



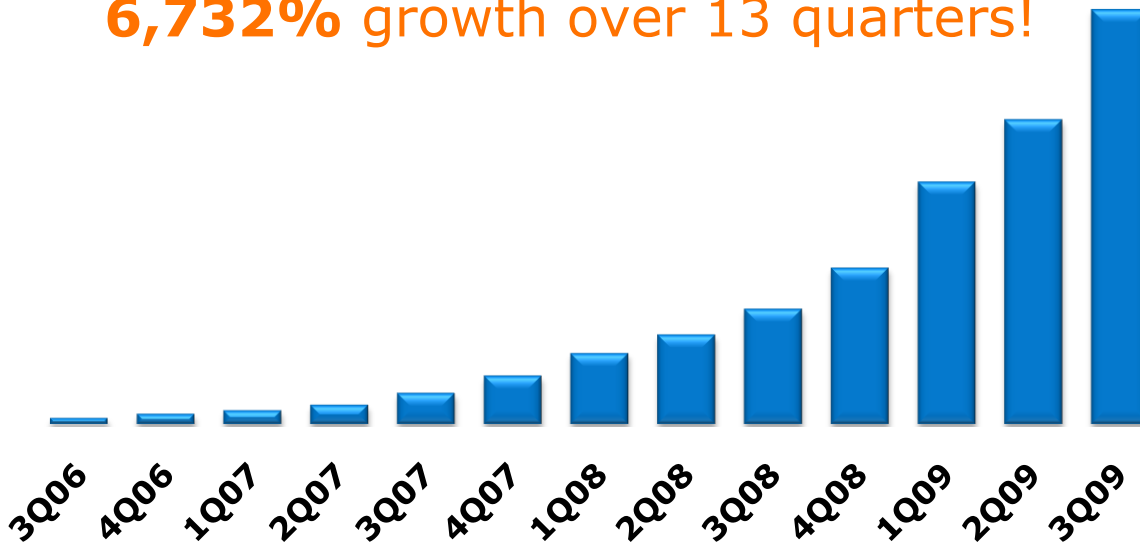
**at&t**

# **Addressing Current and Future Wireless Demand**

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Executive Director – Radio Technology  
AT&T Architecture and Planning

# Rising Demand and The Need to Innovate in the Network

**6,732% growth over 13 quarters!**



- Technology
  - Efficiency
  - Migration
- Network Deployment
  - Architecture
  - Backhaul
  - Buildout
- Spectrum Management



Quality of Experience

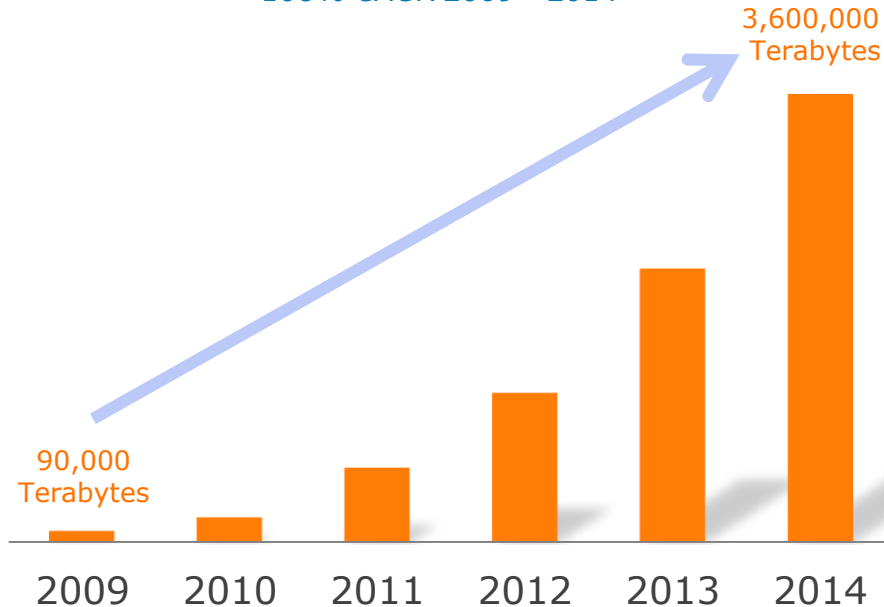
**Growth in Demand is Accelerating!**

**Technology, Spectrum, Deployment and Quality are interrelated in a complex way and must be carefully planned and managed.**

# It Won't Just be AT&T Customer Demand is Surging

## Cisco Forecasts 3.6 Million Terabytes per Month of Global Mobile Data Traffic by 2014

(TB per Month)  
108% CAGR 2009 - 2014



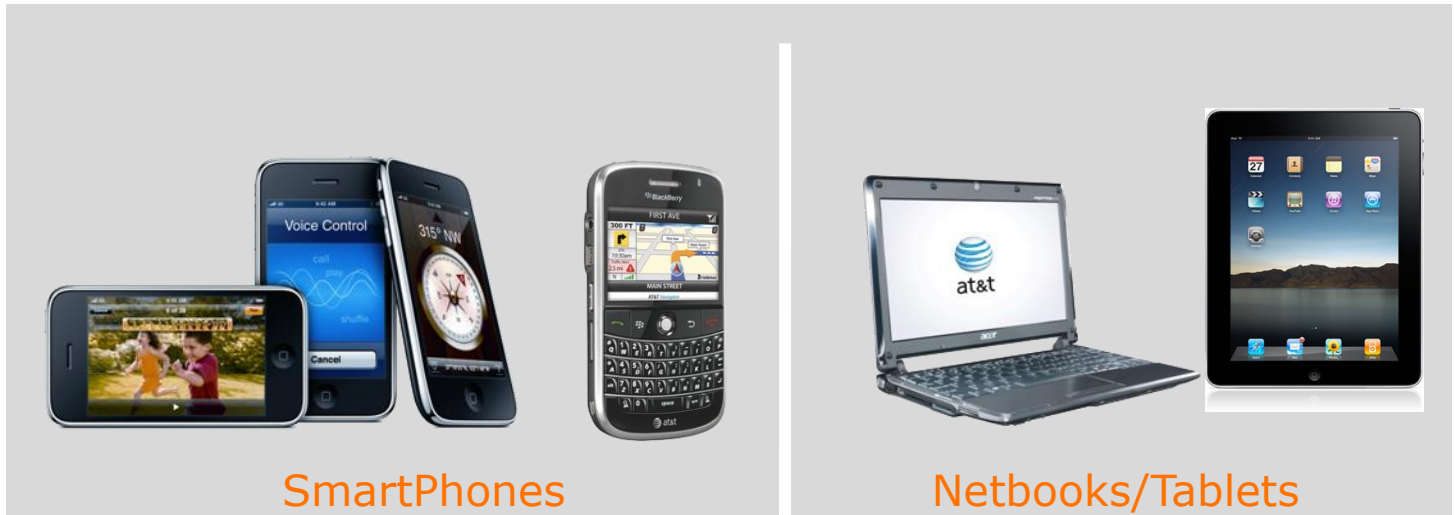
\*Source: Cisco, VNI Mobile, 2010

- Mobile broadband growth outpaces every other platform\*\*
- Pew estimates that by 2020, mobile devices will be the primary Internet devices for most people in the world\*\*\*
- The average smartphone user generates 10 times the amount of traffic generated by the average non-smartphone user\*

\*\*Source: CTIA, Written Ex Parte to FCC, Sept. 29, 2009

\*\*\*Source: Pew Internet & American Life Project, Dec. 2008

# Factors for Data Growth

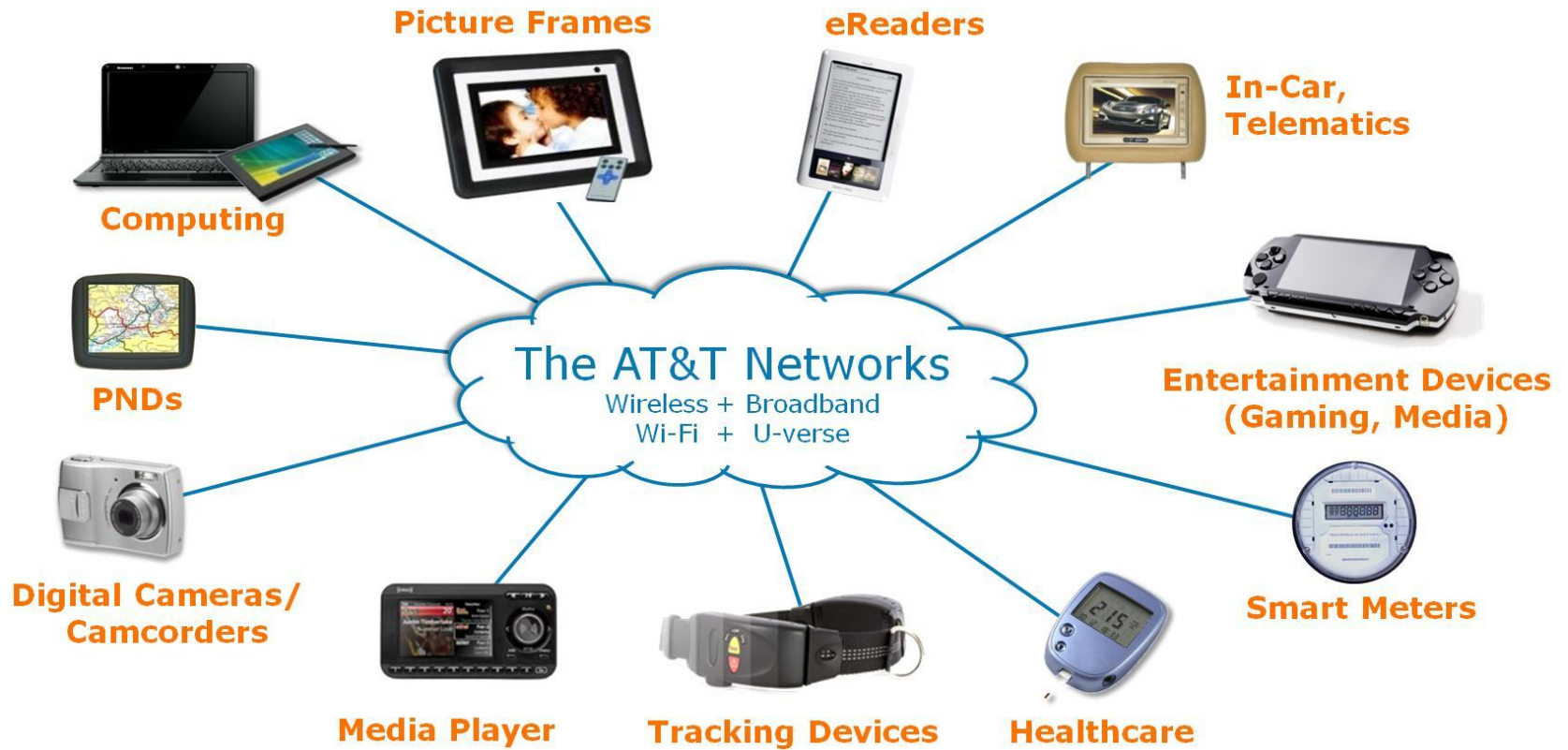


Postpaid subscribers with Integrated devices

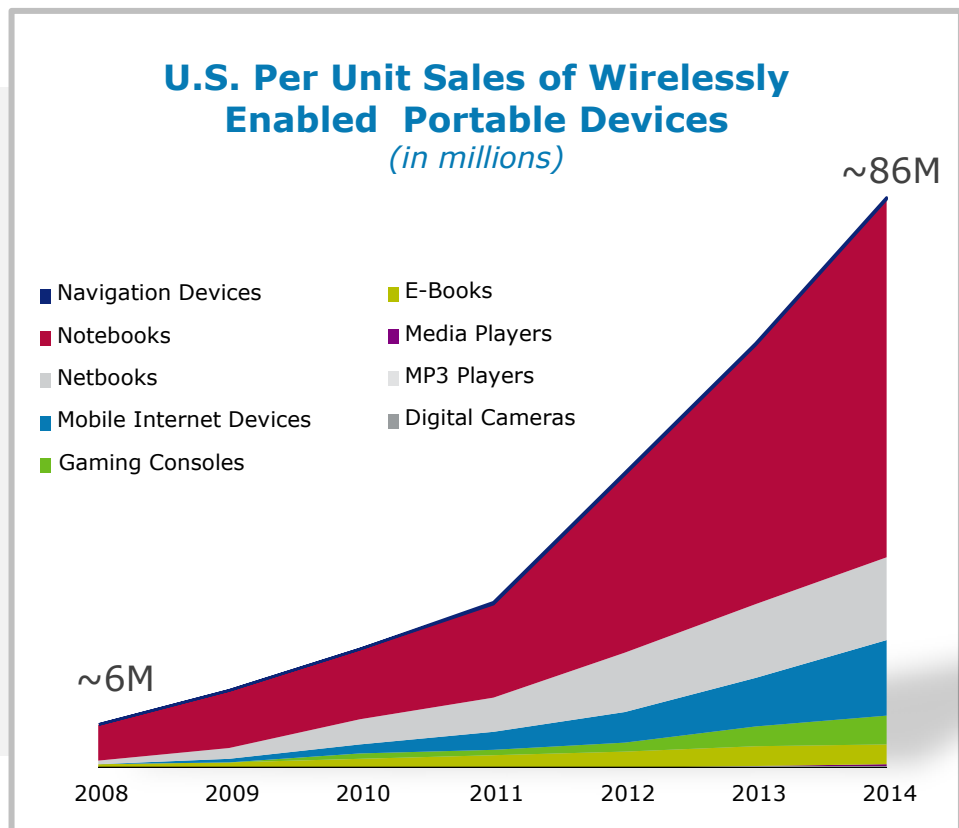


- AT&T has the most smartphone users in the US
- Devices are becoming easier to use
- App stores beginning to proliferate
- Apps using increasing levels of network communication
- Higher use of email, VPN and web access on the go

# A New Generation of Connected Devices



# Emerging Devices Taking Off and Expected to Maintain Growth



\*Source: Strategy Analytics, U.S. Connected Device Forecast, Jan. 2010

## > By 2014:

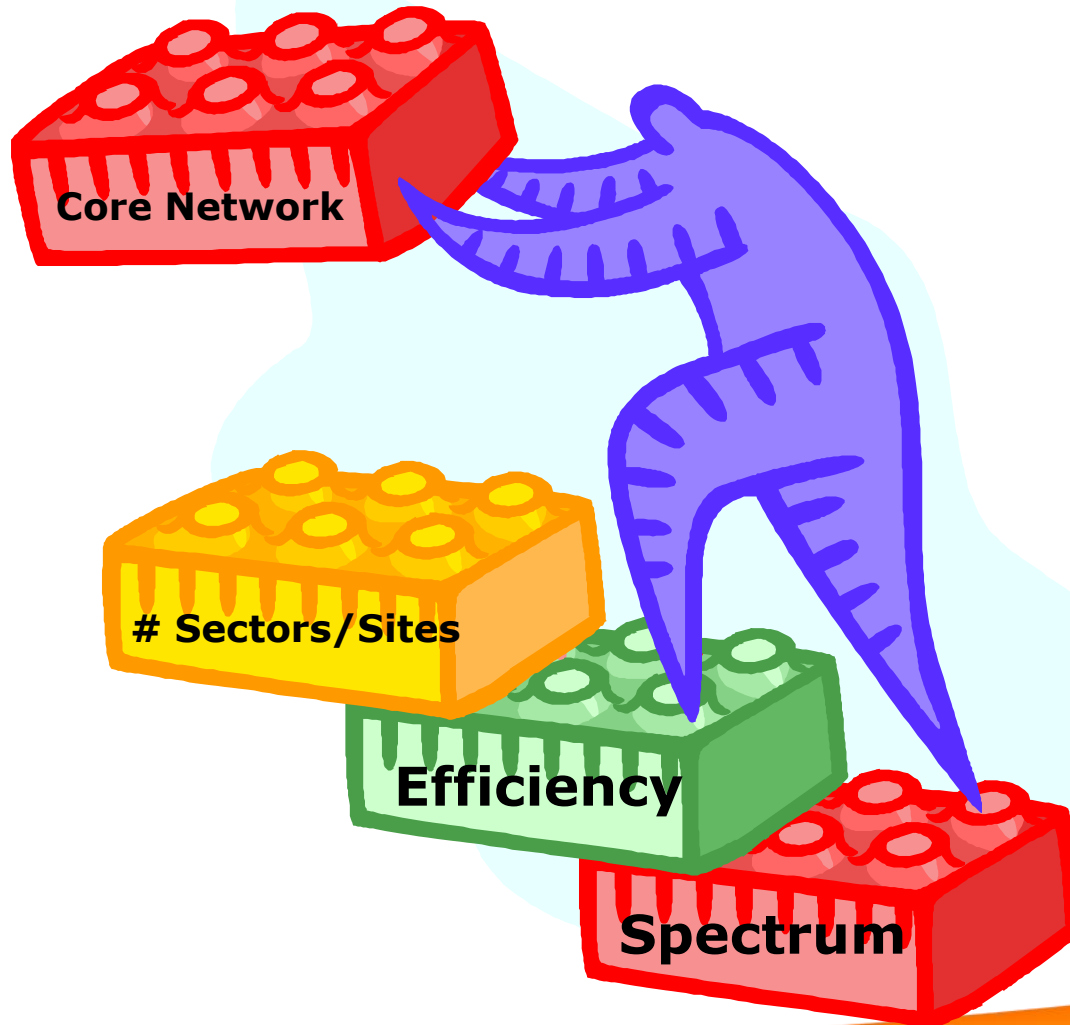
- About 86 million devices
- More than a quarter of emerging devices in the world projected to be in U.S.\*\*
- Annual U.S. retail market value of wirelessly enabled consumer devices estimated to be \$39B\*

## > In 4Q09, U.S. led the world in e-book downloads.\*\*\*

\*\* Source: Strategy Analytics, U.S. Connected Device Forecast, Jan. 2010 and Strategy Analytics, Wireless Consumer Electronics Global Market Forecast May 2009

\*\*\*Source: Wattpad, Global 4Q09 Ebook Metrics Reports, Dec. 2009

# The Building Blocks of Capacity



# How Do We Address This Growth

## Coverage and Propagation

- Aggressively adding cell sites
- Acquisitions to improve coverage
- Addition of new UMTS channels in 850 MHz

## Capacity and throughput - Technology Upgrades

- Aggressive 3G build-out plans, upgrade to HSPA 7.2
- Deployment of additional HSPA carriers
- Enhanced backhaul (fiber based Ethernet)
- Continued evolution of RAN technology

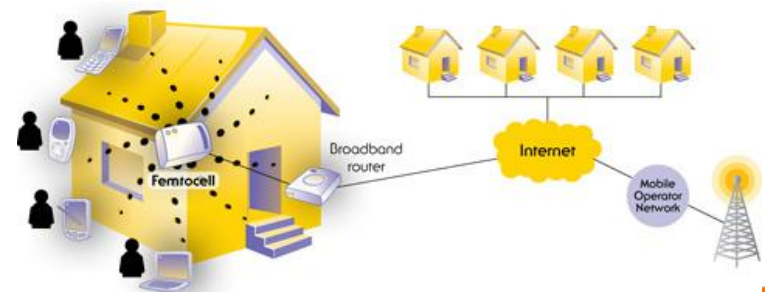
UMTS/HSPA → Evolved HSPA → LTE → LTE Advanced

## Additional Spectrum

- 700 MHz spectrum
- AWS spectrum (1.7 GHz/2.1 GHz)

## Offload Data – Heterogeneous Networks

- Femtocells
- WiFi
- Cellular/Wi-Fi Integration





# LTE Deployment

## AT&T 700 MHz Spectrum

Used **exclusively** for LTE

**Excellent** propagation characteristics

Covers **100% of top 200** markets

Covers **87% of U.S.** population

## AT&T AWS Spectrum

Used for LTE in addition to 700 MHz

2010			
Jan	Feb	March	April
May	Trials		Aug
Sept	Oct	Nov	Dec

2011			
Jan	Feb	March	April
May	Initial Deployment		Aug
Sept		Nov	Dec

- **Initial focus is for data services**
- **CSFB to UMTS for voice**
- **VoIP over LTE in future**
- **Moving to an IMS architecture**



# LTE Targets

## High data rates

- Peak data rates: at least 100 Mbps (DL) / at least 50 Mbps (UL)
- Average user throughput: 3-4 times (DL), 2-3 times (UL) HSPA reference
- Cell-edge user throughput: 2-3 times (DL & UL) HSPA reference

## Low latency

- User plane: Less than 10 ms (RAN RTT)
- Control plane: Less than 100 ms (idle → active)

## High spectral efficiency

- Three times HSPA R6 baseline
- Improved performance for broadcast services

## Simplicity

- Less signaling, auto-configuration of eNodeB

## Spectrum flexibility

- Deployable in a wide range of different spectrum allocations of different sizes
- Unpaired and paired spectrum, variable duplex distance

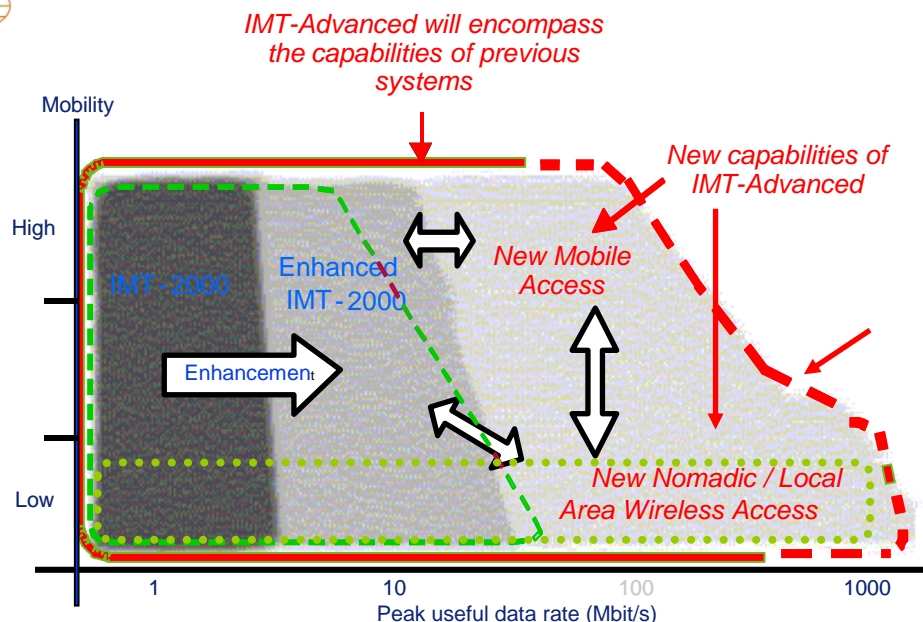
# LTE-Advanced (likely 2014 or later)

- Relays
- Advanced Interference Management
- CoMP
- Carrier aggregation
- Higher order MIMO – up to 8x8, UL MIMO

- Multi-User MIMO
- Performance goals

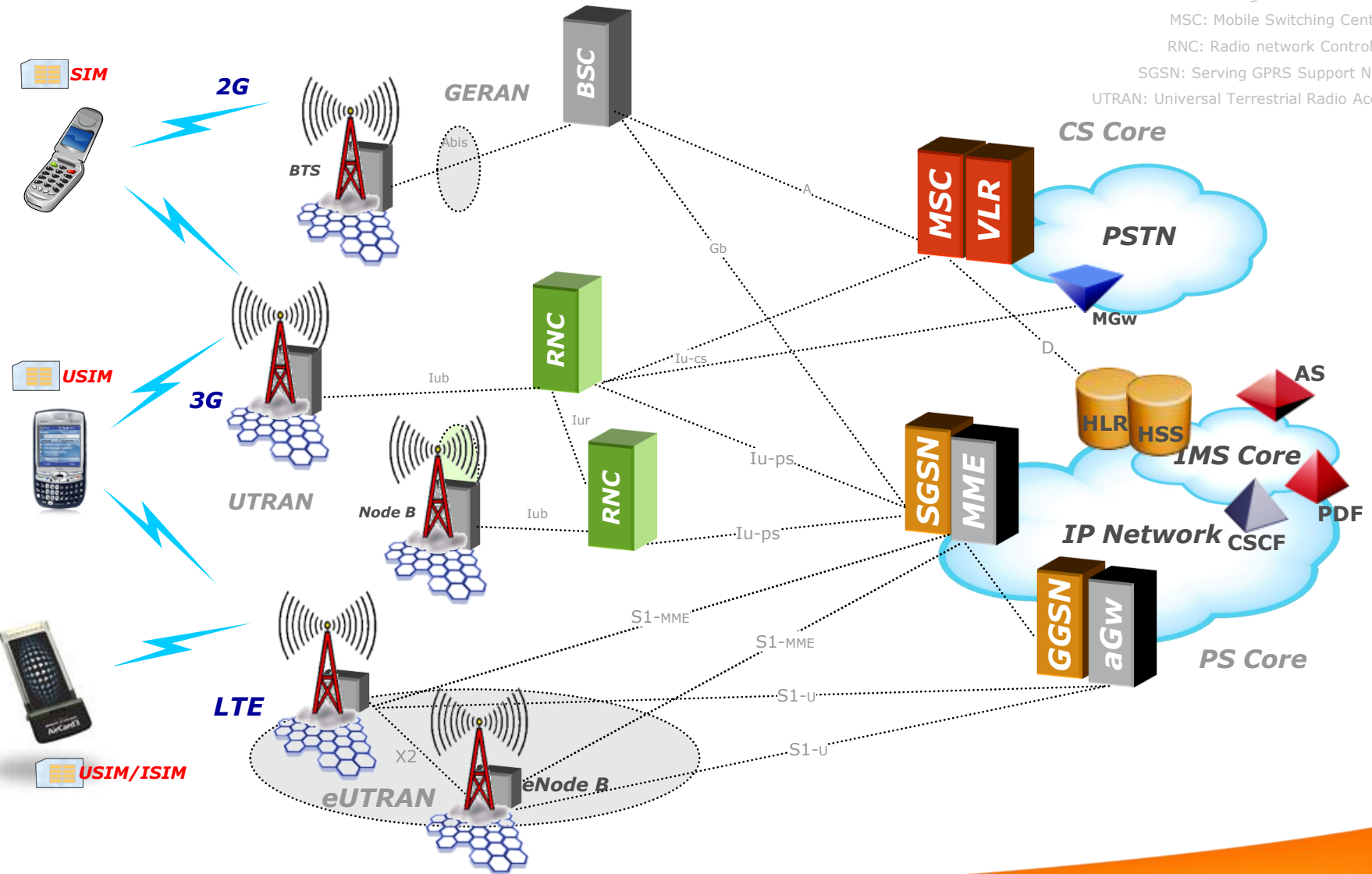


- Wider bandwidth
- Up to 1 Gbps DL
- Reduced latency
- More spectrally efficient

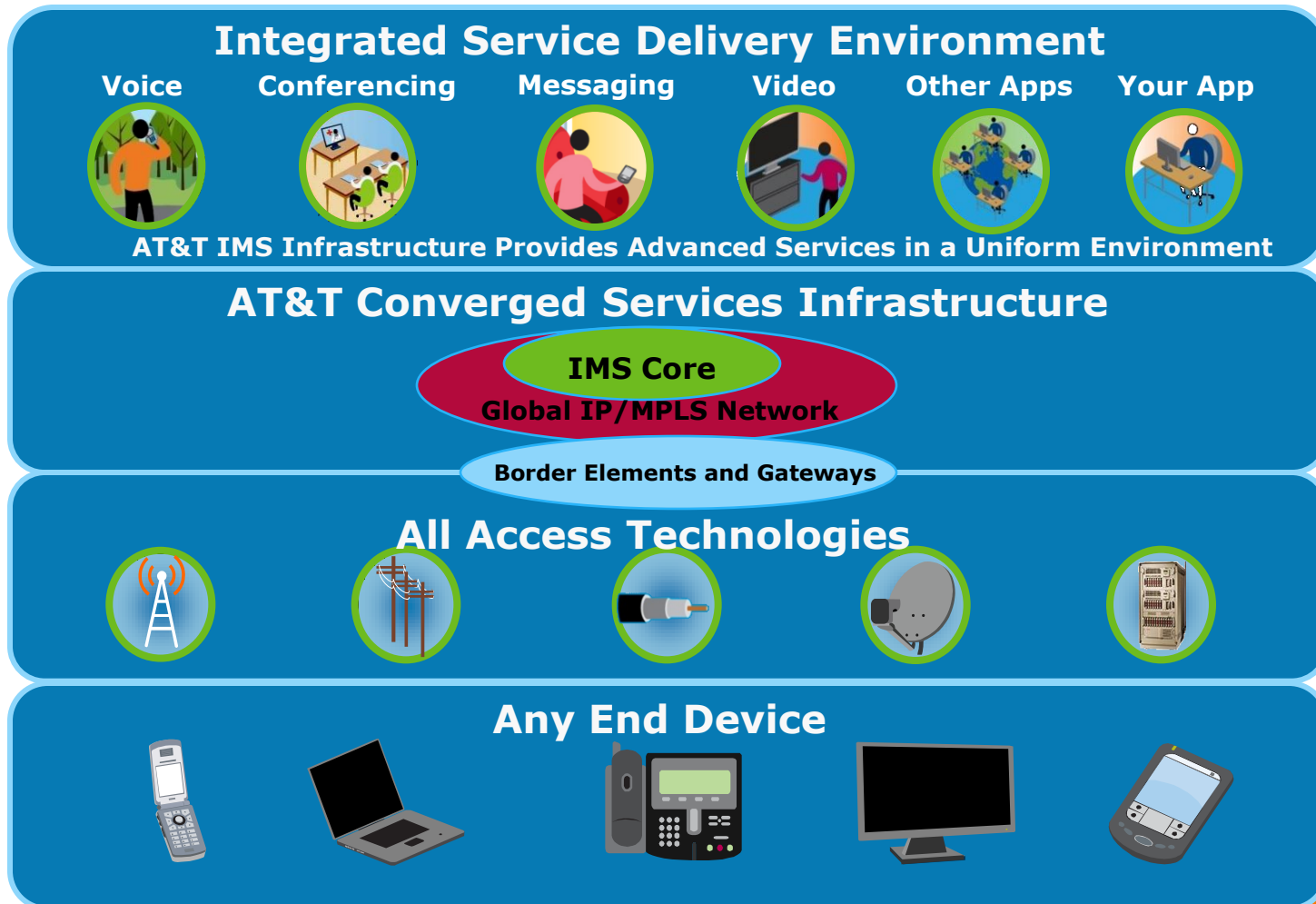


# 3GPP Evolution of Wireless Networks

- 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



# Evolving the Core: AT&T Services Over IP Strategy: Layered Architecture



Connect people to their world,  
everywhere they live and work,  
and do it better than anyone else.

