

AT&T's Vision of LTE

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Outline

- A Short History of Radio Communications as Solutions
- The Vision for LTE as the New Solution

History of High Power Radio Communications

- **Marconi and others 19th Century**
 - Morse Code and International Morse Code
- **AM (amplitude modulated) (High Power Radio - 20th Century)**
 - Atmospheric Noise Problematic (Static during storms)
 - Not complex technically
- **FM (Frequency Modulated) radio**
 - Greater Fidelity (>Bandwidth)
 - Atmospheric Noise issue generally solved
 - Greater Complexity
- **Hi Power 2 way Communications**
 - Few Channels available, spectrum limitations, Power issues at higher frequencies
 - Interference from other users problematic
- **Standardization of Communications Technology started in the 1940's**
 - Television (NTSC Color Standard-1953)
 - Television (ATSC Digital Standard-2009)

History of Radio Communications (2)

- **Cellular Radio (Personal Communications Devices)**
 - **Analog (1st Generation Cellular)**
 - **FDMA**
 - **TDMA (regional standards developed) (2nd Generation Cellular)**
 - US-TDMA
 - GSM
 - **CDMA Family (regional and international standards developed)**
 - UMTS, HSPA, etc.
 - **OFDMA Family (international standards developed)**
- **Cellular Developments (just a few of many)**
 - **SIM/USIM Cards (Subscriber Identity Modules)**
 - **AMR (Adaptive Multirate Vocoder)**
 - **EDGE (Enhanced Data rates for GSM Evolution)**
 - **UMTS, HSDPA, HSUPA, LTE, LTE Advanced**

AT&T's Vision of LTE as *the* Modern Day Solution

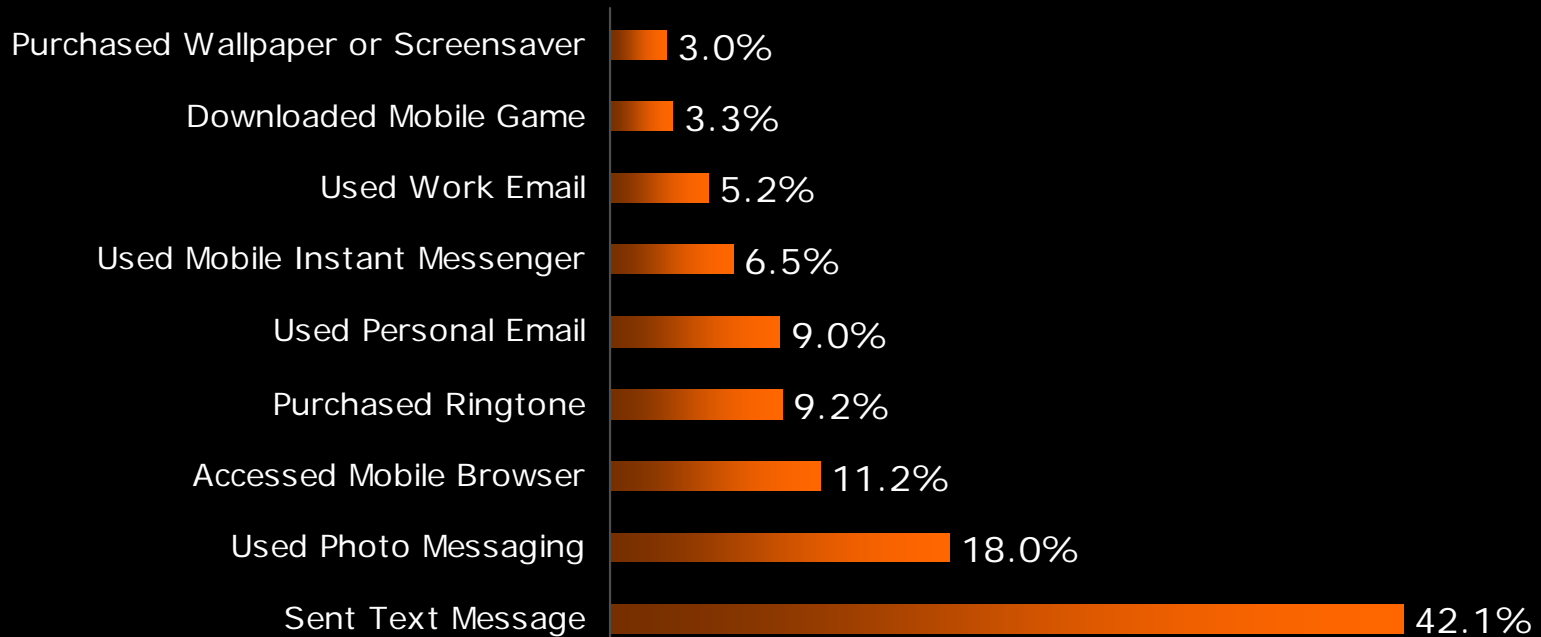
- LTE is a technology solution to enable our business, providing our customers with what they desire in the world of communications, entertainment, and delivered wireless
 - Increase revenue
 - Reduce costs
 - Leverage Investment
- LTE leverages the rich heritage of proven and successful technologies with a future view as part of the 3GPP family
- LTE is important to AT&T and we are directly engaged in the developments of LTE to ensure it's a solution well matched to our vision.

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Growth Drivers: Wireless Data Apps

Percentage of U.S. cell phone subscribers who used their phones for various activities beyond merely making phone calls.



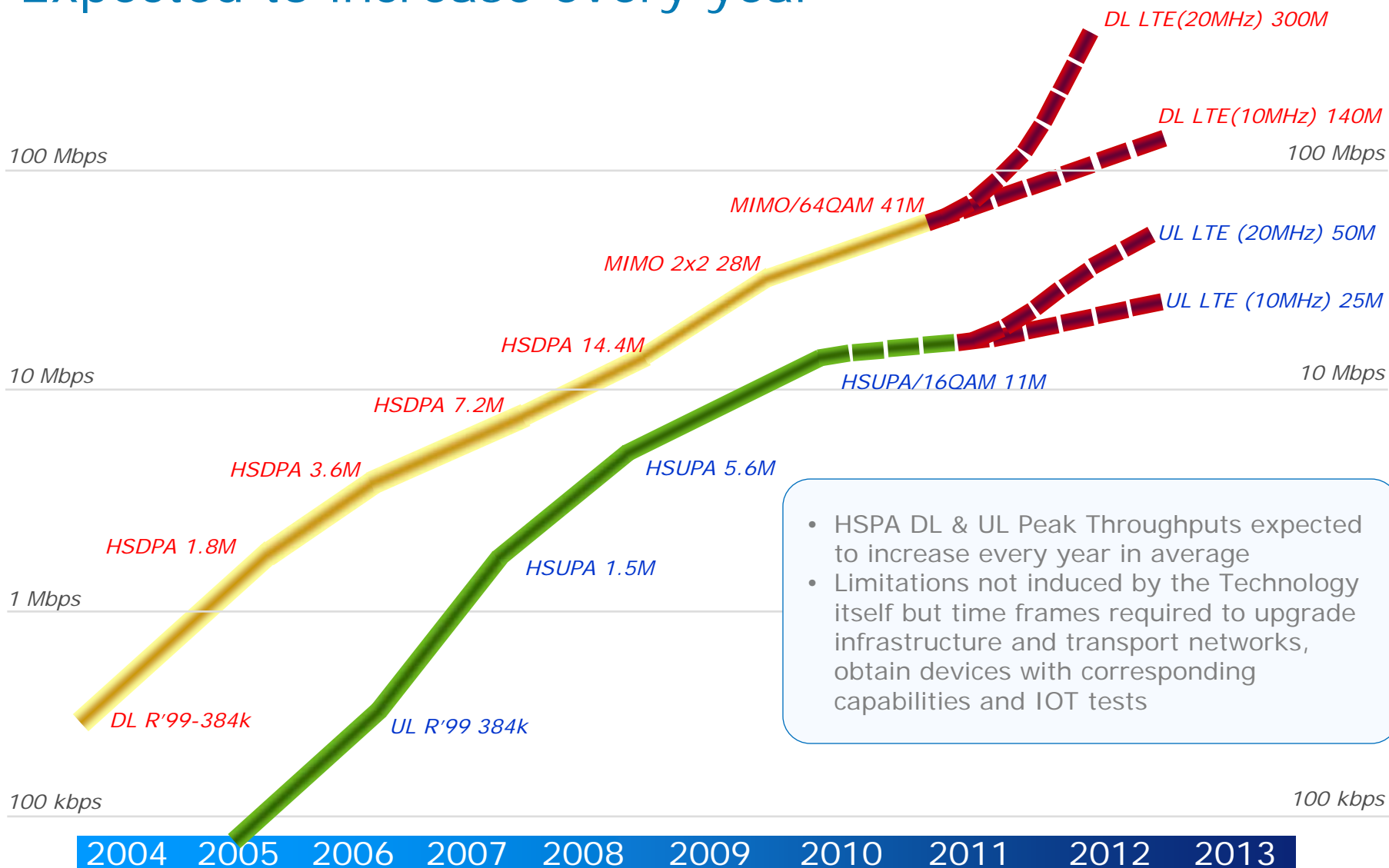
Survey of U.S. Mobile subscribers; Data based on three-month average for period ending July 31, 2007.

Source: M:Metrics Inc.

Modern Day Issues

- User Equipment (UE) - Battery Capacity
- UE Output Power - dynamic range
- Throughput voice/data
- Number of simultaneous users
- Spectral Efficiency
- Spectrum Resource Usage
- Latency
- Radio Interference
- UE Location

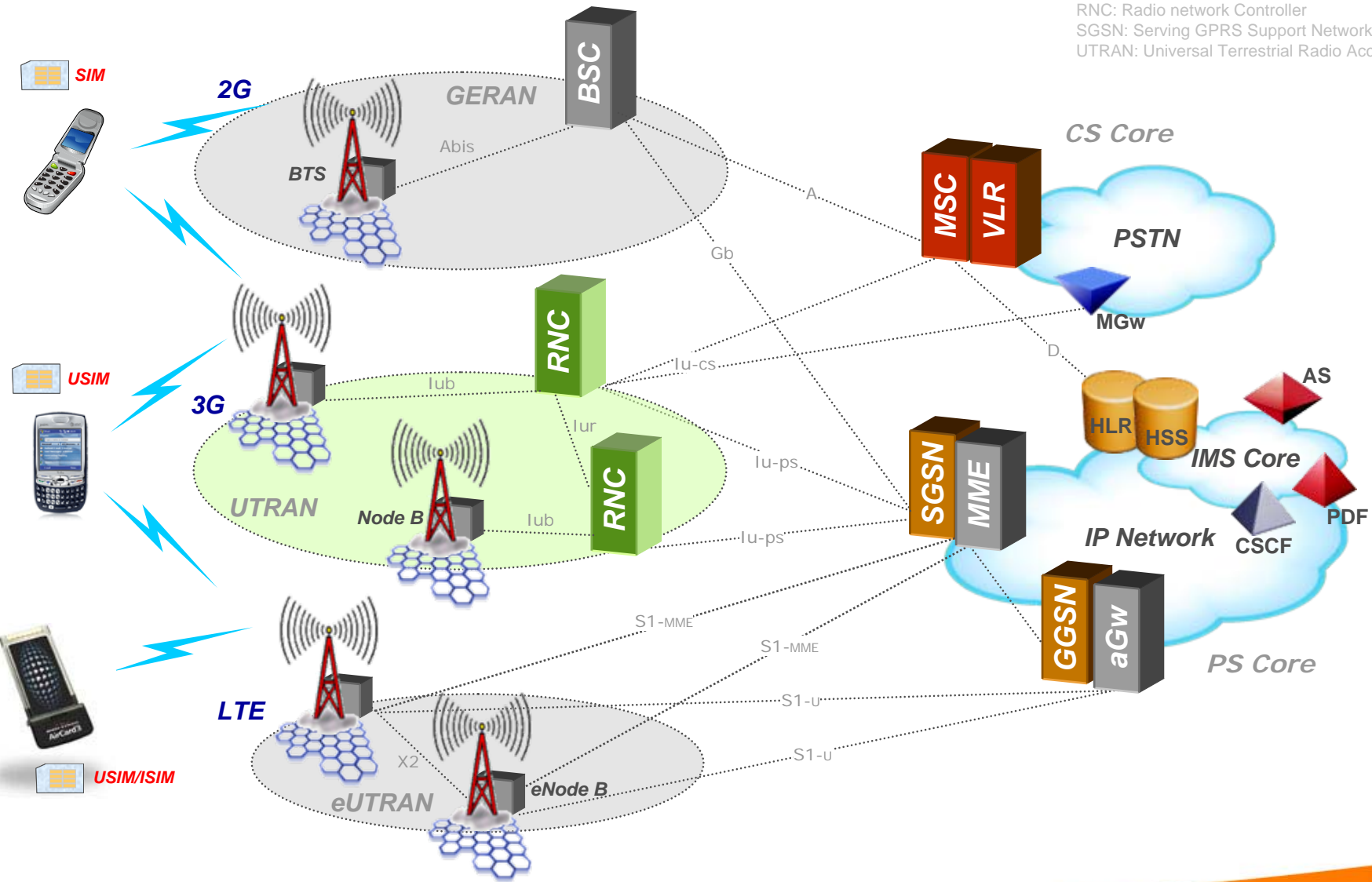
HSPA/LTE Peak Throughput Evolution: Expected to increase every year



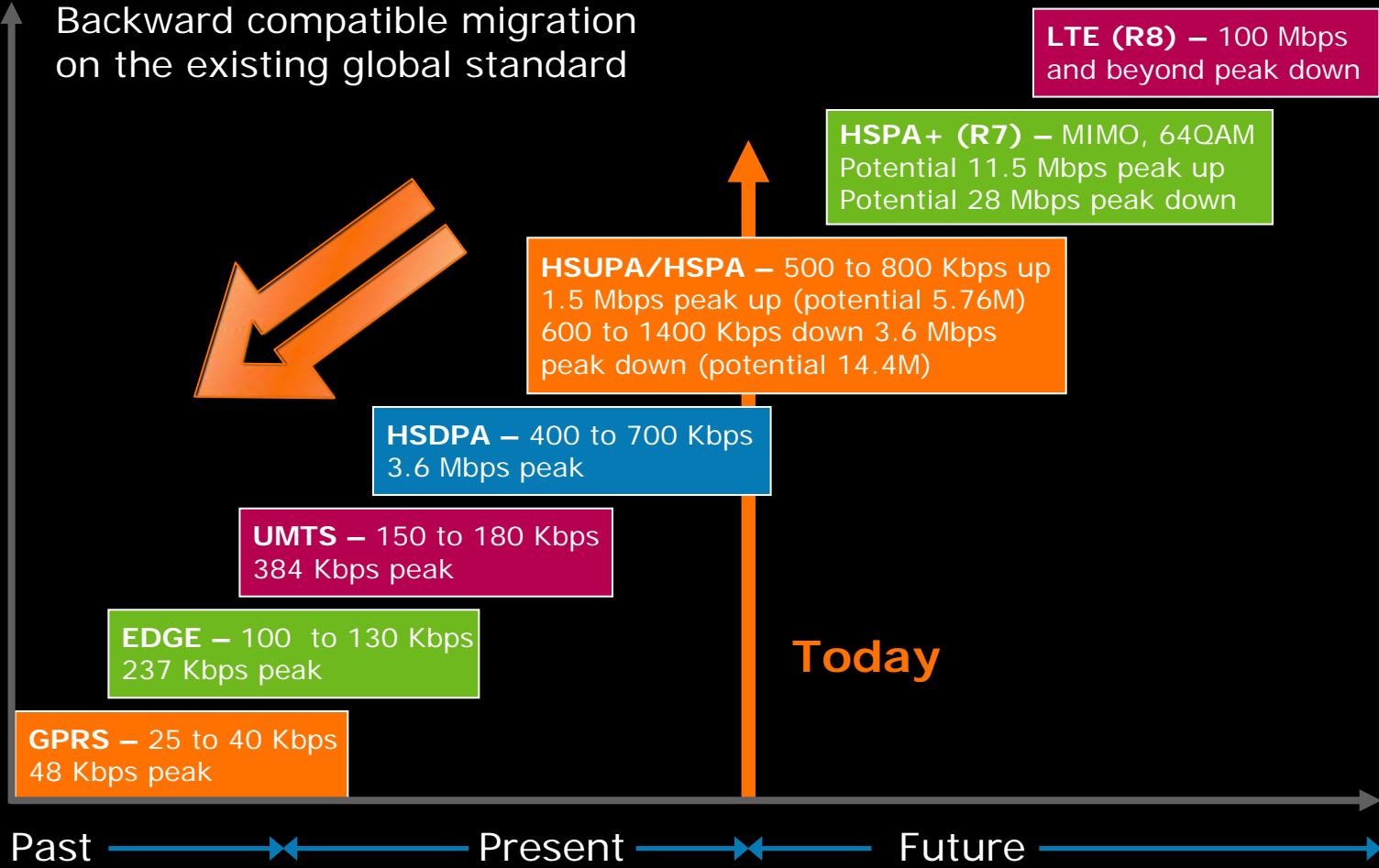
- HSPA DL & UL Peak Throughputs expected to increase every year in average
- Limitations not induced by the Technology itself but time frames required to upgrade infrastructure and transport networks, obtain devices with corresponding capabilities and IOT tests

Simplified Network Architecture

BSC: Base Station Controller
 BTS: Base Transceiver Station
 HLR: Home Location Register
 GERAN: GSM EDGE Radio Access Network
 GGSN: Gateway GPRS Support Network
 LTE: Long Term Evolution
 MSC: Mobile Switching Center
 RNC: Radio network Controller
 SGSN: Serving GPRS Support Network
 UTRAN: Universal Terrestrial Radio Access Network



Seamless Network Access: Continue Mobile Broadband Evolution



Speeds are typical user throughput.

LTE Mobility Advantages

LTE Advantages for Mobility:

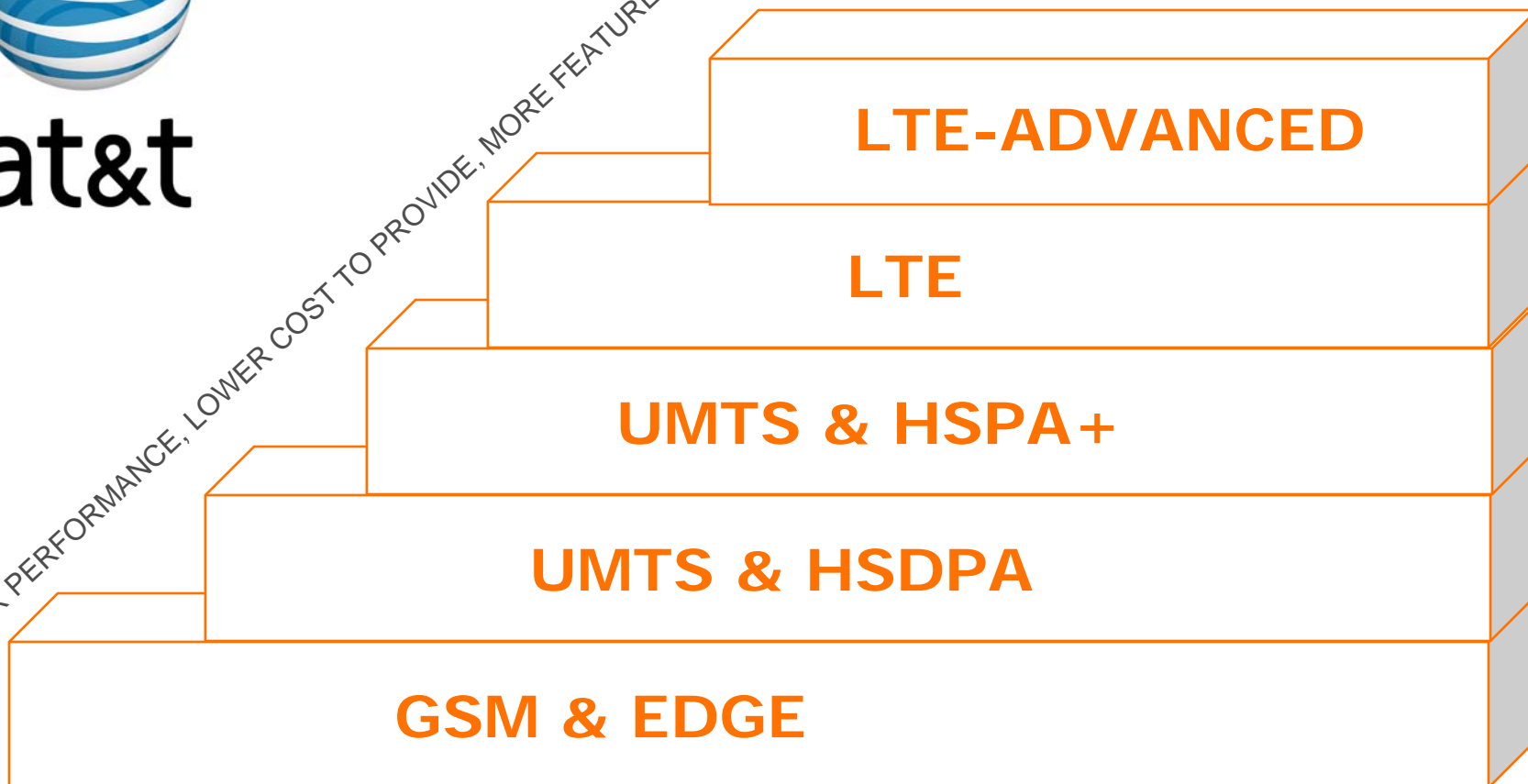
- Most customers, devices and applications
- Supports worldwide roaming
- Compatibility with existing AT&T Networks
- Designed to support efficient voice operation (VoIP)
- Simplified Network Structure

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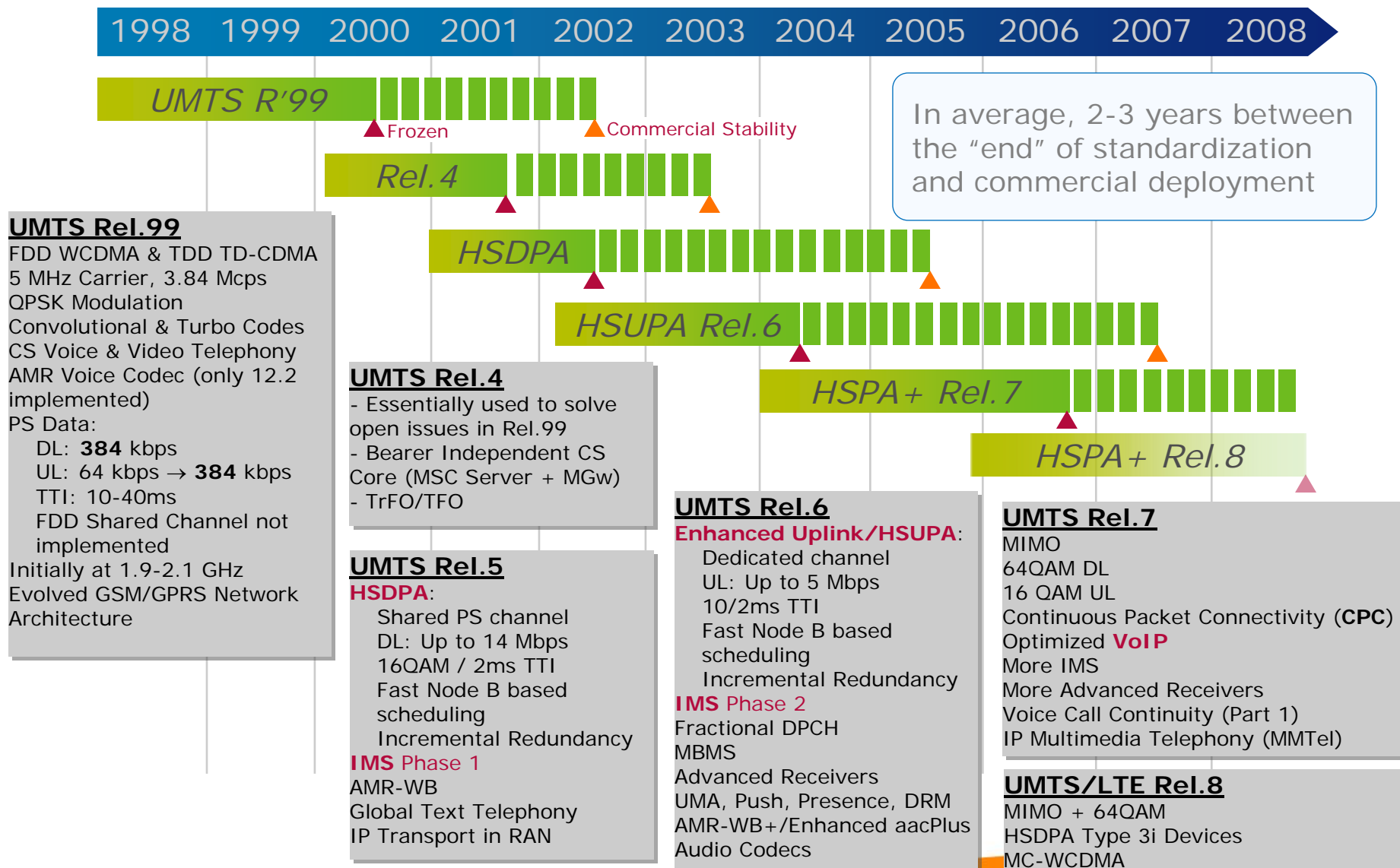


GREATER PERFORMANCE, LOWER COST TO PROVIDE, MORE FEATURES & SERVICES

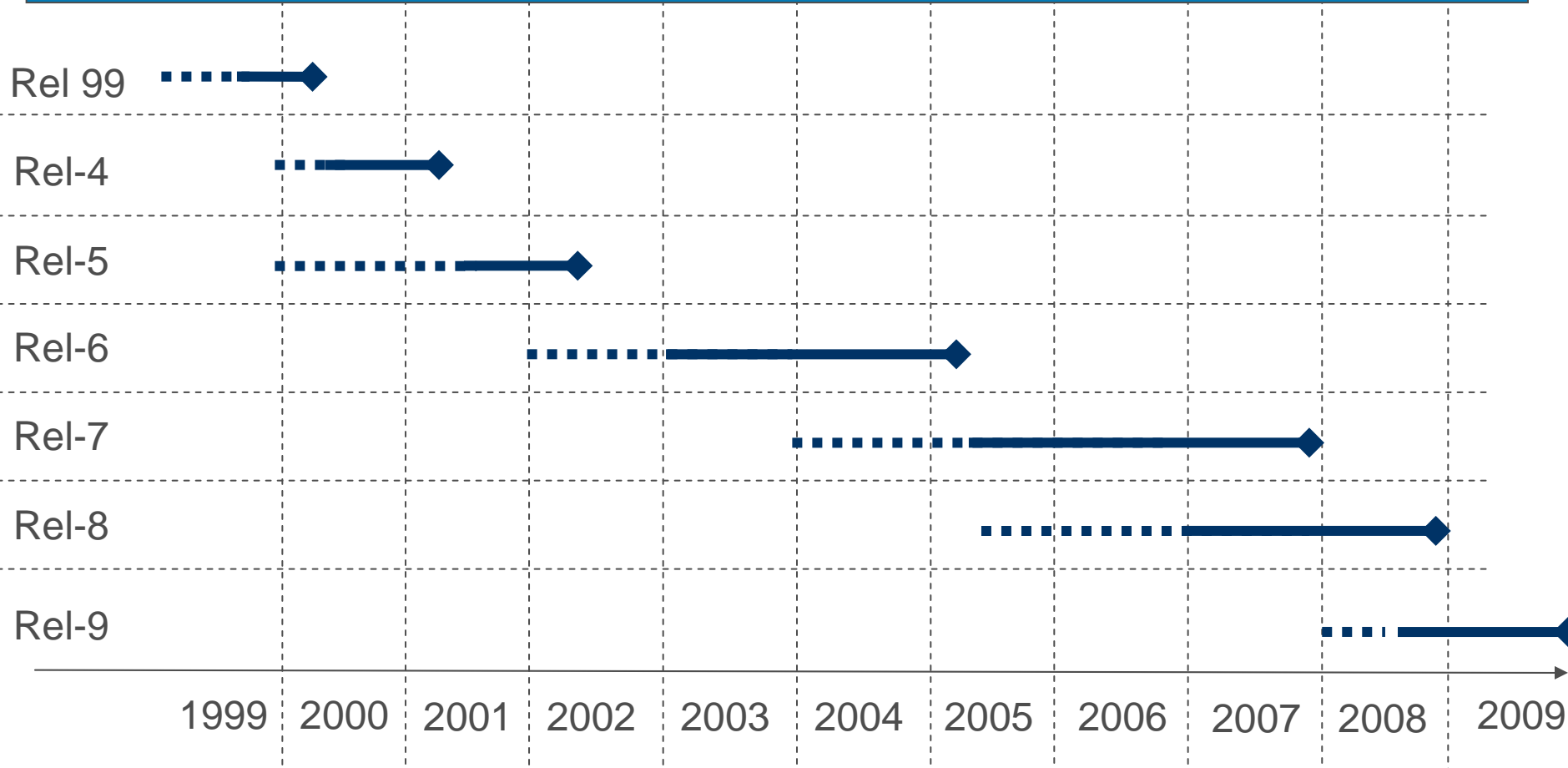


The 3GPP Technology Family Has a Rich Past and a Bright Long Term Future

UMTS/HSPA/LTE Specification Evolution



3GPP Radio Specifications Development



GSM & the Evolved Family of UMTS/HSPA and LTE Technologies Dominate Worldwide



At end of 2008, 4 billion connections to mobile devices worldwide (3.4 billion GSM/UMTS/HSPA)

320+ million connections UMTS/HSPA (77% market share of the 415 million 3G subscriptions)

258+ UMTS/HSPA Operators

100+ Countries with UMTS/HSPA

100+ Operators worldwide announced expectations to have Next Generation Mobile Networks using LTE from 2010 & beyond

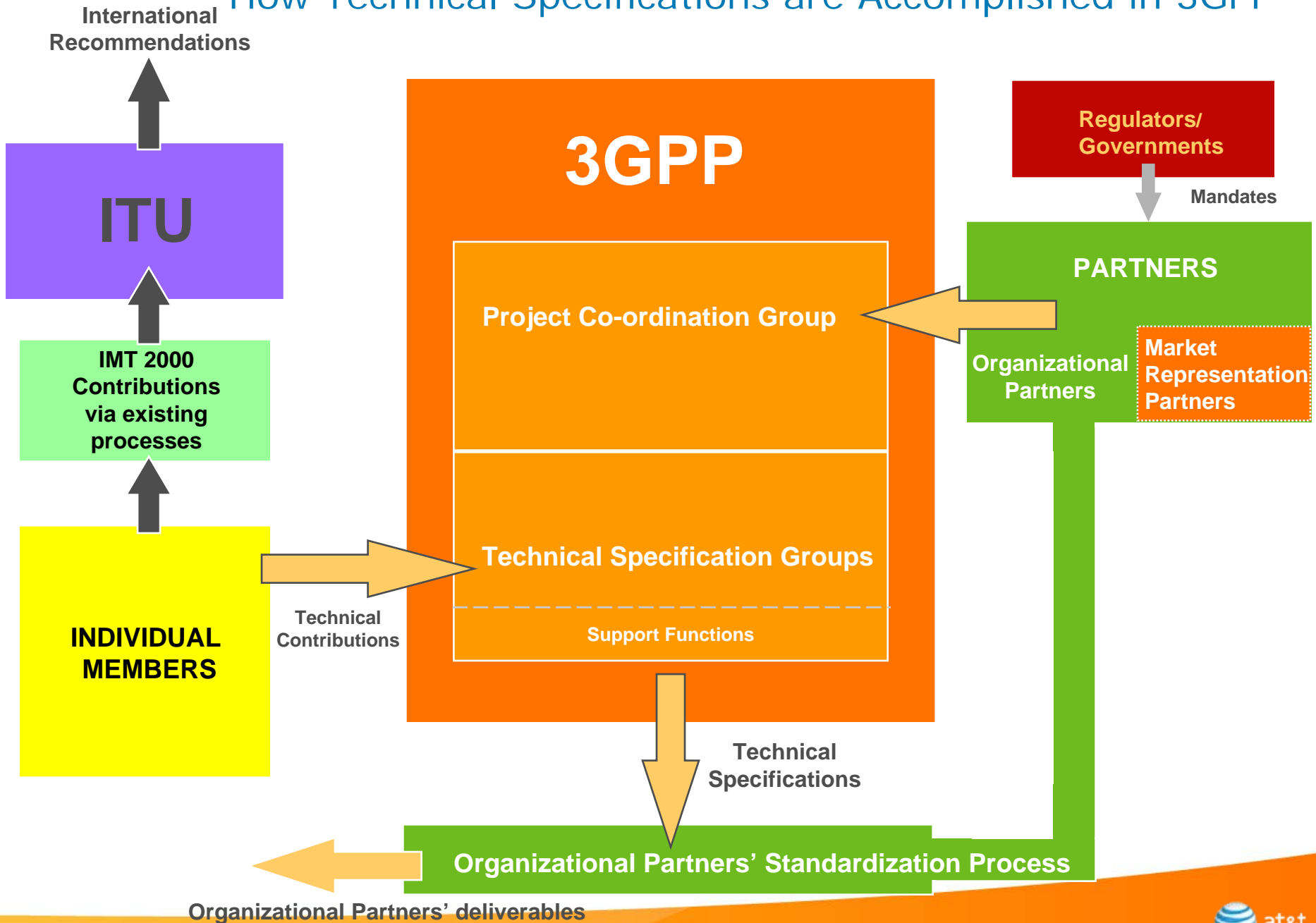
Unmatched international roaming capabilities and rich features/service sets

Source: 3G Americas

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How Technical Specifications are Accomplished in 3GPP



Technology Development

- Because technology development is costly, most development is done in the International Standards Community.
- AT&T participates heavily in the international and domestic standards community (3GPP, OMA, ITU, ATIS, TIA, and others) in both the leadership and the working levels.



at&t

Thank You!

Termonology

FDD: Frequency Division Duplex

GSM: Global System for Mobile Communications

GPRS: General Packet Radio System

EDGE: Enhanced Data Rates for GSM Evolution

UMTS: Universal Mobile Telecommunications Service

HSDPA: High Speed Downlink Packet Access

HSUPA: High Speed Uplink Packet Access

HSPA: High Speed Packet Access

LTE: Long Term Evolution

TDD: Time Division Duplex

TTI: Transmission Timing Interval