# Realizing LTE:
## Understanding the Challenges and Planning for LTE Introduction

Maria E. Palamara
Director – CDMA-LTE Strategy
Alcatel-Lucent

January, 2009

# Agenda

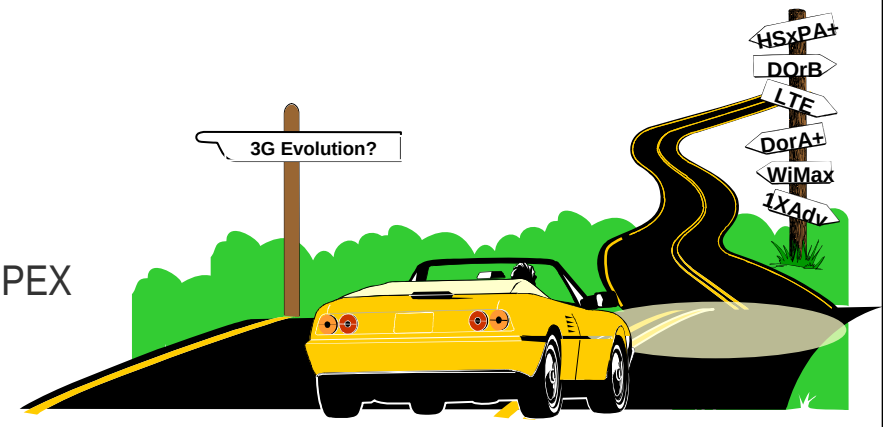
1. Market Backdrop & Key Challenges of LTE Evolution
2. Managing Technology Risk
3. Making the Most out of Available Spectrum
4. Assuring Service Quality During the Transition
5. Summary

# Market Backdrop

# Market Highlights

## Big Events of 2008 in North America

- FCC Auction of 700 MHz Spectrum
  - Verizon and AT&T are big winners
- Verizon Announcement of LTE Plans
  - Aggressive plans for nationwide LTE deployment in 700 MHz
- Major Economic Slowdown & Recession
  - CAPEX spending cutbacks affect vendors
- Open Access in Mobile gains Momentum
  - Market Success of the 3G iPhone and Advent of Google's Android
  - Rise of the non-operator "application stores"
- AT&T launches HSPA widely,
  Sprint/Clearwire launches WiMAX selectively
  - The High Speed Data Marketing wars continue
- Increased attention on reducing CAPEX and OPEX




**Planning evolution to LTE has become a major consideration for operators**

# Mobile Data Explosion
# The iPhone Phenomenon

Apple reports they have shipped 4M iPhones (Feb08)

- ATT claim they have activated ~2M
  - Analyst claims 20% unlocked
- Number 2 seller of smart phones in the US (28%), behind BlackBerry (41%)
- Target is 10M sales by end of 2008

Business Model

- Apple controls applications
- Apple splits application revenue 30% Apple, 70% application vendor
- AT&T gets data airtime revenue

## What makes the iPhone so compelling?

Apple continues to extend and innovate:

- Data functionality:
- Usability: Improving power and storage
- Applications: Exchange email, SDK for appl developers
- Ecosystem: Web sites specifically designed for iPhone

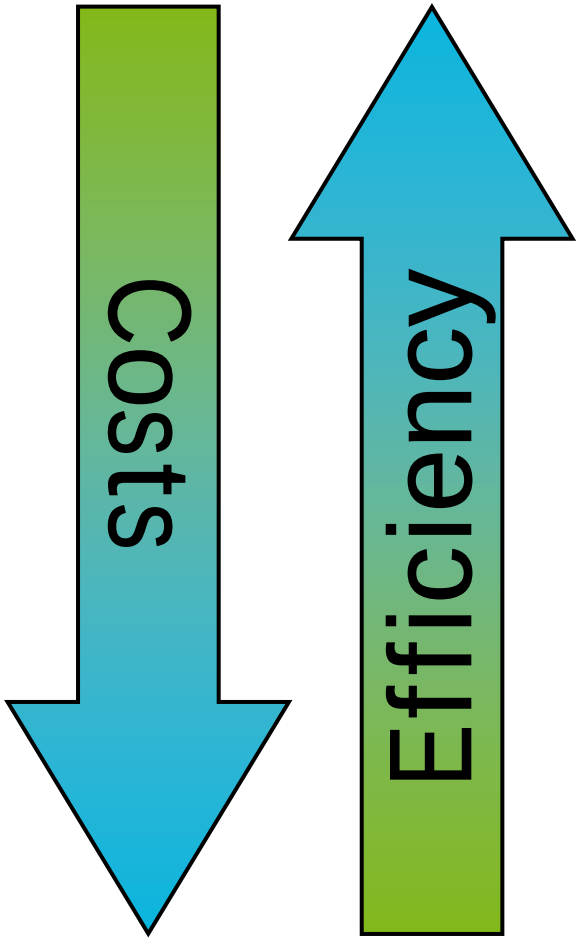
# Key Challenges in Migrating to LTE

## Top 5 Operator Worries:

- Cost effective evolution to LTE & IMS
- Spectral Efficiency
- Service Quality
- Rural and Indoor Coverage Performance
- CAPEX and OPEX Efficiency

## Evolving to LTE… Managing the Challenges:

- Managing Technology Risk
- Maximizing Spectrum Utilization
- Maintaining Network & Service Quality During Transition
- Managing Capital Expenditures
- Controlling Backhaul Costs
- Developing a Device Ecosystem




**Minimize Cost Per Data Bit to Support Profitability in an Open Access Environment**

# Managing Technology Risk

# Alternate Risk Management Strategies
# Transforming to an All IP Mobile Network

## CDMA Customers

### Lots of Spectrum
### Aggressive Migration Strategy

1. Start with existing CDMA voice/data network
2. Upgrade to EVDOrA for data, start IP transformation in radio access & backhaul
3. Add EVDO VoIP and IMS, starting IP transformation at service layer
4. Gradually add LTE, improving profitability of access in high use areas first
5. Expand LTE to ubiquitous network, as user demand dictates
6. Eventually, full replacement of CDMA network when users are all migrated

### Constrained Spectrum
### Conservative Migration Strategy

1. Start with existing CDMA voice network
2. Add LTE carrier for data (full footprint deployment), improving competitiveness with mobile handsets
3. Implement CDMA 3G1x voice capacity enhancements, clearing additional spectrum for LTE data
4. Gradually rescale LTE bandwidth as CDMA spectrum clears, and migrate applications to LTE
5. Add IMS and VoIP to LTE to offer simultaneous voice & data
6. Eventually, full replacement of CDMA when LTE voice is proven

**LTE VoIP capacity & quality will determine when significant voice transition will begin**

# Alternate Risk Management Strategies
# Transforming to an All IP Mobile Network

**W-CDMA/GSM Customers**

## Early LTE adopters
## Aggressive Migration Strategy

1. Start with existing GSM/W-CDMA voice/data network
2. Deploy LTE in new bands in overlay as a complement of 2G/3G network capacity for data in hot zones
3. New AWS/700MHz band or unused band for 2G/3G
4. Expand LTE to ubiquitous network, as user demand dictates
5. Eventually, full replacement of W-CDMA network when users are all migrated

## HSPA+ adopters
## Conservative Migration Strategy

1. Start with existing GSM/W-CDMA voice/data network
2. Deploy HSPA+ in dual band networks
3. Deploy LTE in later stage using new bands as a complement of HSPA+ (capacity)
4. High band (AWS/1.9GHz) coupled with low band (700/850MHz) for better coverage
5. Growing existing HSPA capacity and deploy LTE ready modules
6. Eventually, full replacement of W-CDMA network when users are all migrated

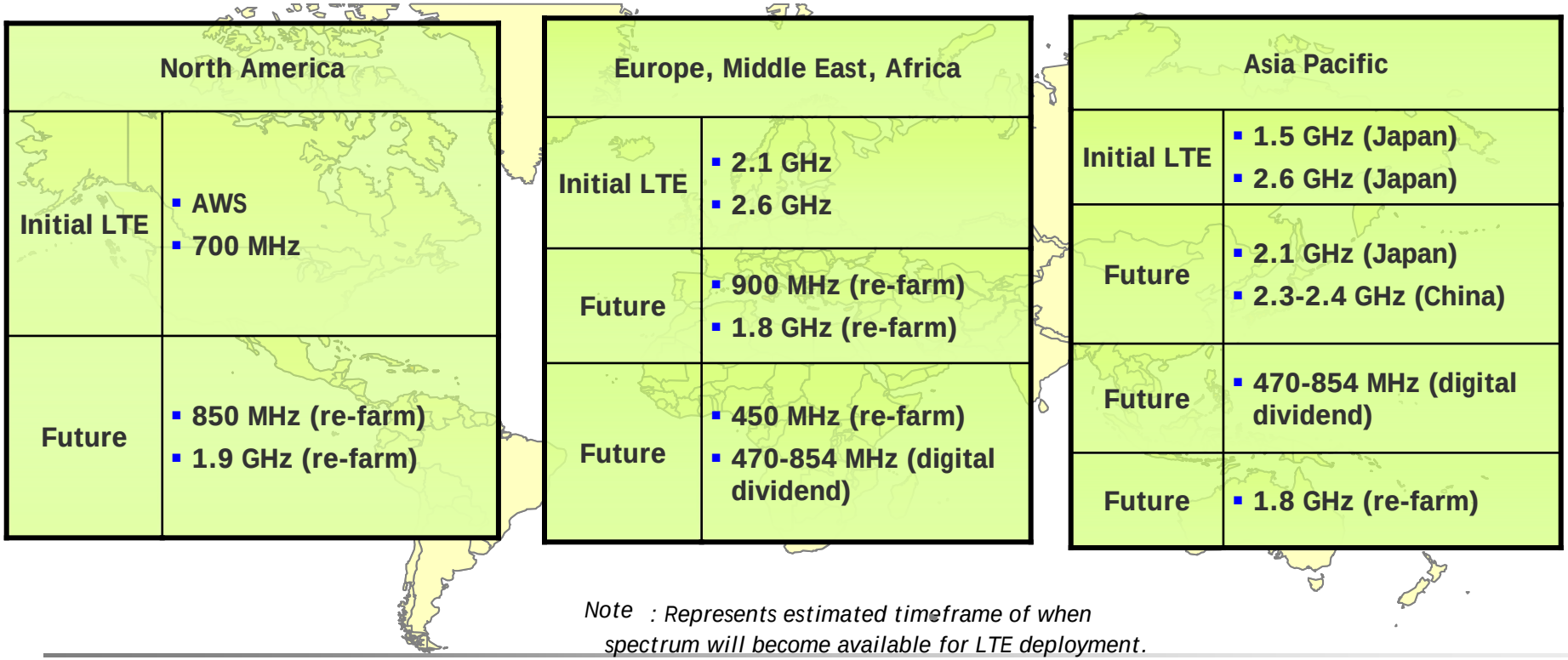
**Operator focus in 2009 on HSPA+ or LTE but not both simultaneously**

# Making the Most of Available Spectrum

# LTE Spectrum Options

LTE deployable in any of the “3GPP” bands,… (and more)

- **FDD :** 2.6 GHz, 2.3 GHz, 2.1 GHz,1900 MHz,1800 MHz,1700/2100 MHz, 1500 MHz, 900 MHz, 850 MHz, 700 MHz, 450 MHz…….
- **TDD :** 2.6 GHz**,** 2.3 GHz, 1.9/2.1 GHz……..



| North America | |
|---|---|
| Initial LTE | ▪ AWS<br>▪ 700 MHz |
| Future | ▪ 850 MHz (re-farm)<br>▪ 1.9 GHz (re-farm) |

| Europe, Middle East, Africa | |
|---|---|
| Initial LTE | ▪ 2.1 GHz<br>▪ 2.6 GHz |
| Future | ▪ 900 MHz (re-farm)<br>▪ 1.8 GHz (re-farm) |
| Future | ▪ 450 MHz (re-farm)<br>▪ 470-854 MHz (digital dividend) |

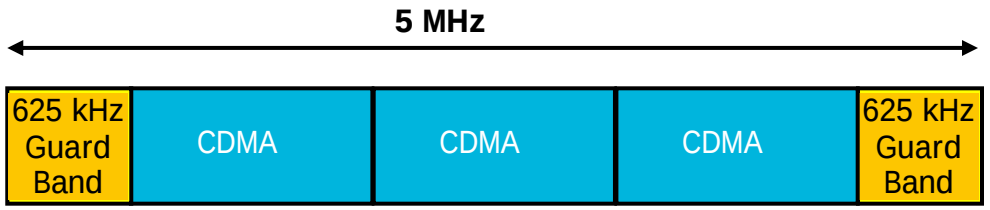
| Asia Pacific | |
|---|---|
| Initial LTE | ▪ 1.5 GHz (Japan)<br>▪ 2.6 GHz (Japan) |
| Future | ▪ 2.1 GHz (Japan)<br>▪ 2.3-2.4 GHz (China) |
| Future | ▪ 470-854 MHz (digital dividend) |
| Future | ▪ 1.8 GHz (re-farm) |

*Note : Represents estimated timeframe of when spectrum will become available for LTE deployment.*

# CDMA to LTE Migration in a 5 MHz Band

Preliminary view

**3 CDMA Carriers**




**2 CDMA Carriers & 1 1.4-MHz LTE Carrier**


**1 CDMA Carrier and 2 1.4-MHz LTE Carriers**


**1 5-MHz LTE Carrier**

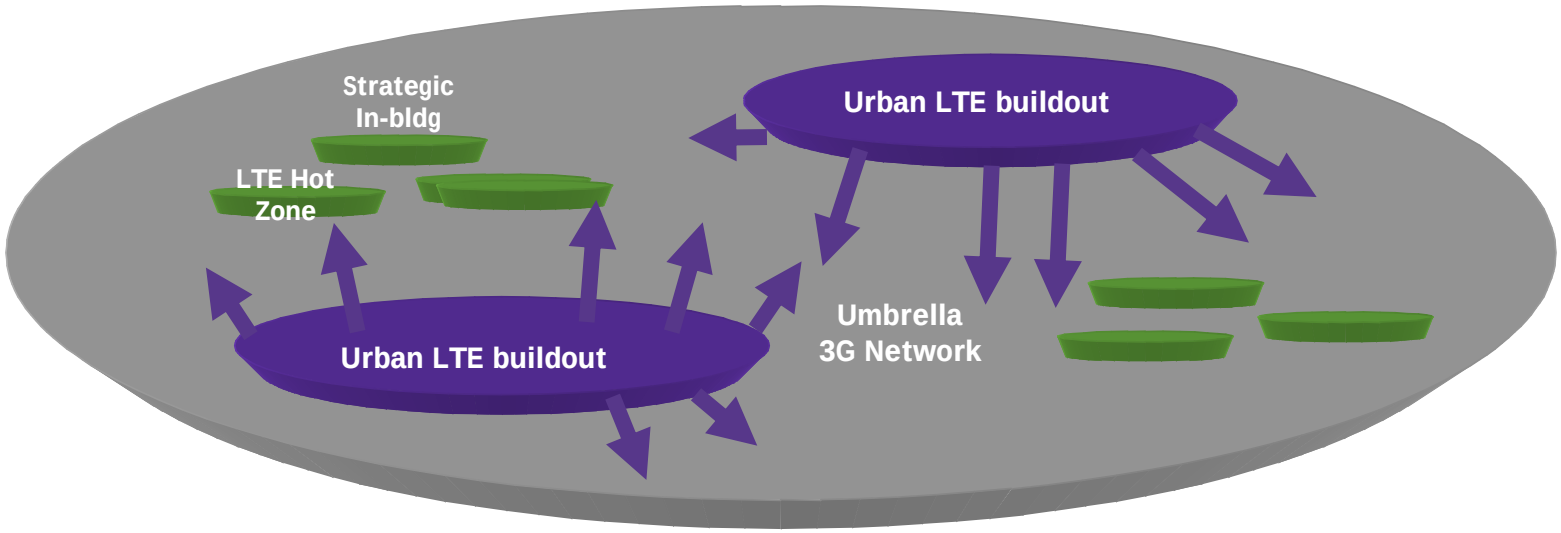

- The above carrier assignments consider CDMA block-edge guard band, inter-channel guard band, CDMA/LTE channel raster and CDMA/LTE channel bandwidths
- The required guard band between LTE and CDMA carriers depends on the LTE UE transmitter emission mask requirement which is not defined or finalized in TS 36.101

# Assuring Service Quality During Transition

# 3G to LTE Seamless Mobility – Value Proposition

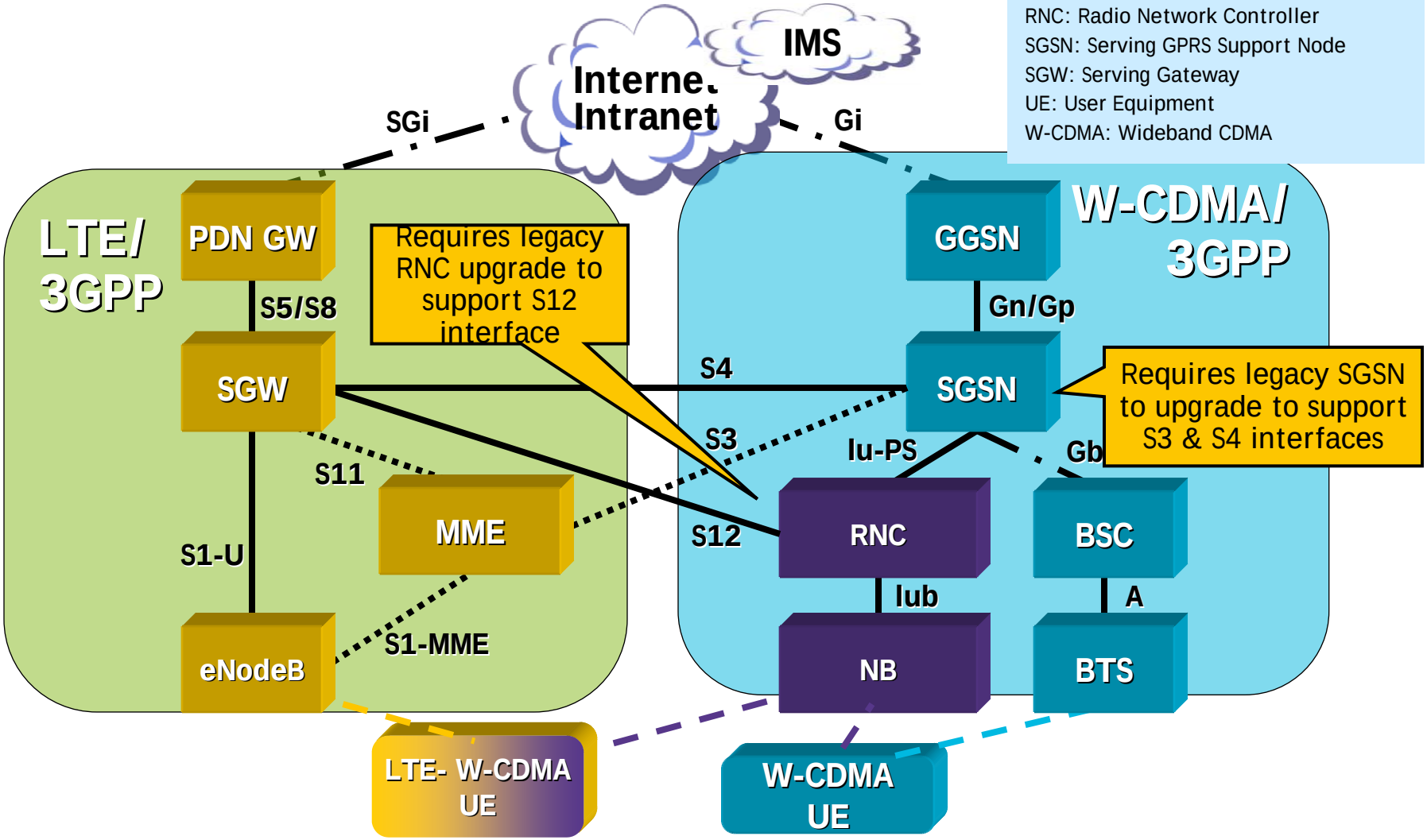
3G/LTE Seamless Mobility will be critical for a successful LTE deployment

- LTE technology deployment will likely occur in stages…high data traffic areas first
- Users will continue to demand uninterrupted coverage
- 3G/LTE Interworking assures market competitiveness during the transition

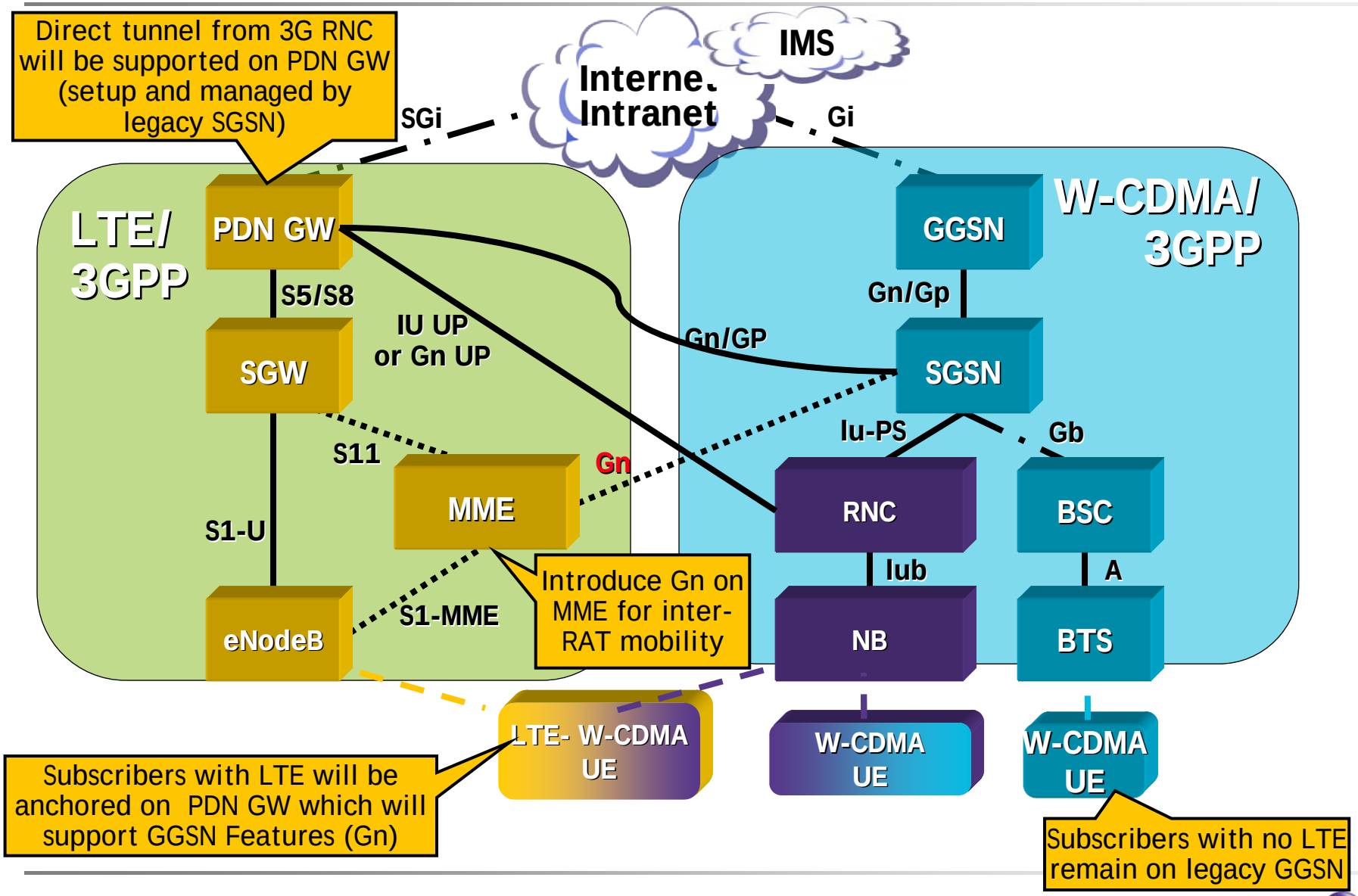


# LTE to W-CDMA Interworking – 3GPP Release 8

BSC: Base Station Controller
BTS: Base Transceiver Station
GGSN: Gateway GPRS Support Node
LTE: Long Term Evolution
MME: Mobility Management Entity
NB: Node B
PDN GW: Packet Data Network Gateway
RNC: Radio Network Controller
SGSN: Serving GPRS Support Node
SGW: Serving Gateway
UE: User Equipment
W-CDMA: Wideband CDMA



# LTE to W-CDMA Interworking – Pre 3GPP Release 8

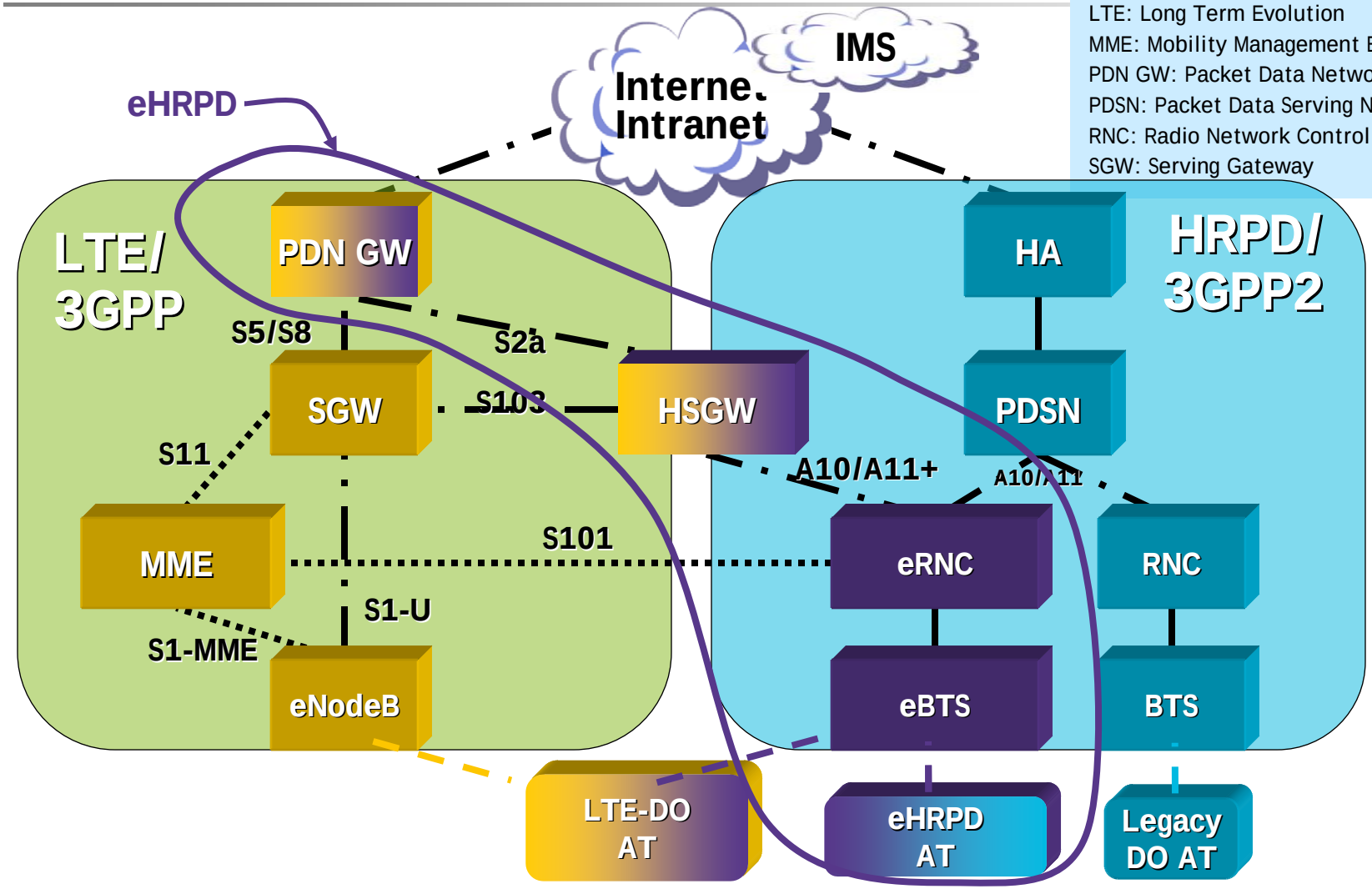


# eHRPD: Enabling Seamless Mobility & Handoff Between EV-DO & LTE

- Enhances traditional EV-DO (HRPD) to enable future seamless IP mobility with LTE base on 3GPP Standards for enhanced Packet Core (ePC)
- Moves the IP mobility anchor out of the Home Agent and into the PDN-Gateway
- Changes from a client-Mobile IP based IP Mobility model to Proxy Mobile IP.
  - No more foreign agent
  - the HSGW implements Proxy Mobile IP
  - the handset uses Simple IP
- Uses EAP-AKA for RAN authentication
  - Instead of PAP/CHAP, EAP-AKA conforms to 3GPP standards
- Leverages IPv6, although IPv4 could also be used with eHRPD
  - Enables larger IP address space for mobiles, and simplifies security

# LTE to eHRPD/HRPD Interworking

AT: Access Terminal
eRNC: Enhanced RNC
HA: Home Agent
HRPD: High Rate Packet Data
HSGW: HRPD Serving Gateway
LTE: Long Term Evolution
MME: Mobility Management Entity
PDN GW: Packet Data Network Gateway
PDSN: Packet Data Serving Node
RNC: Radio Network Controller
SGW: Serving Gateway




**ALU is pioneering cost-effective multimode solutions for HRPD/LTE in standards and network and handset product solutions**

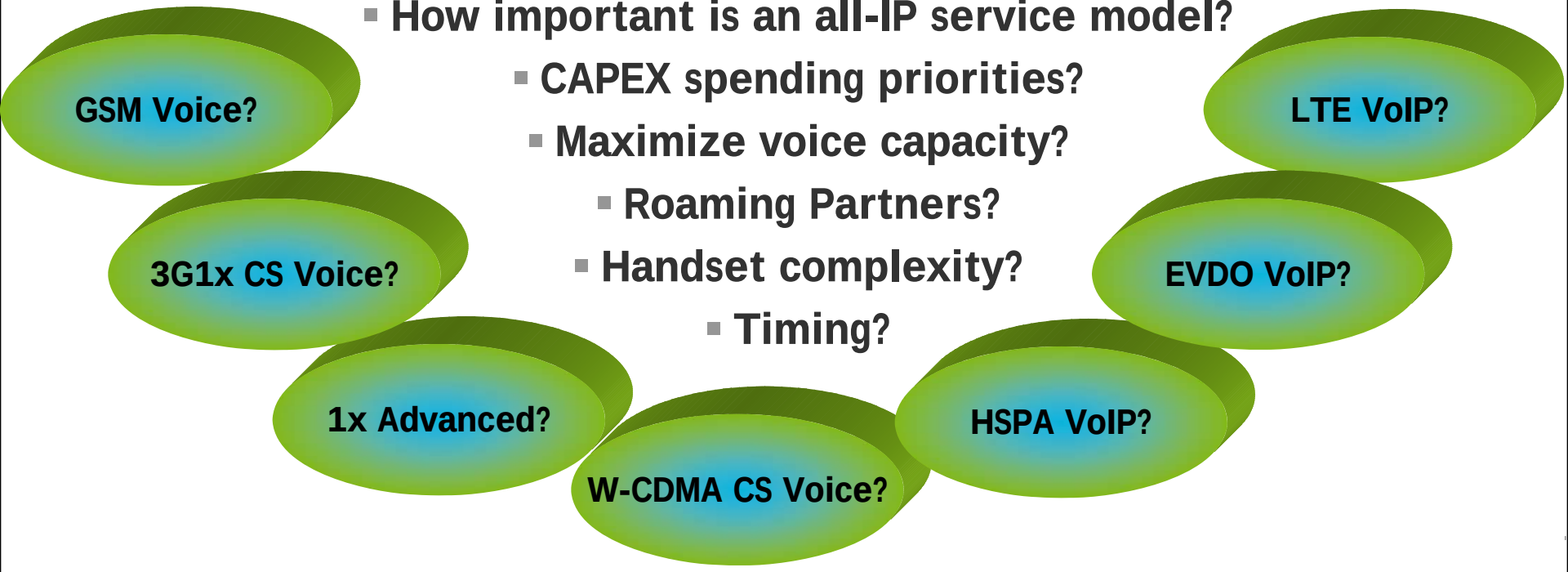
# What about voice?

**LTE only for voice *and* data?**

**Or LTE data and traditional 3G1x, GSM or W-CDMA voice?**

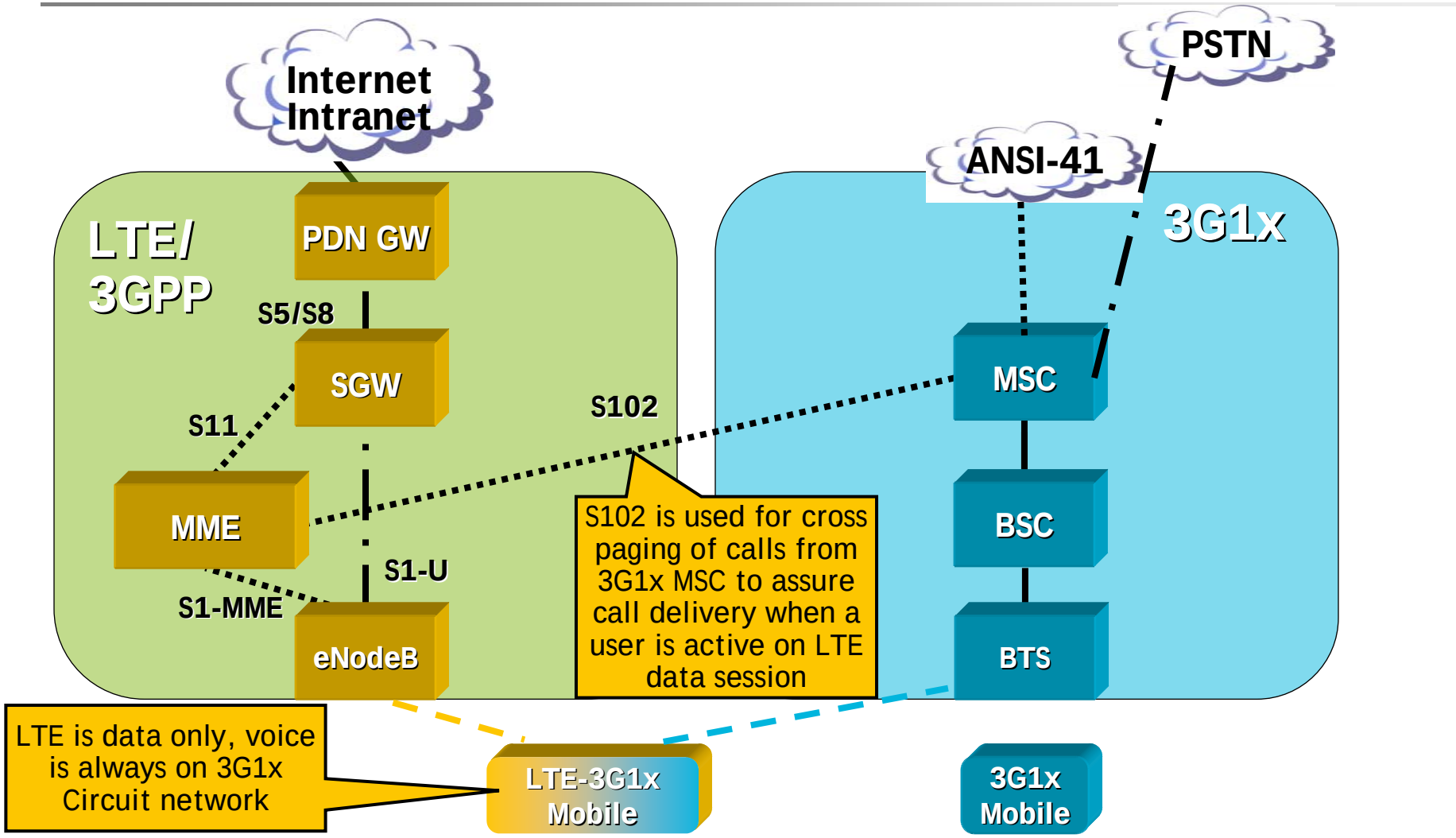
*Factors to consider:*

- **How important is simultaneous voice & data?**
- **How important is an all-IP service model?**
- **CAPEX spending priorities?**
- **Maximize voice capacity?**
- **Roaming Partners?**
- **Handset complexity?**
- **Timing?**



# 3G1x and LTE Voice Interworking: Circuit Switch Fallback

GSM & W-CDMA Have Similar Solutions to Enable Voice Interworking with LTE



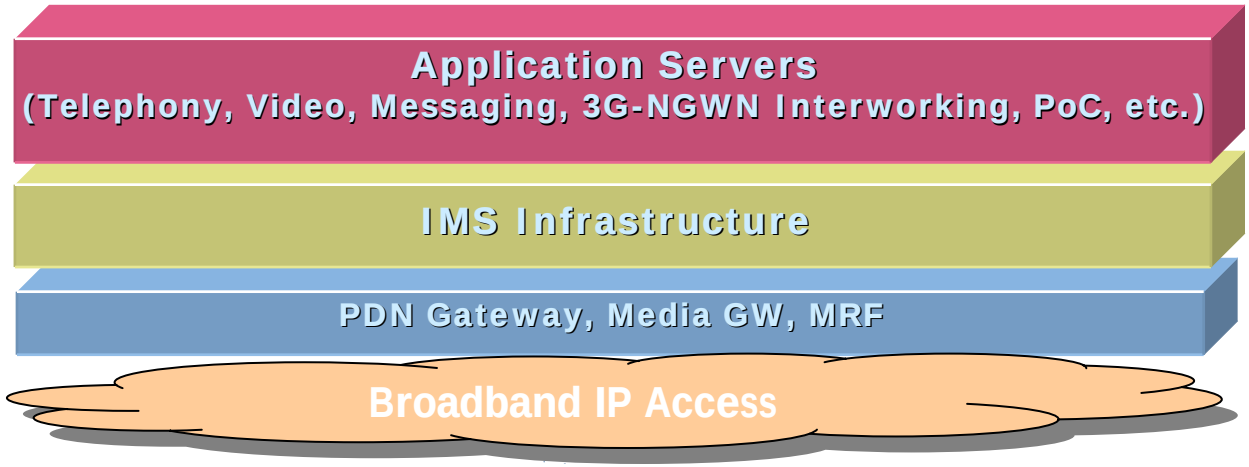

Use case: LTE is used for Data only, and 3G1x circuit voice is used for all voice calls. LTE coverage overlaps 3G1x coverage. No IMS VoIP is required, however dual mode handsets will not be capable of simultaneous voice and data service.

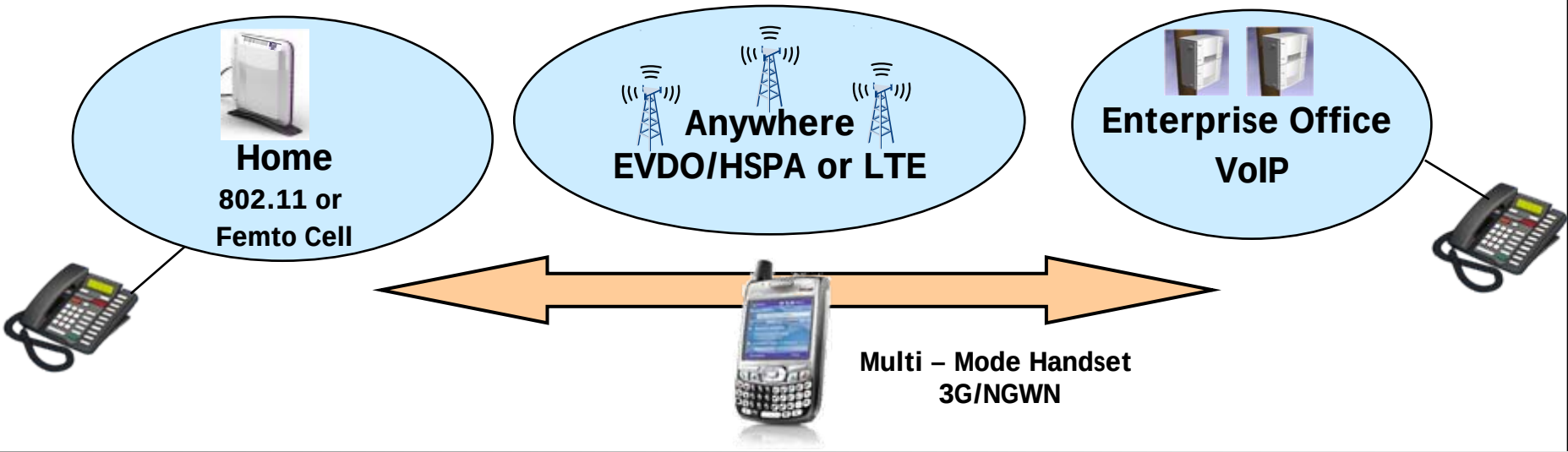
# IMS-Based VoIP Enables A Seamless User Experience

## A Core Network & Service Investment that is NGWN-Ready & Access Agnostic

**IMS VoIP will enable a seamless user experience for multimedia services.**

**Operators gain critical experience for LTE ALL-IP**




**NGW RAN will coexist with 3G access for some time. ALU proven expertise in Interworking across access technologies will make this a seamless user experience**

# Summary

# Keeping Competitive During the transition

## Leverage all existing assets to maximum advantage!

- **Voice and data**
- **Interwork existing technologies with LTE as efficiently as possible**

## Don't drop the ball on competitive user services!

- **Develop a plan to address subscriber demands for innovative services**
- **advanced services and devices**

**Millennials** (11-30 years old)

The addressable market for Next Generation Wireless!

- Over the next 5 years they will transform the way in which voice and data services are accessed and used
- As the Millennials age, their consumer behaviour will translate into the enterprise
- Current behavior in using technology, applications, and devices will continue into their adult lives and become the norm

www.alcatel-lucent.com