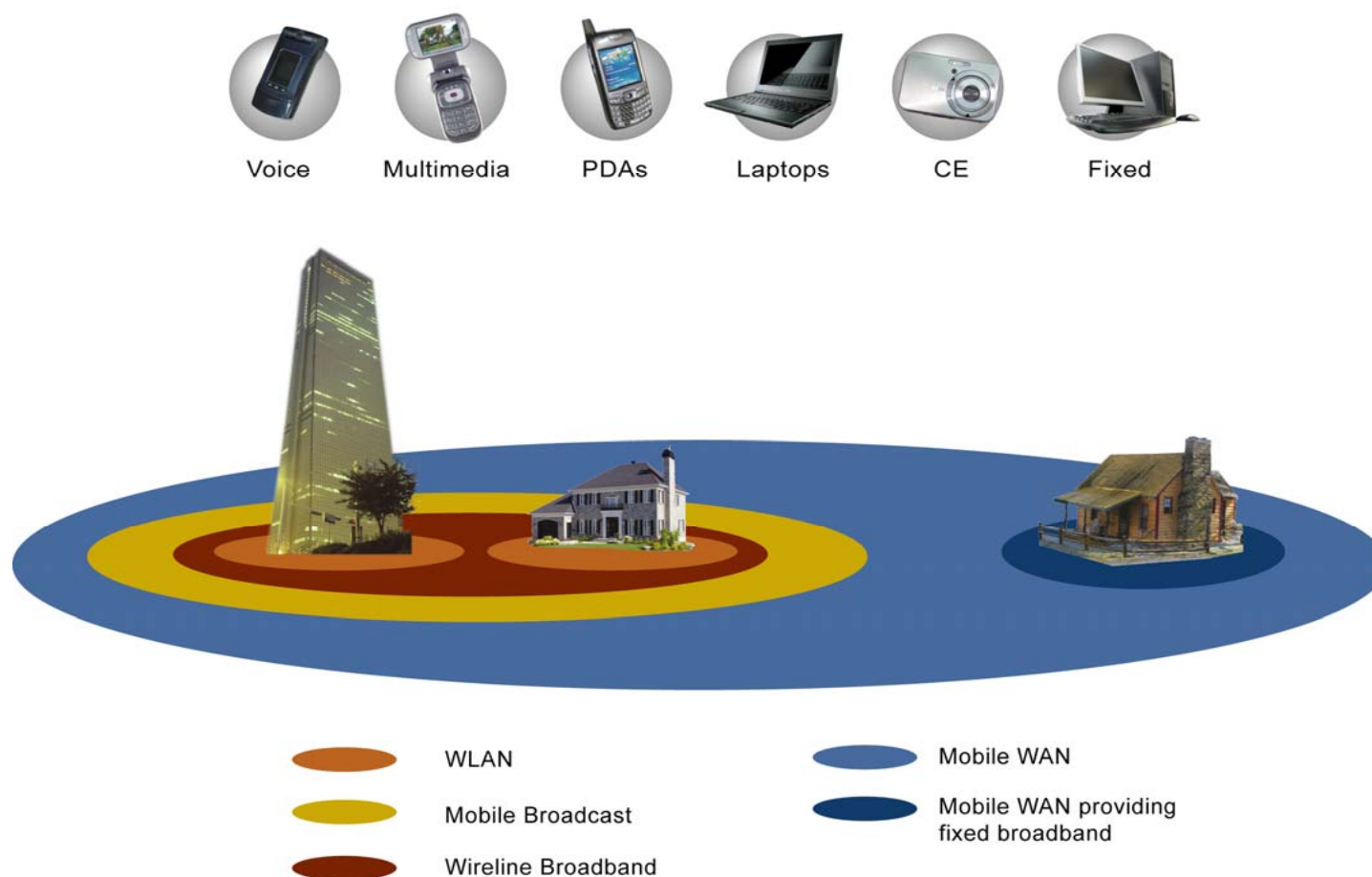
Unlicensed Spectrum for Local & Personal Area Networks

- **Unlicensed Services Are a Useful Complement to Licensed Services**
- **Unlicensed ideal for short-range applications including wireless LANs (e.g. WiFi), PANs (e.g. Bluetooth & UWB) and cordless phones**
- **Unlicensed spectrum can offload traffic from licensed spectrum, freeing that spectrum for longer-range uses**
- **Interference in short-range systems can often be managed with the interfering and interfered-with systems controlled by one person**
- **Since unlicensed spectrum is best suited for short range WLAN and PAN uses, the higher-frequency regions of the spectrum (e.g. 2.5 GHz) are well-suited for unlicensed use, increasingly with MIMO**

Network Evolution

Common All-IP Core Network Supporting Multiple Air Interfaces

- Selection of access based on service requirements, availability, cost
- Full range of devices access the same content across different IP networks

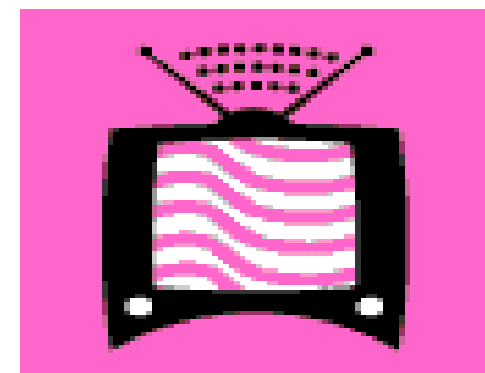


Spectrum Policy Should Aim to Achieve the Most Efficient Use of a Scarce Resource

- **Auctions are proven to be an efficient means of allocating scarce resources. The FCC just completed its largest and most successful auction ever, raising over \$13B for the U.S. Treasury.**
- **The predominant method of wireless access to the internet is and will continue to be over wide area networks in licensed spectrum.**
- **The lower regions of the spectrum are best suited for licensed services.**
 - **Licensed services can best take advantage of the propagation characteristics of the lower frequencies, and attract the necessary capital to drive innovation and network expansion.**
- **Allocations of prime spectrum below 700 MHz to unlicensed use encourage overuse of this spectrum.**
 - **There are no incentives to use unlicensed spectrum as efficiently as possible.**

TV “White Spaces” Should be Auctioned

- This is very valuable spectrum, with excellent propagation characteristics.
- The best way to take advantage of these unique propagation characteristics is to maximize power while controlling for interference.
- This combination of high power and excellent propagation could be especially useful in rural areas.
- If allocated to unlicensed use, power levels will need to be limited to control for interference.

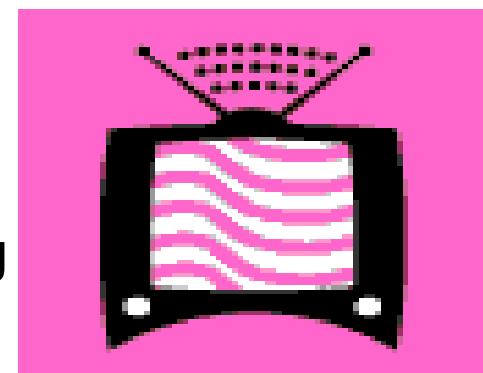


Cont.....

TV “White Spaces” Should be Auctioned

Cont.....

- **Proposals to make this spectrum available prior to the DTV Transition are jumping the gun.**
- **The Digital TV Transition should proceed according to current schedules, as the FCC recently stated in its NPRM.**
- **Licensing the white space will facilitate a transition away from over-the-air TV to more efficient uses of the TV spectrum.**



Promises of Muni WiFi Systems are Often Exaggerated

- Muni WiFi has been claimed as the solution to:
 - Public safety communications needs
 - Broadband last-mile connectivity
 - Last resort communications during natural disasters
- The jury is out on cost & performance
 - e.g. “WiFi Outlook Cloudy in Mountain View”
http://unstrung.com/document.asp?doc_id=109919&WT.svl=news2_2
- Unresolved issues include:
 - Coverage limitations and service quality
 - Managing interference
 - Capital & Operating Costs
 - Sustainability of long-term business case.
- The risk to spectrum policy: Muni WiFi advocates seek additional unlicensed spectrum allocations to reduce interference, which, if granted, could deprive the public of the highest and best use of the spectrum



Clinica Kausay Wasi, Peru

*Empowering Citizens Globally by Providing Wireless Connectivity to Remote **Medical Clinics***

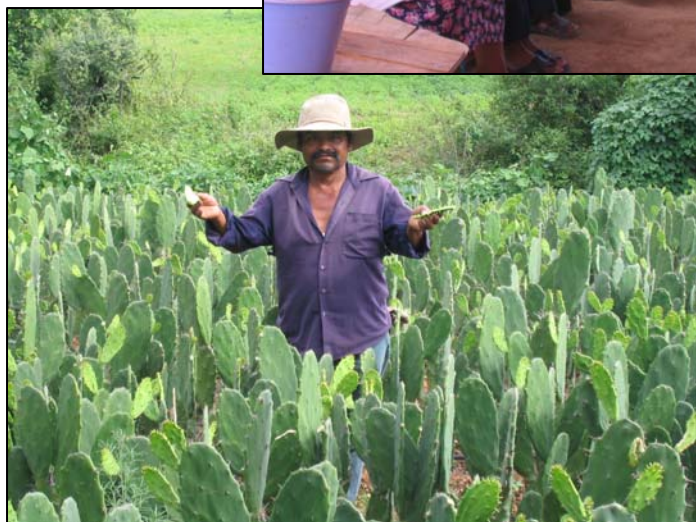


- The clinic coordinated with Northwest Medical Teams to bring physicians who volunteer to serve impoverished residents that have no access to healthcare
- As of March 2006, over 3,000 residents have received medical attention
- With CDMA wireless connectivity, the clinic can now communicate with medical professionals from all over the world



Wireless Reach™ Mexico

*Empowering Citizens Globally by Providing Wireless Connectivity to Enable **Microfinance** for Remote Areas*



- Integrate technical and policy expertise
- Building both individual and institutional capacity in the formation of highly skilled Mexican telecommunications and development policy professionals

Digital **Education** Pilot Project in Brazil

3G Wireless Broadband Access with CDMA2000 1x EVDO @ 450 MHz



Partnership between Lucent, Anatel (Brazil's regulatory agency) and other organizations to demonstrate CDMA2000 1xEV-DO broadband data capabilities and coverage at lower frequencies for universal broadband access (2004).



Thank You.