

Spectrum for U.S. Wireless

The Case for More Spectrum
for Commercial Mobile Radio Services in the U.S.

May 9, 2002



Overview

- The Original ITU Assumptions Justifying 3G Spectrum Requirements are Still Valid:
 - Population
 - Penetration
 - Spectrum Efficiency
- Current Wireless Trends Confirm that Spectrum Requirements for All Services (including Advanced Services) are as Great or Greater than the ITU Estimates:
 - Minutes of Use
 - Reliance on Wireless vs. Wireline
 - Data Usage
 - Encryption
- Advanced Wireless Services Will Need Significantly More Spectrum by 2010

Part 1: The Original ITU Assumptions Justifying 3G Spectrum Requirements Are Still Valid

- Population density of urban areas will drive maximum demand model.
- Penetration projections for wireless service are based on forecasts.
- Cell sizes will vary (pico, micro, macro) – and will be smaller than current cell sites, making more efficient use of spectrum through greater re-use.

ITU Population Assumptions for 2010

- North American Central Business District (CBD) population density for most densely populated cities:
 - 140,000 per square kilometer (multi-level, office environment)
 - 75,000 per square kilometer (urban pedestrian environment)
 - 3,000 per square kilometer (vehicular environment)

Assumption Validation

- Manhattan & Chicago Loop CBDs already met the higher population density levels twelve years ago, based on 1990 census data:
 - Midtown Manhattan = 210,402 per square kilometer;
 - Downtown Manhattan = 153,754 per square kilometer;
 - Chicago Loop = 196,356 per square kilometer.
- Looking beyond the narrow CBD other U.S. cities already exceeded or approached the lower 75,000 population density threshold twelve years ago:
 - New York City = 101,211 per square kilometer
 - Chicago = 92,100 per square kilometer
 - San Francisco = 74,434 per square kilometer
 - Washington, DC = 68,853 per square kilometer
- In future, more cities will meet these thresholds, based on population growth trends.

ITU Penetration Assumptions for 2010

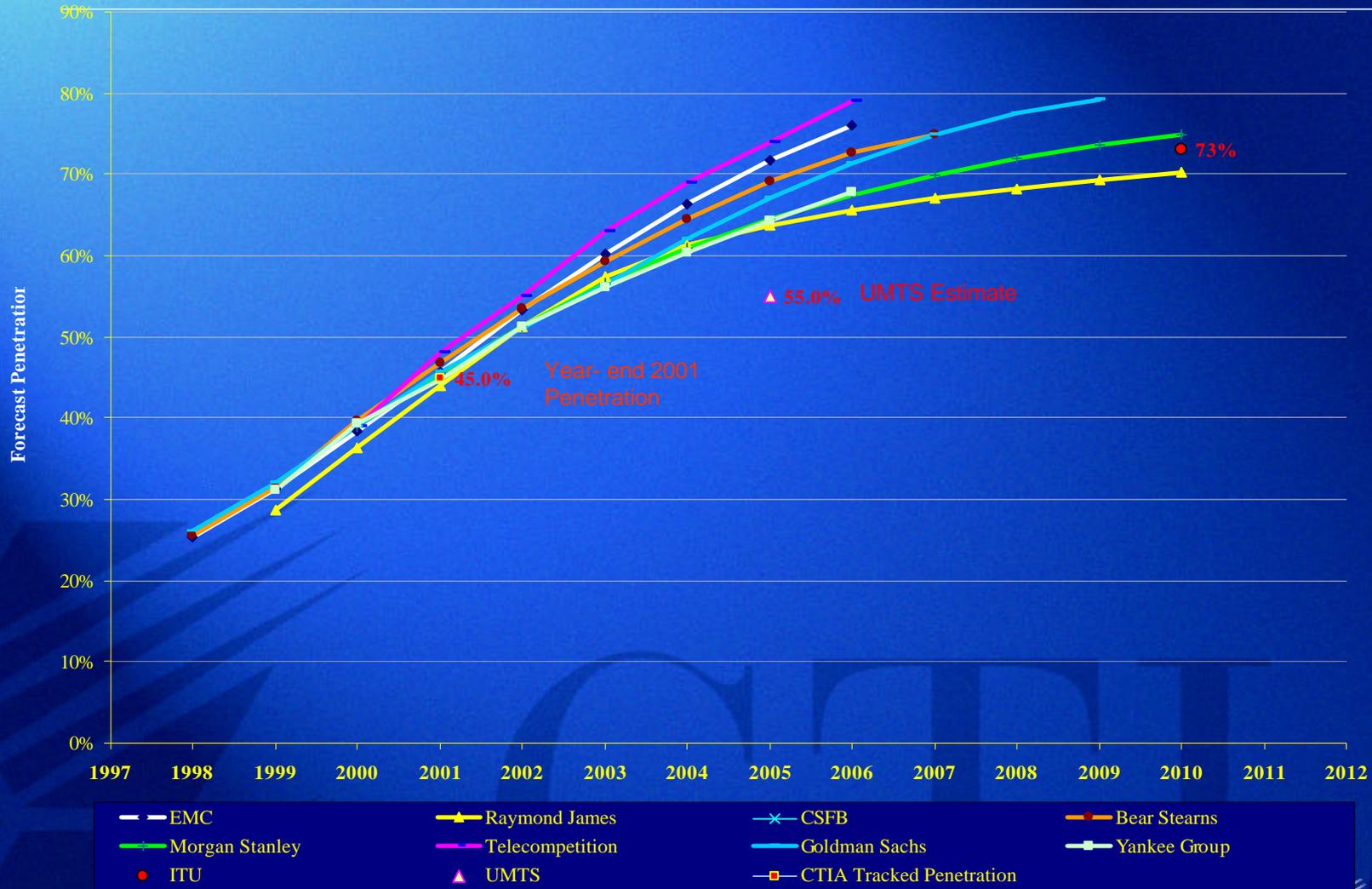
- 73 % voice penetration (16 kbps)
- 40 % short messaging penetration (14 kbps)
- 13 % switched data (64 kbps)
- 15 % multimedia (384/64 kbps down/up)*
- 15 % high multimedia (2Mbps/128 Kbps down/up)*
- 25 % basic symmetrical multimedia (128/128 kbps down/up)*

*Spectrum required for downlink/uplink varies asymmetrically between services, driven by the amount of information transmitted down/up, with variation ranging from 0.18 down/up to 38.17 down/up per Telecompetition analysis of multiple applications.

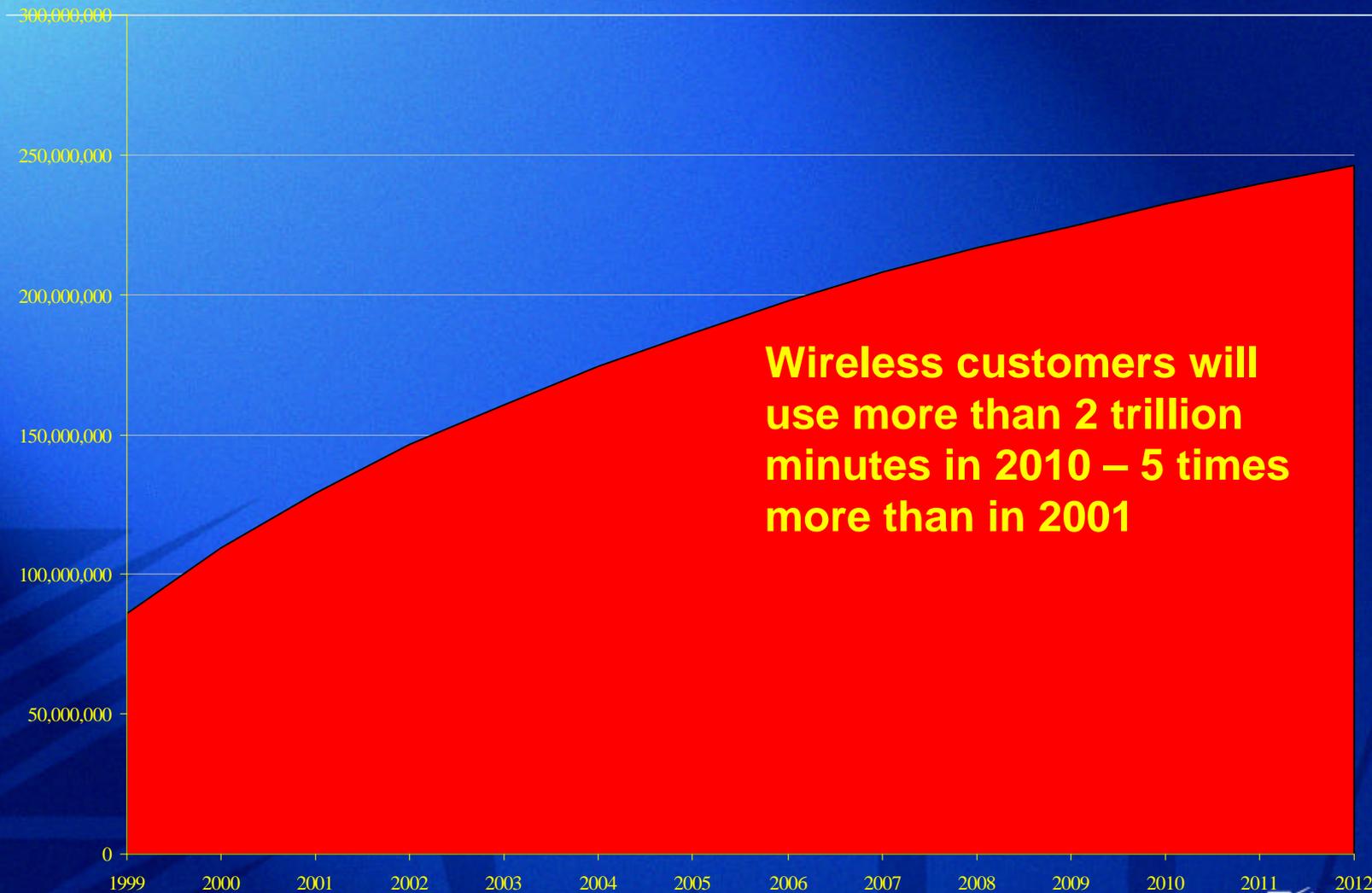
Assumption Validation: Recent Analyst Projections Outstrip the ITU's Voice Penetration Projections for 2010

- ITU estimated voice penetration at 73 percent in 2010.
- Recent voice projections (made year-end 2001 and first quarter 2002) confirm and exceed the UMTS and ITU estimates in spite of the recent U.S. economic slowdown.
 - Morgan Stanley projects 76 percent penetration in 2010.
 - Goldman Sachs projects 75 percent penetration in 2007, and 79 percent penetration in 2009.
 - Bear Stearns projects 75 percent penetration in 2007.
 - EMC projects 76 percent penetration in 2006.

Recent U.S. Subscriber Forecasts Exceed UMTS 2005 Forecast, Trends Suggest Will Exceed ITU 2010 Forecast



It's Projected There Will Be More Than 230 Million Wireless Subscribers by 2010



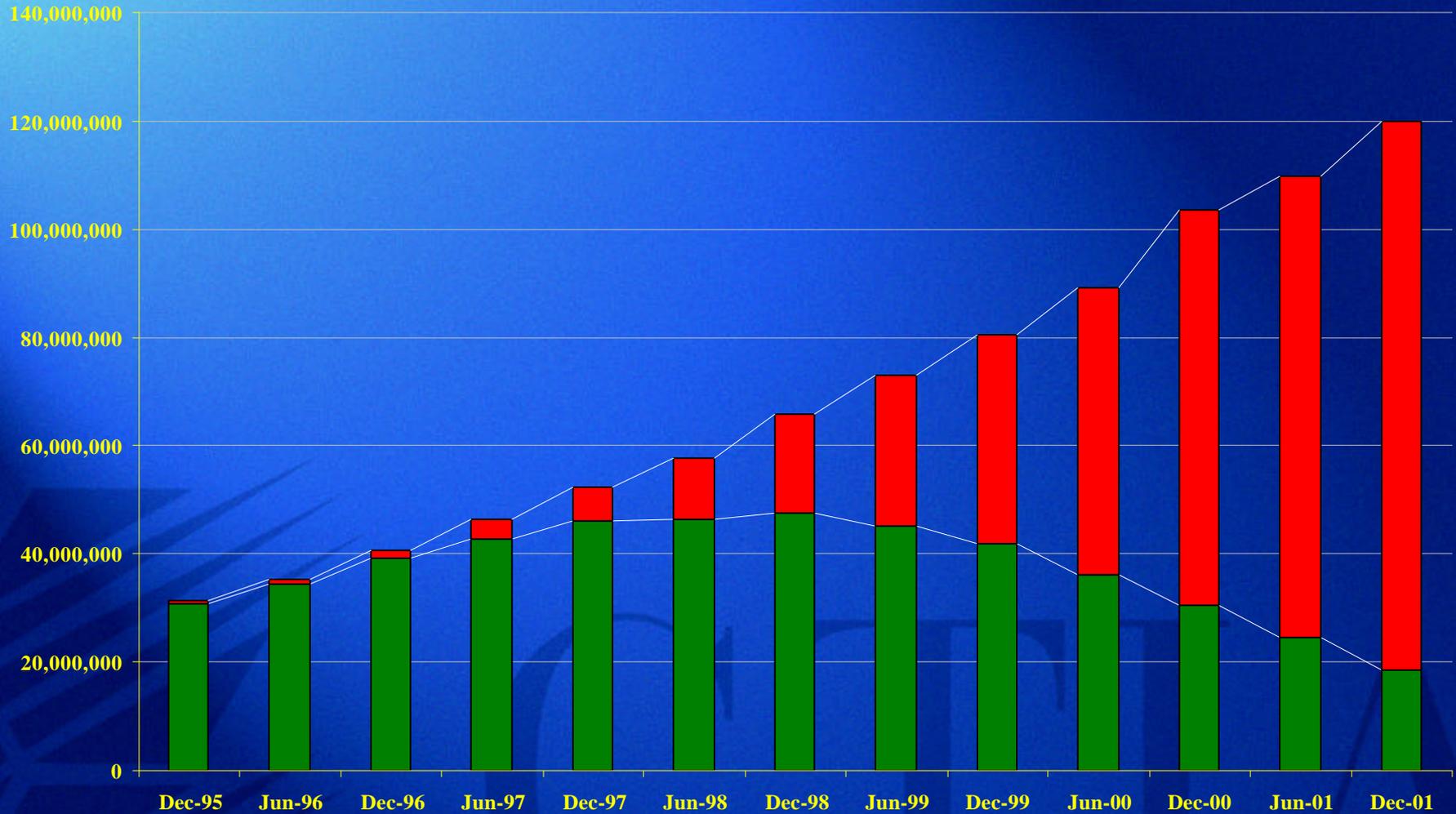
Wireless customers will use more than 2 trillion minutes in 2010 – 5 times more than in 2001

Source: Multiple Analysts

ITU Spectrum Use Assumptions for 2010

- Assumed improvements in spectrum utilization by CMRS networks, with the adoption and implementation of new technology;
- Already assumed 60 percent of CBD traffic will be carried by non-licensed networks.

85 Percent of All U.S. Wireless Subscribers Are Already Digital



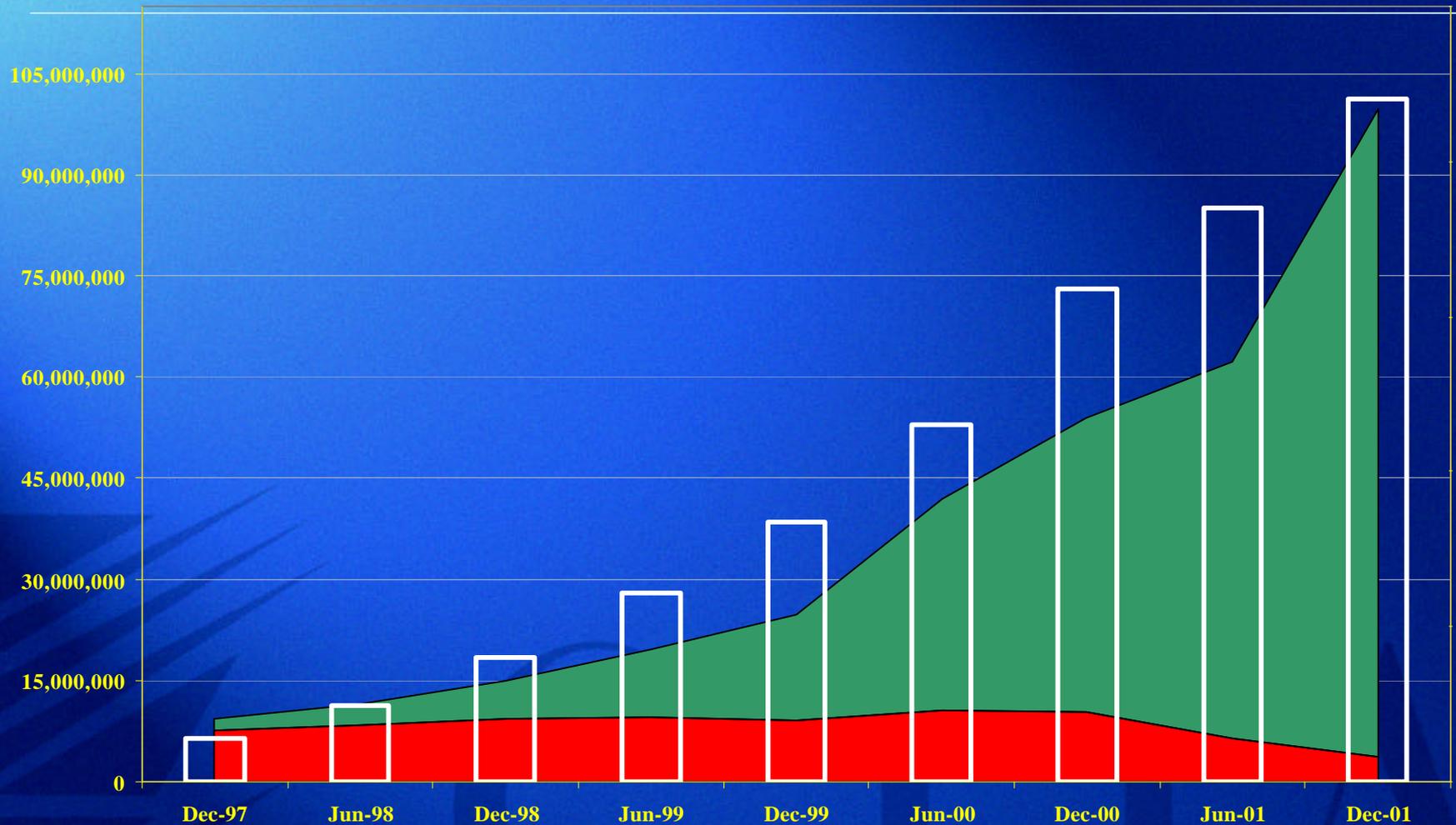
Source: CTIA

■ Derived Analog Subscribers

■ Reported Digital Subscribers



As Digital is Deployed, Subscription Grows, More Capacity Is Both Created – and Consumed



Source: CTIA

■ Analog Minutes of Use ■ Digital Minutes of Use □ Reported Digital Subscribers



Summary:

The ITU Analysis is Valid – But Too Conservative

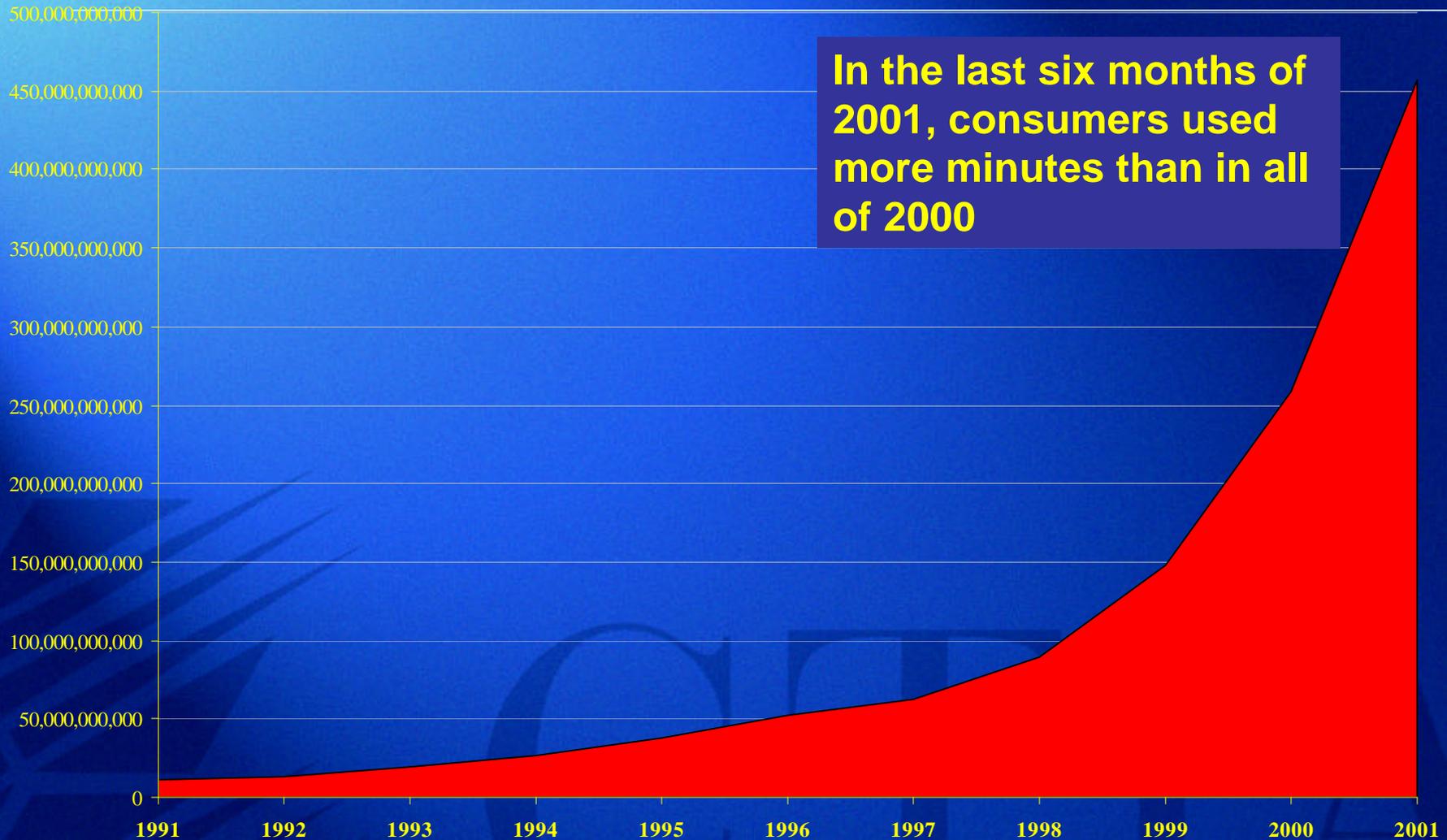
- ITU assumptions justifying 390 MHz spectrum estimate have proven too conservative based on data on:
 - Population
 - Penetration
 - Spectrum efficiency

Part 2:

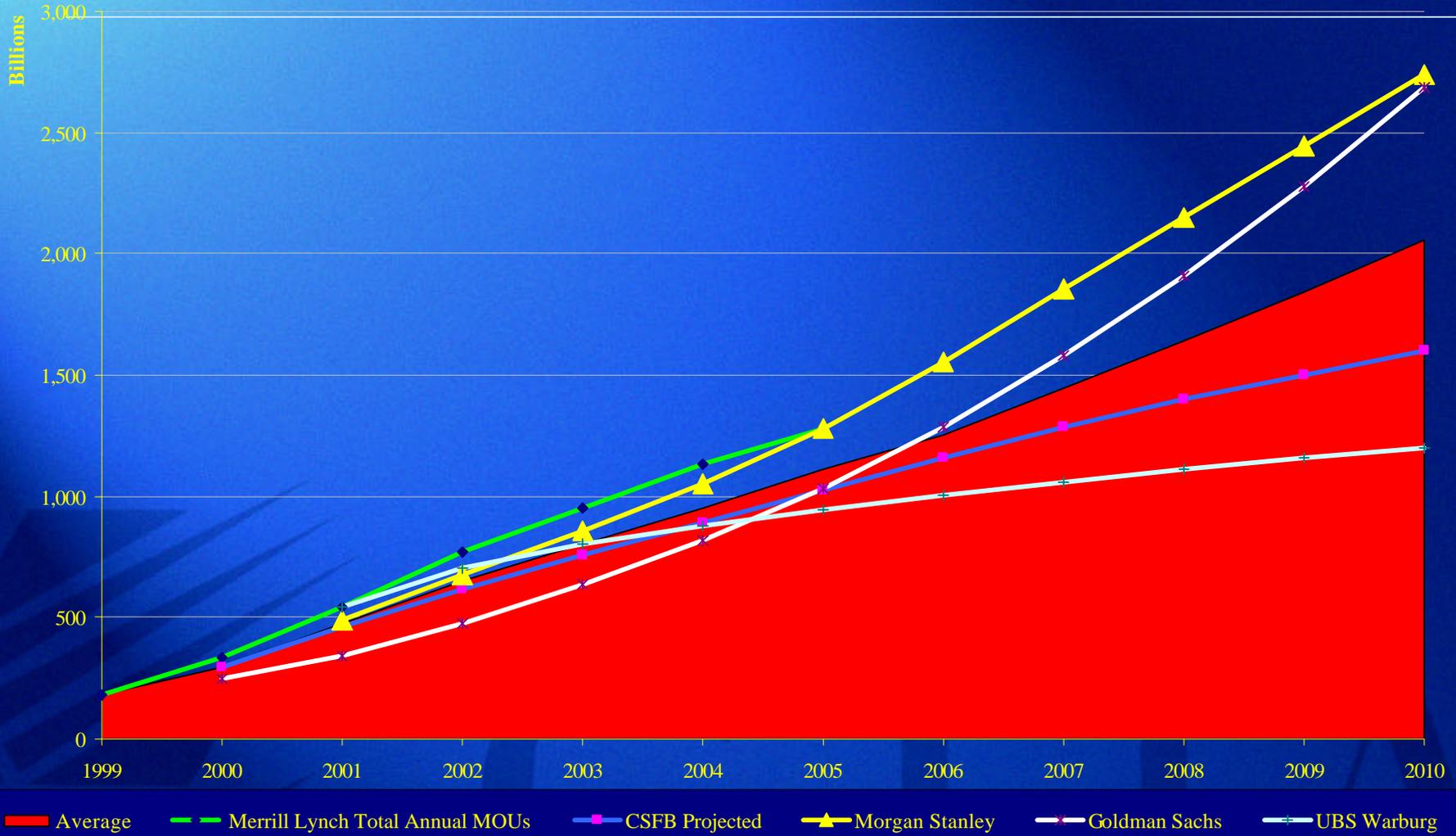
Current Wireless Trends Justify More Spectrum

- Current wireless trends confirm that spectrum requirements for all wireless services (including advanced services) are as great or greater than the ITU estimates:
 - Minutes of Use
 - Reliance on Wireless vs. Wireline
 - Data Usage
 - Encryption

U.S. Wireless Consumers Used More Than 456 Billion Minutes in 2001



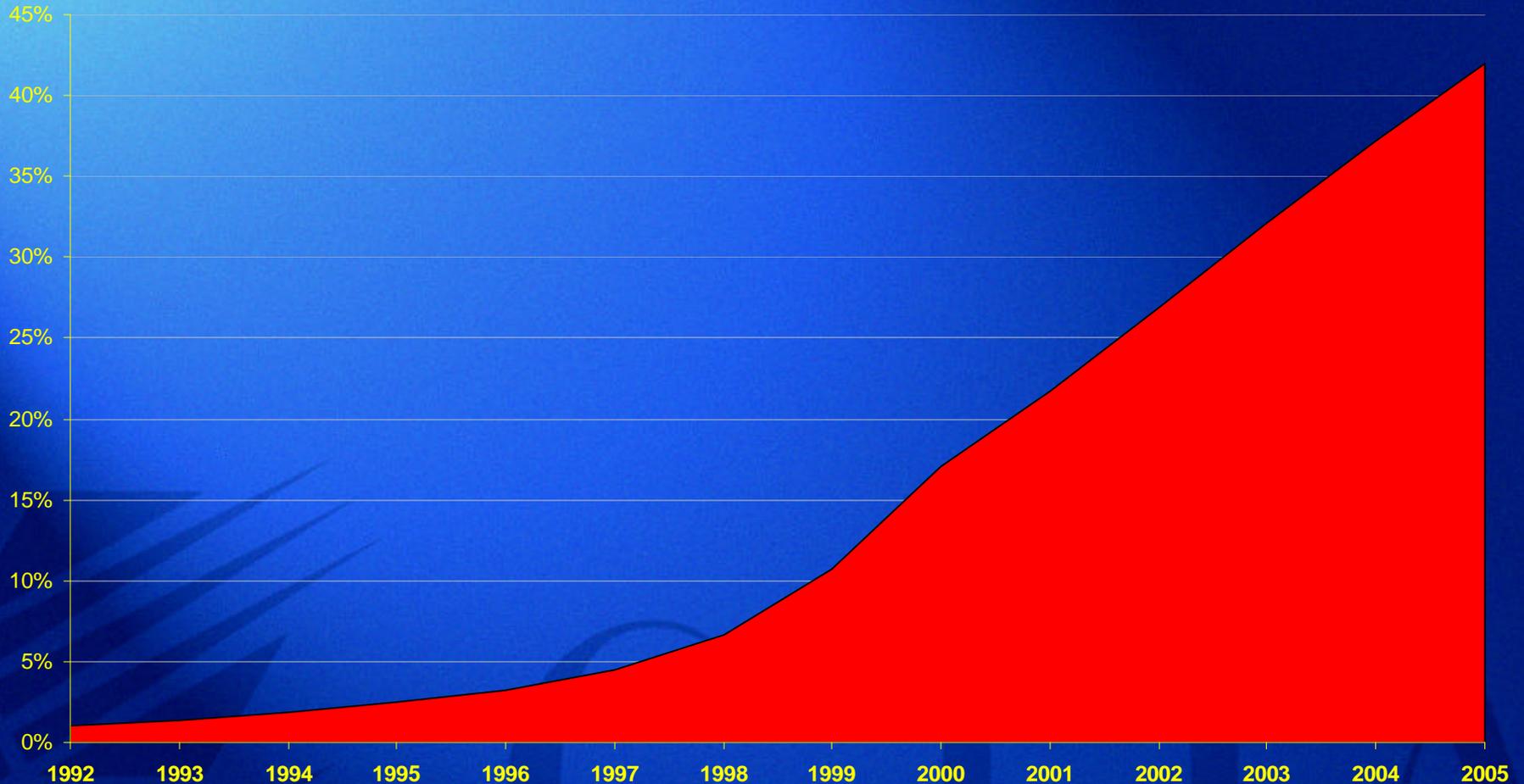
Wireless MOUs are Expected to Grow to More Than 1 Trillion in 2005, and Over 2 Trillion by 2010



Consumers' Reliance on Wireless vs. Wireline Service is Increasing Fast

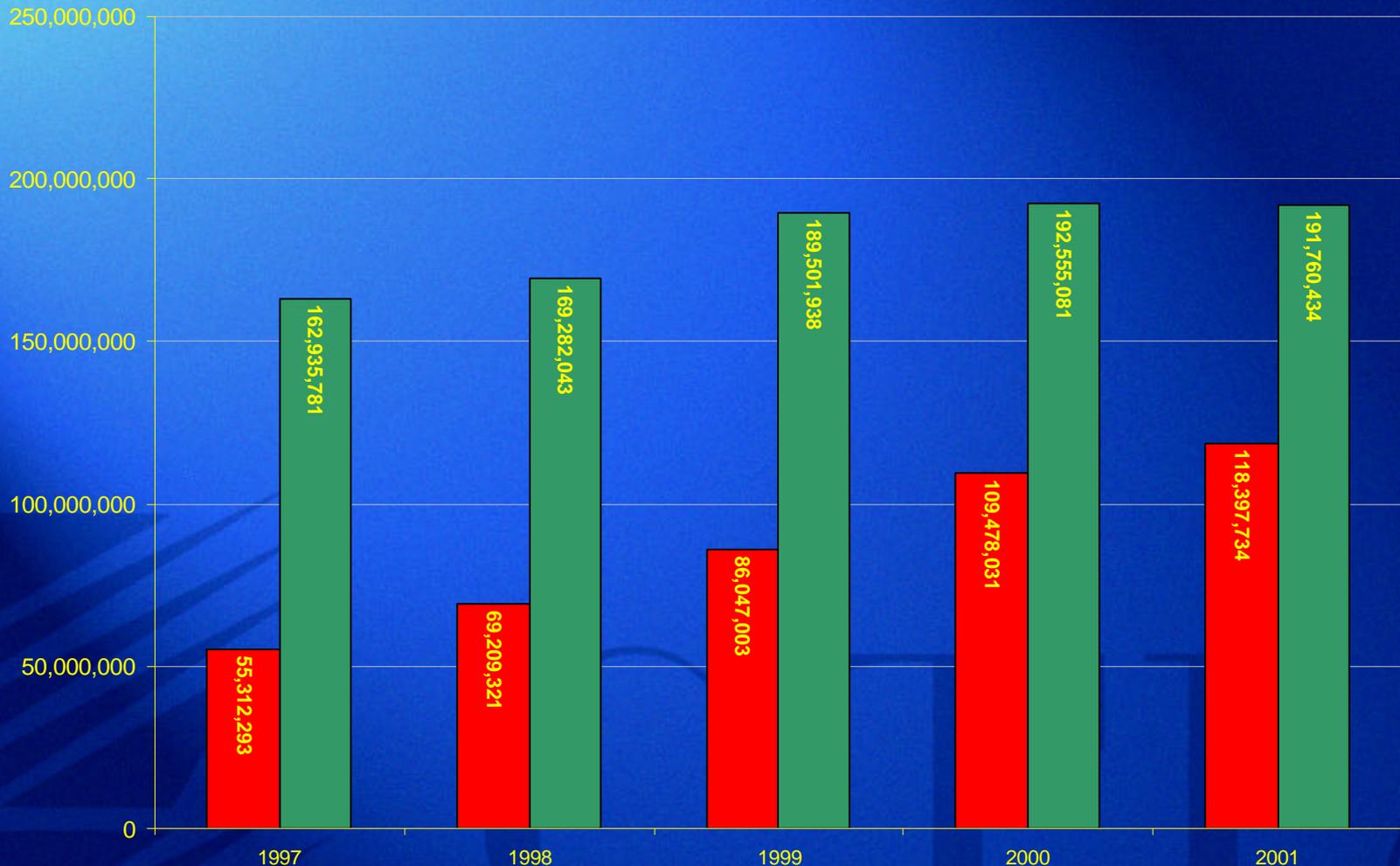
- Wireless is increasingly substituting for wireline service;
 - 18 percent of wireless consumers consider their wireless phone their primary phone;
 - 10 million wireline access lines have already been replaced with wireless;
 - 10 million more wireline access lines will be replaced by 2005;
 - Wireless MOUs amounted to 17 percent of all telecommunications industry minutes in 2001;
 - DB Alex Brown projects total MOUs will grow 32 percent annually through 2007, “driven by increasing subscribers and usage and by the introduction of next generation wireless services”
 - The Yankee Group expects wireless MOUs to amount to more than 40 percent of all telecommunications industry minutes by 2005.

Wireless Will Equal More Than 40 Percent of All U.S. Telecommunications Usage in 2005



Sources: CTIA and Yankee Group

Wireless is Already Equal to 38 Percent of All Telecommunications Lines in the U.S.



Sources: CTIA and FCC

■ Wireless Subscribers

■ Wireline Switched Access Lines

Wireless Data Service Projections

- In-Stat/MDR predicts two-thirds of American workers will use wireless devices as part of their jobs by 2004.
- Jupiter Media Metrix estimates U.S. wireless web users will grow to 96 million by 2005.
- Gartner Group projects 90 percent of professionals / telecommuters will use high-speed wireless data services by 2005, with 137 million wireless data users in North America.
- AMI Partners projects half of entire U.S. workforce to be mobile by 2006, totaling 67 million workers, with over 26.4 million commercial wireless data users.
- In-Stat/MDR projects 52 million wireless data subscribers in 2005; 39 million business wireless data users in 2006.
- Ovum projects overall U.S. wireless data penetration of 67 percent by 2007.

Wireless Data Service Projections

- Personal use of laptops and PDAs for wireless e-mail and office system access will increase, as well as machine-to-machine communications, such as automated user updating by e-mail systems, and specialized applications such as medical monitoring, etc.
- SMS – globally short message service / text messaging is growing dramatically – from 1 billion a day at year-end 2001 it is expected to reach 3 billion daily by year-end 2002.
- Interoperability has been resolved in the U.S., laying ground for SMS to take off in the next three years, with SMS message volumes reaching 150 billion a year.
- Multi-media Messaging Service (MMS) combines text, images, audio and video, and is expected to build upon the SMS experience - including applications focused on both consumers and business users.

Deploying Data Forces A Trade-off of Voice Capacity to Provide Data Capacity, When Demand for Both is Growing

- 1 X-EV DO (data only – high speed) requires a 1.25 MHz channel.
- Dedicating such channels to data reduces available voice capacity (by 20 percent effectively), but this is necessary in order to offer broadband service.
- At the same time, voice and data usage is growing.
- Data holds out a large promise, but this puts carriers in a dilemma – making them face “Hobson’s choice” – do you do data or do you do voice?

Security Requires Encryption – and More Capacity

- Greater encryption will be needed for some types of traffic, including homeland security-related communications, priority access communications, and multiple other sensitive – private and governmental – communications.
- Per GeoTrust, encryption slows down communications speeds, increasing holding time, thus requiring more spectrum to handle traffic volumes when call and message volumes are increasing.

Priority Access Service Requires Spectrum

- Current proposals are for a predetermined percentage – up to 25 percent – of capacity to be set aside for priority access in case of emergency.
- This reduces the capacity available for consumers and business users during crisis periods, when their demands are greatest. (For example, on September 11th, New York City experienced a 1,200% increase in calls.)

Analysts Continue to Project Demand for 3G

The UMTS Forum's analysts revisited the 3G forecasts in 2001 and 2002, taking into account September 11 and the economic slowdown.

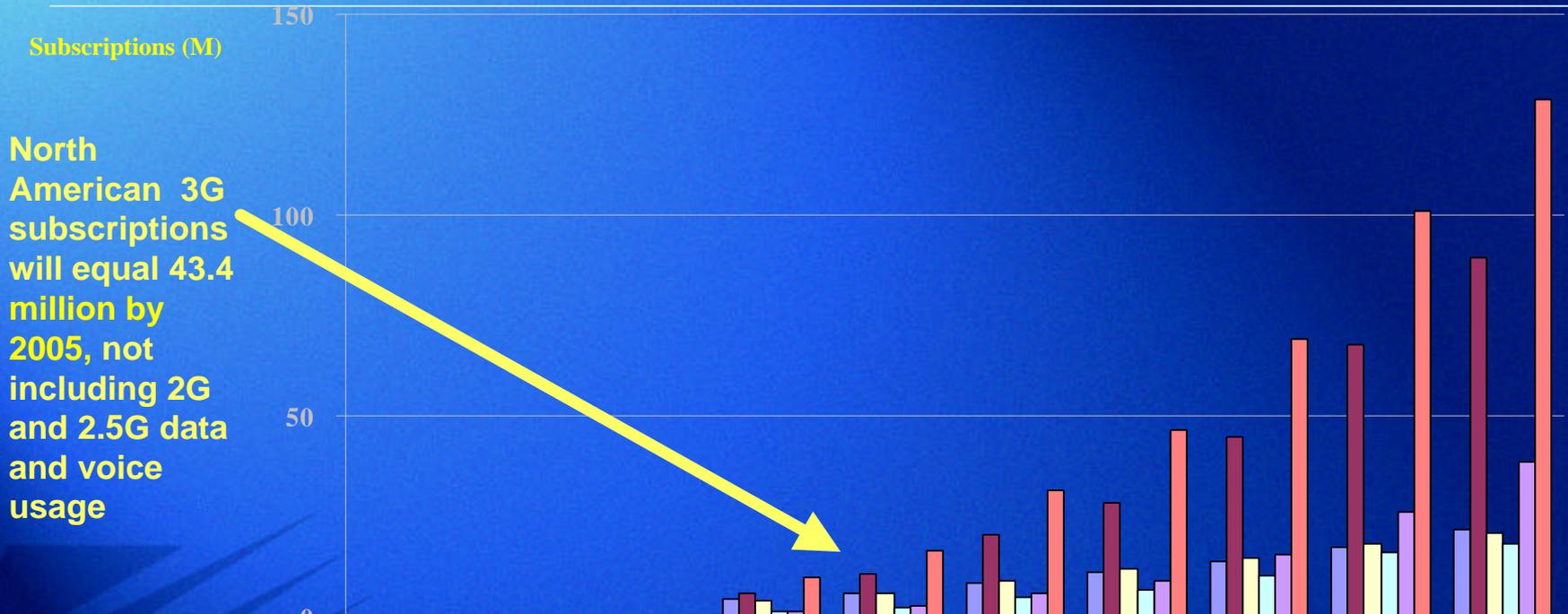
Current global forecasts, based on industry and market factors, assume:

- Slow adoption for the first five years.
- “Complex services will take time to develop and service will be adopted slowly through 2005 in the developed countries.”
- “Issues involving handsets and 3G service delivery are short-term and resolvable and will not affect the longer-term viability of 3G services.”

The UMTS Forum's analysts have concluded that:

- “The demand for 3G mobile data service is real.”

Telecompetition Projects Millions of 3G Subscriptions in North America in 2005 - 2010



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
■ Customized Infotainment	-	-	-	4.6	5.8	8.3	11.1	13.8	17.2	21.8
■ Mobile Intranet / Extranet Access	-	-	-	5.8	10.5	20.2	28.5	44.9	67.6	89.2
■ Consumer MMS	-	-	-	3.9	5.6	8.9	11.9	14.6	18.0	20.6
■ Mobile Intranet Access	-	-	-	1.2	2.4	4.9	6.7	10.3	16.1	18.0
■ Business MMS	-	-	-	1.4	2.6	5.7	8.9	15.6	26.2	38.6
■ Simple Voice	-	-	-	9.6	16.5	31.5	46.6	69.2	100.9	128.9

The Bottom Line: Advanced Wireless Services Will Need Significantly More Spectrum by 2010

- Overall wireless usage is growing;
- More spectrum is needed in order to get on the glidepath for spectrum-intensive applications;
- Data and voice applications will demand more bandwidth.