SAE
–
The Core Network for LTE

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Agenda

- Basics of LTE
- LTE and SAE
- SAE Architecture
- SAE Introduction
- Summary

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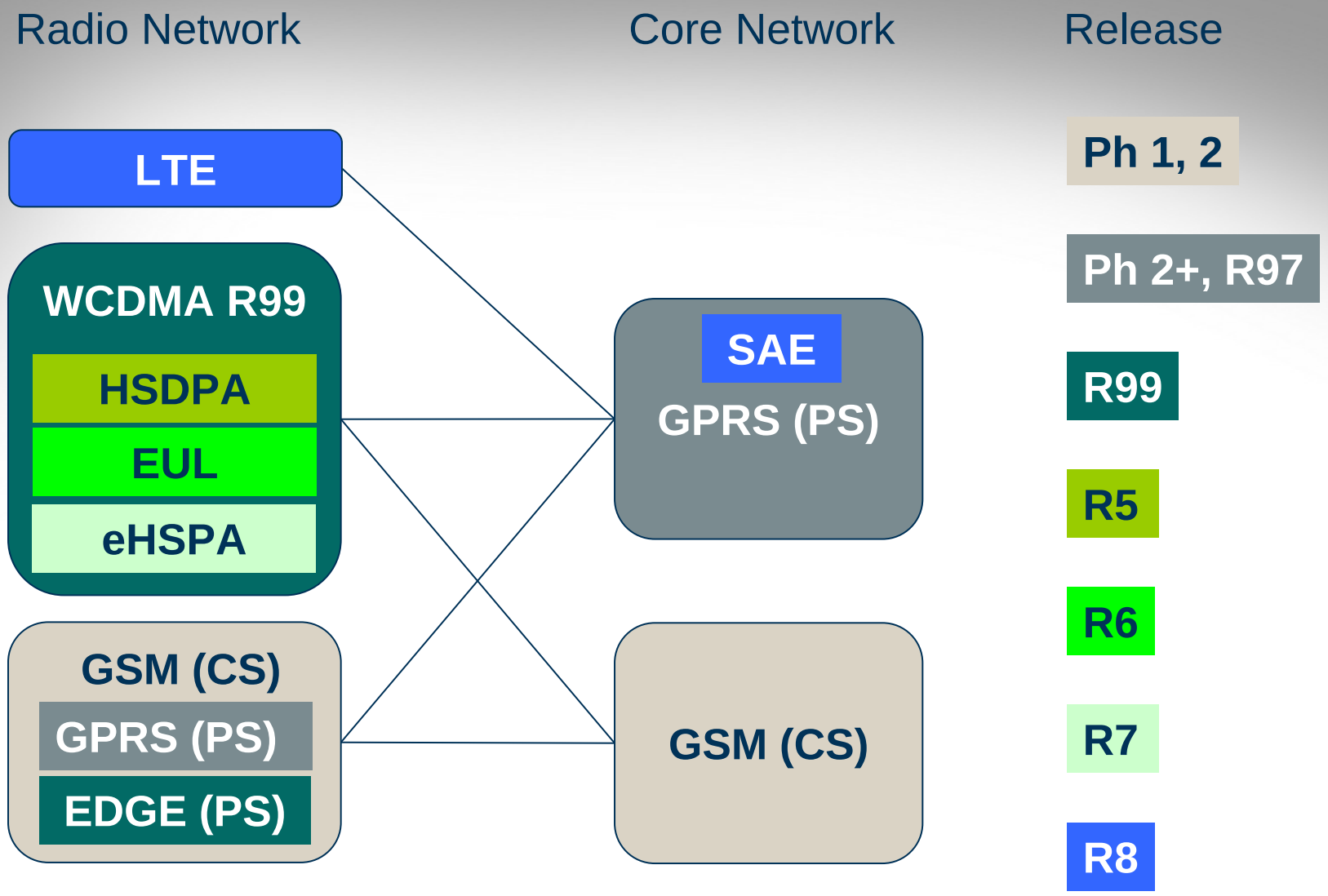
From GSM to LTE



LTE/SAE Visions

- LTE/SAE shall further enhance the 3GPP community competitiveness and cost efficiency with respect to mobile and fixed services, providing data rates beyond 100 Mbps
- LTE/SAE shall be suited for refarming of e.g., the GSM bands and deployments in upcoming allocations
- LTE/SAE shall utilize common technologies for different modes, e.g., FDD, TDD, in different frequency bands, with different bandwidths
- The ecosystem for 3G shall be expanded, giving high volumes and vendor competition in ONE common equipment and applications market for both LTE/SAE and 3G

Broadband growth

> 1.8 billion subscriptions 2012

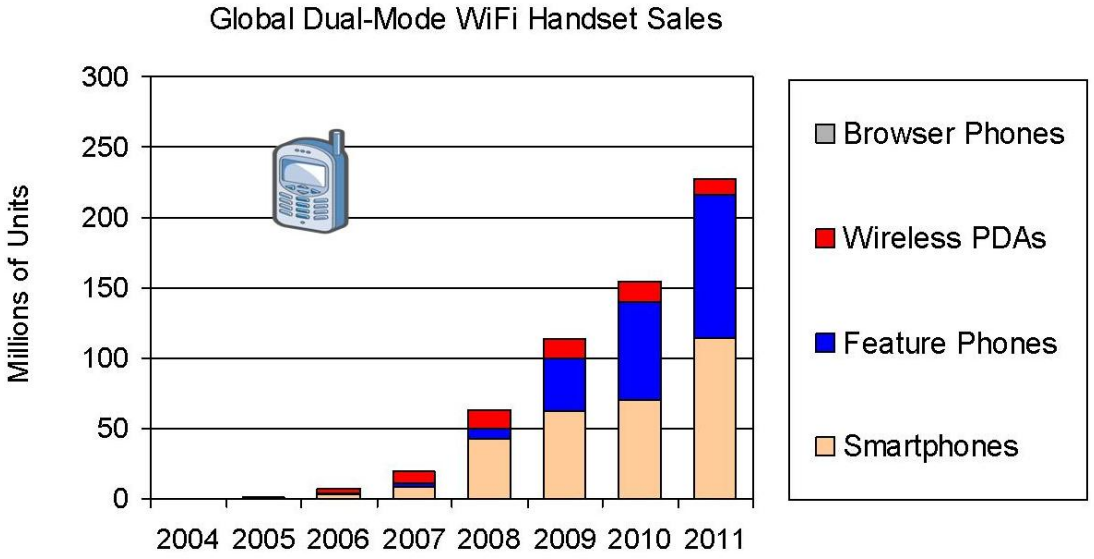
Source: OVUM, Strategy Analytics & Internal Ericsson

Broadband becomes personal

Integration with other accesses
2G/3G/LTE and WLAN

- A main new area introduced in SAE is the integration with other access types for fixed and nomadic usage such as Fixed Broadband, WLAN at home, WLAN hot spots and WiMAX
  - Session mobility between 2G/3G/LTE and other access types
  - Roaming using other access types

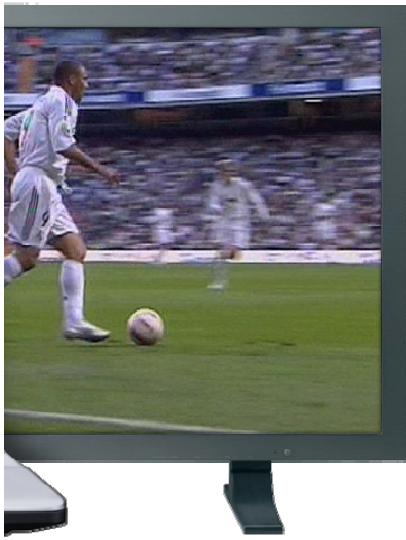
- Strong growth of WLAN enabled 2G/3G handsets



Source: Strategy Analytics

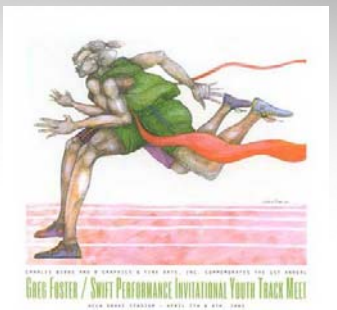
LTE/SAE Concepts

- Flat 2-node architecture for optimized payload path
- Excellent scalability
- High level of security
- Simple QoS model
- Low delays
- Efficient radio
- Flexible spectrum utilization
- Cost efficient deployment



Driving forces for LTE/SAE

- Performance
  - Higher peak rates
  - Higher bandwidth
  - Low delay/latency



- Cost efficiency
  - Low cost per bit
  - Low OPEX
  - Simpler operation
  - Cost-effective migration

- Spectrum flexibility
  - New and existing bands
  - Flexible bandwidth
  - Duplex flexibility: FDD and TDD

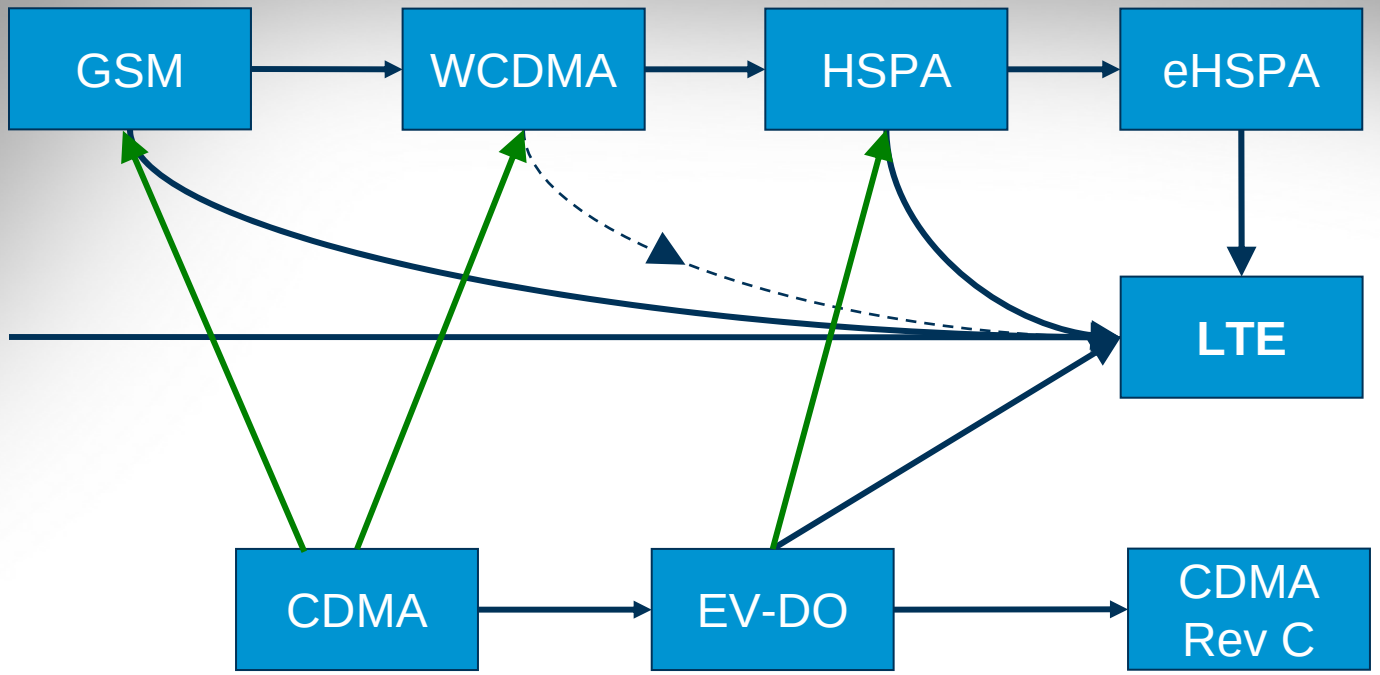
3GPP LTE Performance Targets

- **High data rates**
  - Downlink: >100 Mbps
  - Uplink: >50 Mbps
  - Cell-edge data rates
    2-3 x HSPA Rel. 6
- **Low delay/latency**
  - User plane RTT: <10 ms
  - Channel set-up: <100 ms
- **High spectral efficiency**
  - Targeting 3 x HSPA Rel. 6
- **High Performance Broadcast services**
- **Cost-effective migration**

Focus on services from the packet-switched domain

Network evolution

Opportunities for LTE



LTE supports a multitude of implementation scenarios

3GPP bands for LTE FDD & TDD

FDD		
Band	**”Identifier”**	**Frequencies (MHz)**
I	**IMT Core Band**	1920-1980/2110-2170
II	**PCS 1900**	1850-1910/1930-1990
III	**GSM 1800**	1710-1785/1805-1880
IV	**AWS (US & other)**	1710-1755/2110-2155
V	**850**	824-849/869-894
VI	**850 (Japan)**	830-840/875-885
VII	**IMT Extension**	2500-2570/2620-2690
VIII	**GSM 900**	880-915/925-960
IX	**1700 (Japan)**	1750-1785/1845-1880
X	**3G Americas**	1710-1770/2110-2170

TDD		
Band	**”Identifier”**	**Frequencies (MHz)**
a	**TDD 2000**	1900-1920 2010-2025
b	**TDD 1900**	1850-1910 1930-1990
c	**PCS Center Gap**	(1915)1910-1930
d	**IMT Extension Center Gap**	2570-2620

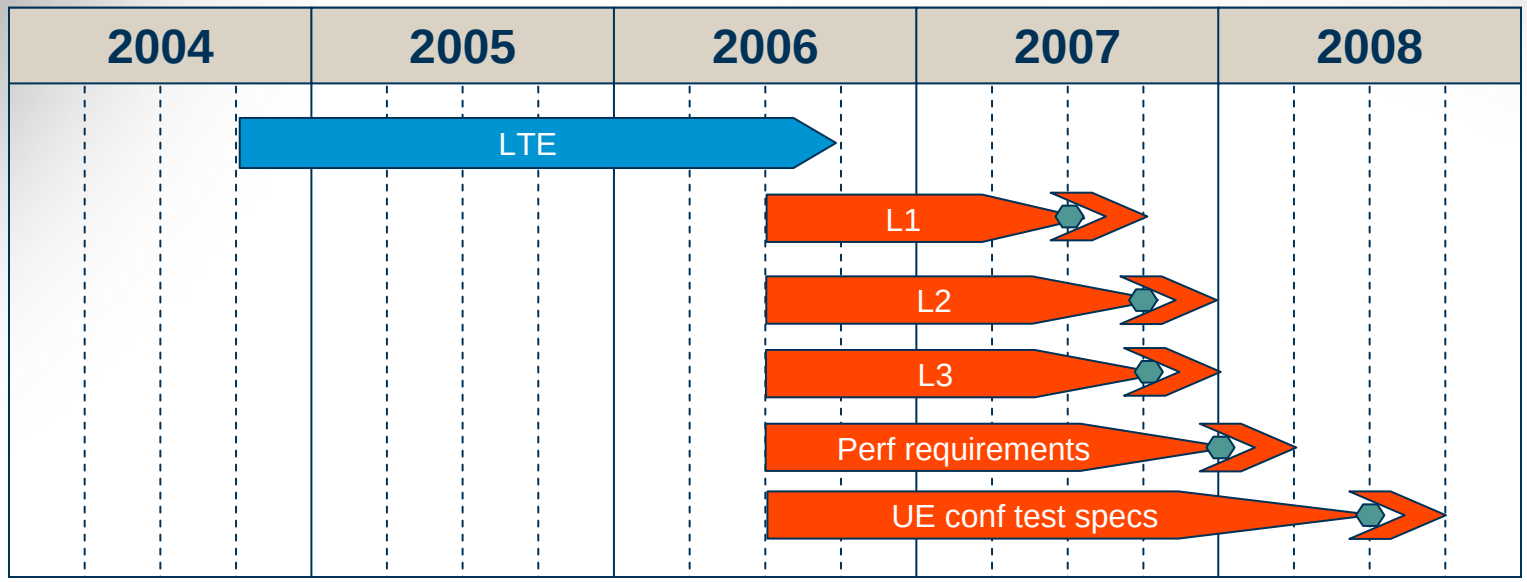
Wide range of bands enables global support

Additional bands proposed to be specified in 3GPP

- 450-470 MHz
- **698-806 MHz for US**
- part of 698-862 MHz for CEPT and others
- **3400-3800 MHz**

*In **bold** to be specified in a near time schedule*

LTE Standardization timeline



Technical studies

Specifications

Technically stable specifications (>80% complete)

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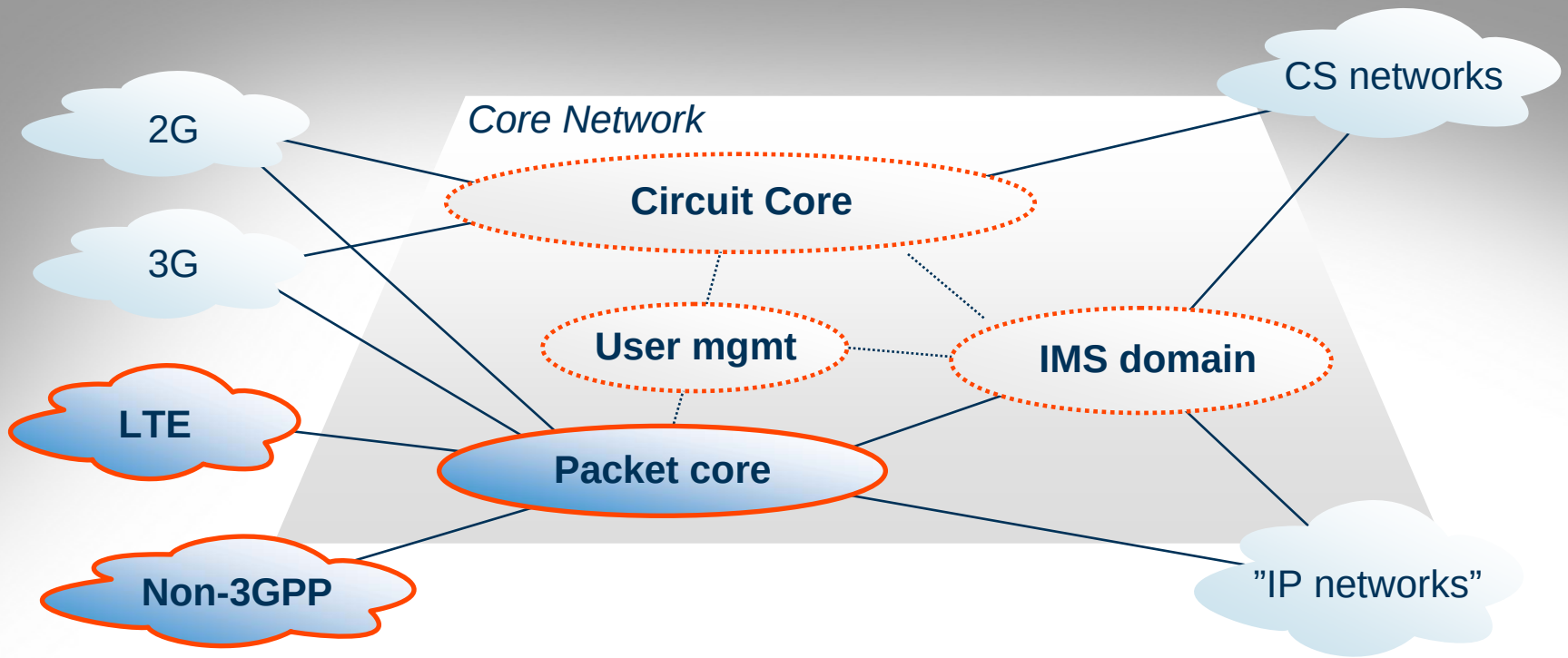
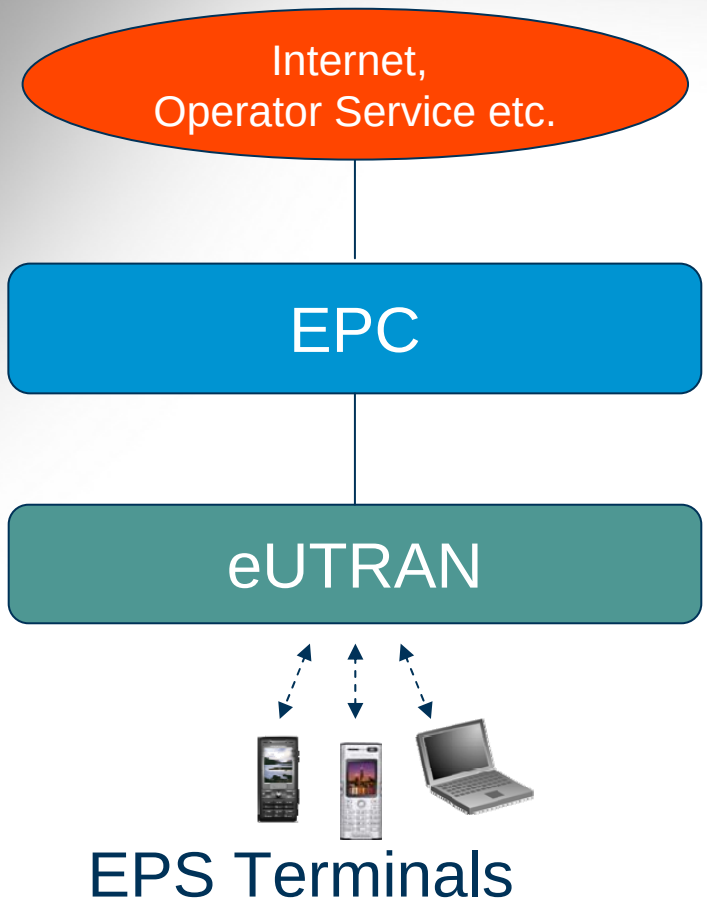
What is LTE and SAE?



Teminology

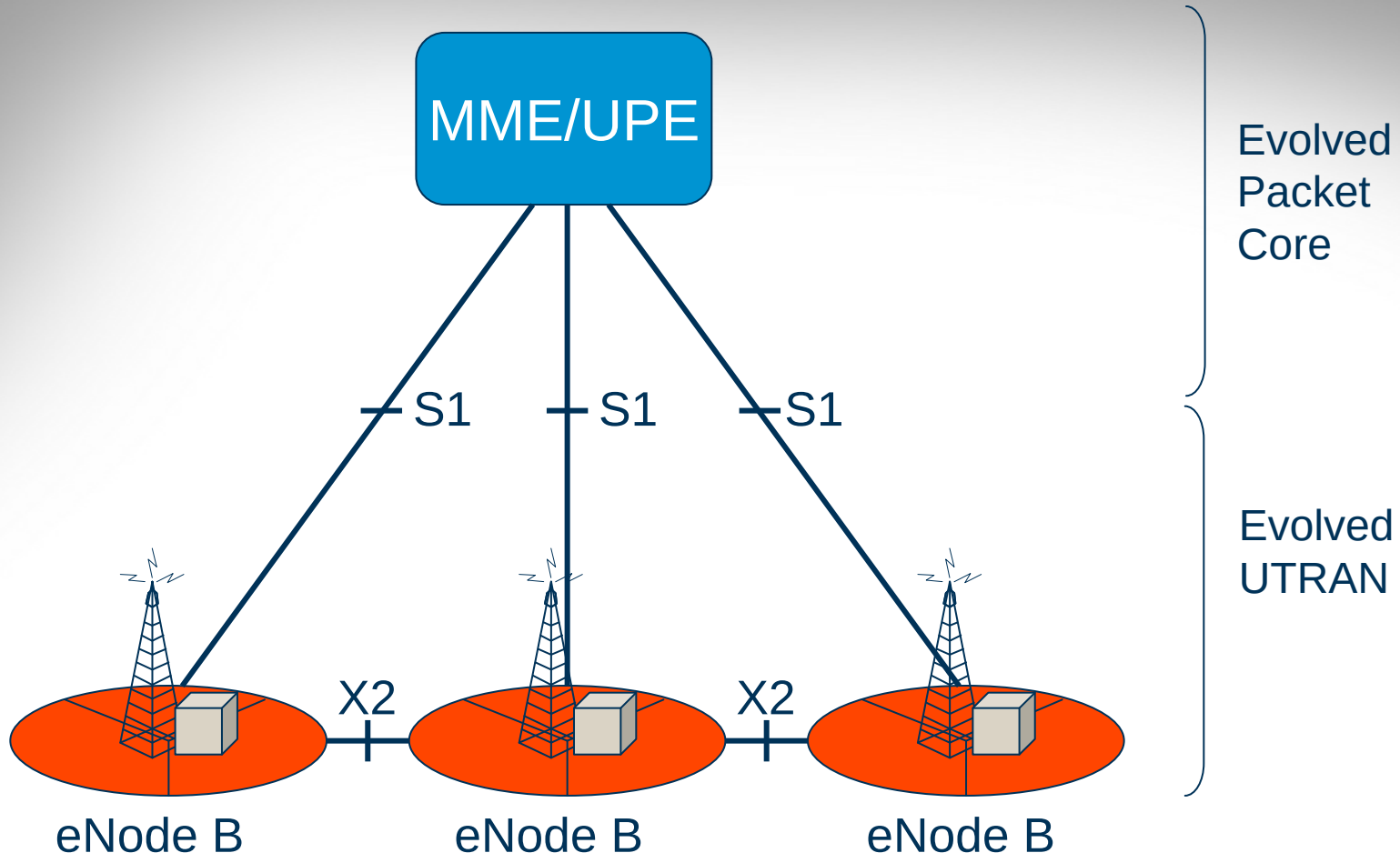
LTE = Long Term Evolution (also known as eUTRAN)
SAE = System Architecture Evolution
(3GPP technical study item defining EPC)
EPC = Evolved Packet Core
EPS = Evolved Packet System incl EPC, LTE and terminals

EPS (LTE/SAE) Architecture



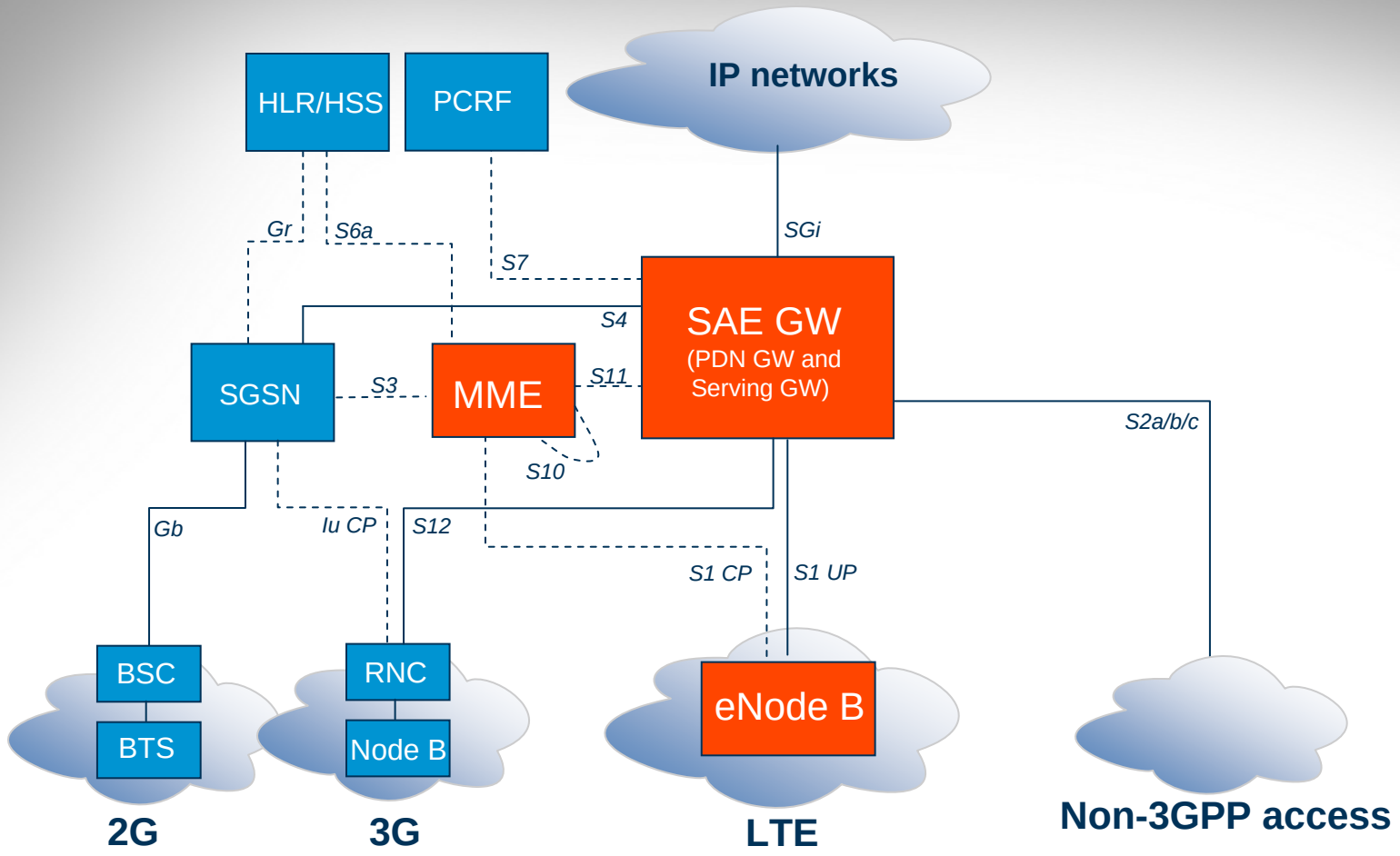
- The EPS architecture is made up of an EPC (Packet Core Network) and an eUTRAN Radio Access Network
- The CN provides access to external packet IP networks and performs a number of CN related functions (e.g. QoS, security, mobility and terminal context management) for idle (camped) and active terminals
- The RAN performs all radio interface related functions for terminals in active mode

eUTRAN (LTE) interfaces



MME: Mobility Management Entity
UPE: User Plane Entity

EPS Architecture



EPS Functionality Distribution

- The Enhanced Node B (eNB) hosts the following functions:
  - Radio Resource Management
    - Radio Bearer Control
    - Radio Admission Control
    - Connection Mobility Control
    - Dynamic allocation of resources to UEs in both uplink and downlink (scheduling)
  - IP header compression and encryption of user data stream
  - Selection of an MME at UE attachment
  - Routing of User Plane data towards SAE Gateway
  - Measurement and measurement reporting configuration for mobility and scheduling
- The MME hosts the following functions
  - Distribution of paging messages to the eNBs
  - Security control
  - Idle state mobility control
  - SAE bearer control
  - Ciphering and integrity protection of NAS signalling.
- The SAE Gateway hosts the following functions:
  - Termination of U-plane packets
  - Switching of U-plane for support of UE mobility

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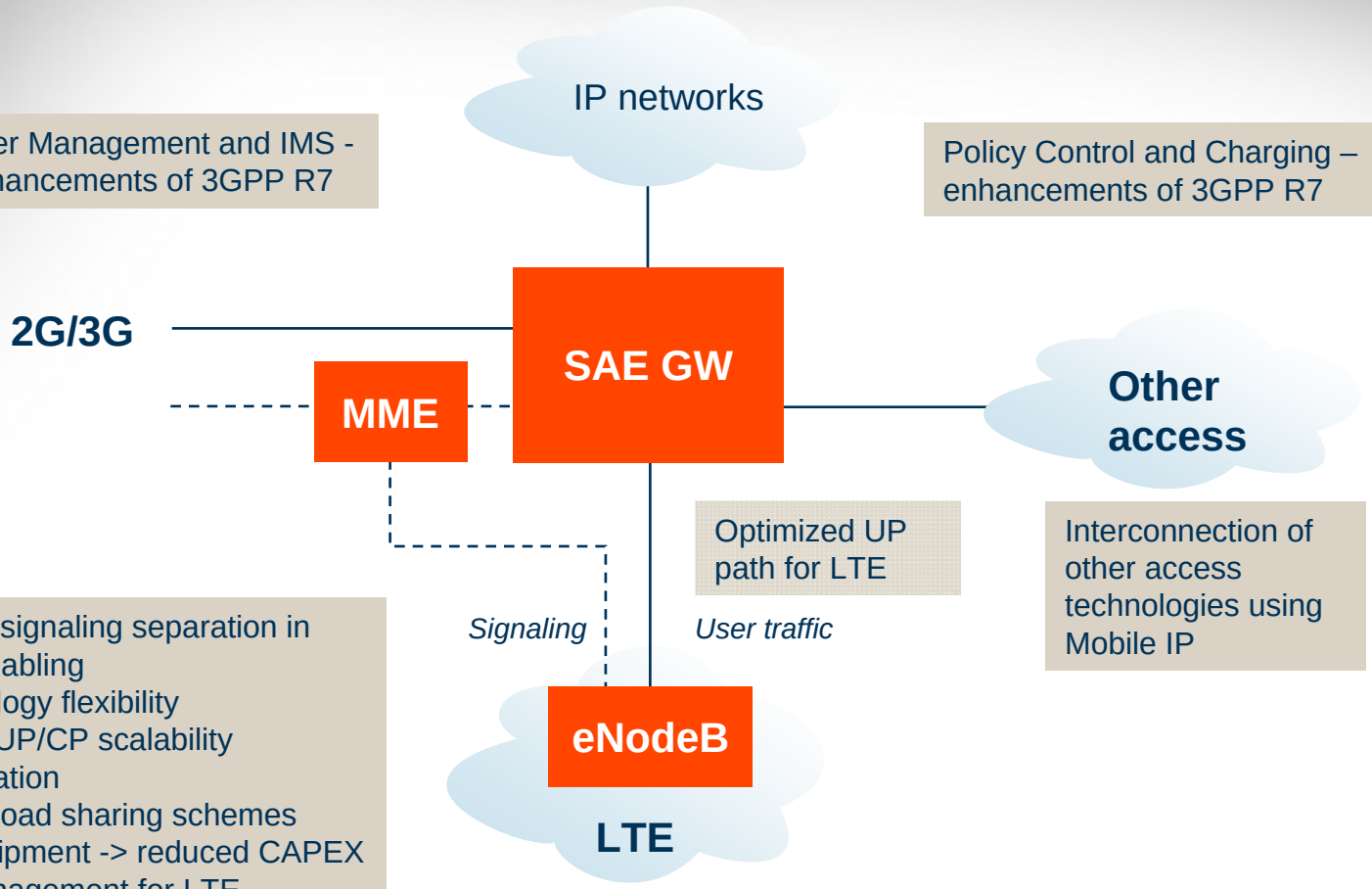
LTE and SAE architecture

Optimized for performance and cost efficiency



User traffic and signaling separation in core network enabling

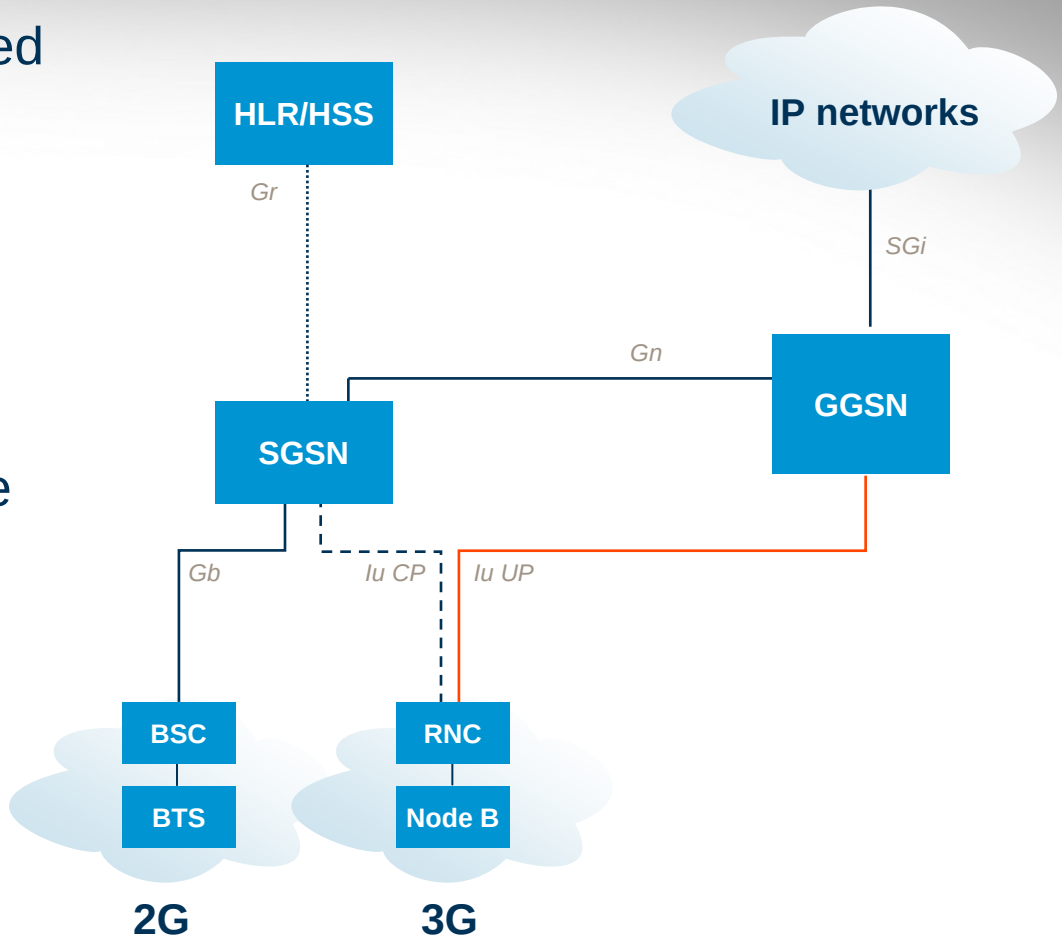
- Network topology flexibility
- Independent UP/CP scalability
- Efficient migration
- Independent load sharing schemes
- Reuse of equipment -> reduced CAPEX
- Common management for LTE and 2G/3G → reduced OPEX

MME = ”Mobility Management Entity”
eNodeB = the LTE base station

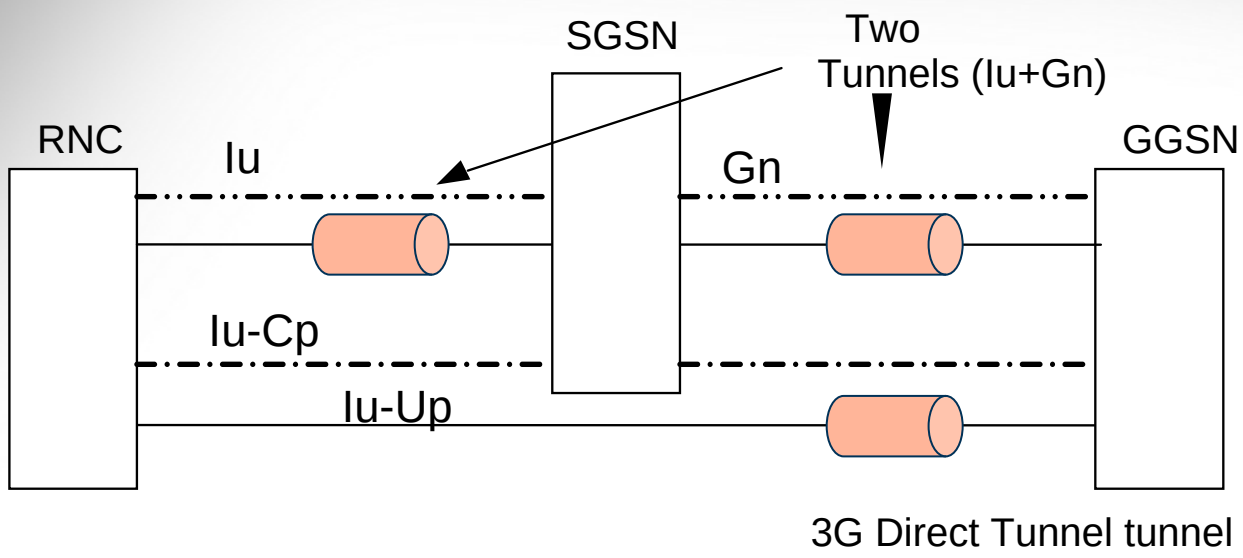
3G Direct Tunnel

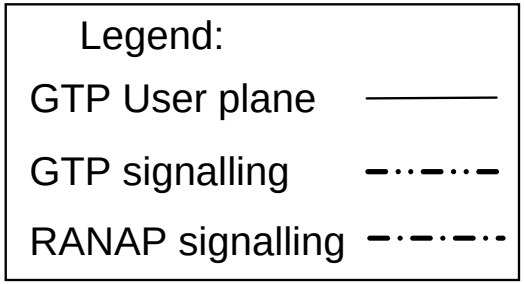
Packet Core network optimization for HSPA

- ”Direct Tunnel” support added for 3G payload optimization
- Cost efficient scaling for Mobile Broadband deployments
- Increased flexibility in terms of network topology
- Allows the SGSN node to be optimized for control plane
- Specifications part of 3GPP rel-7
- Designed for operation in legacy (GGSN/UTRAN) networks
- First step towards the SAE architecture



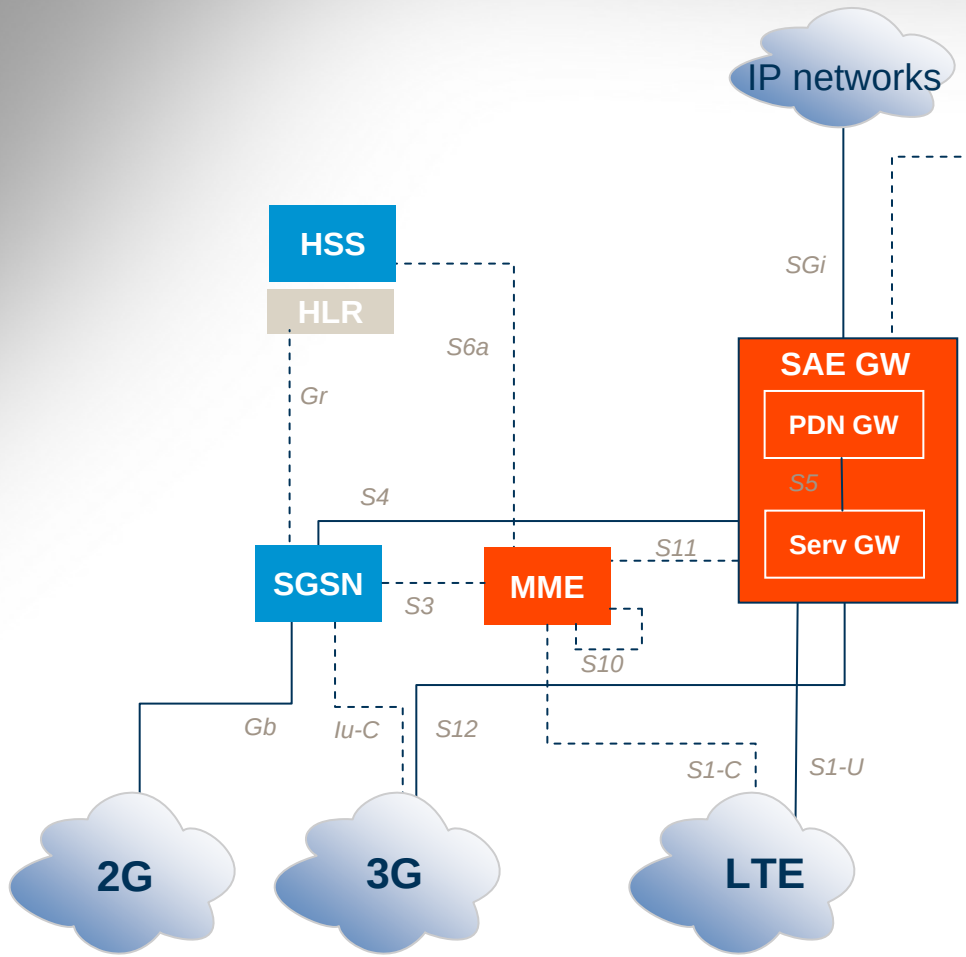
3G Direct Tunnel – concept
Direct connect between RNC and GGSN





SAE architecture 3GPP operator

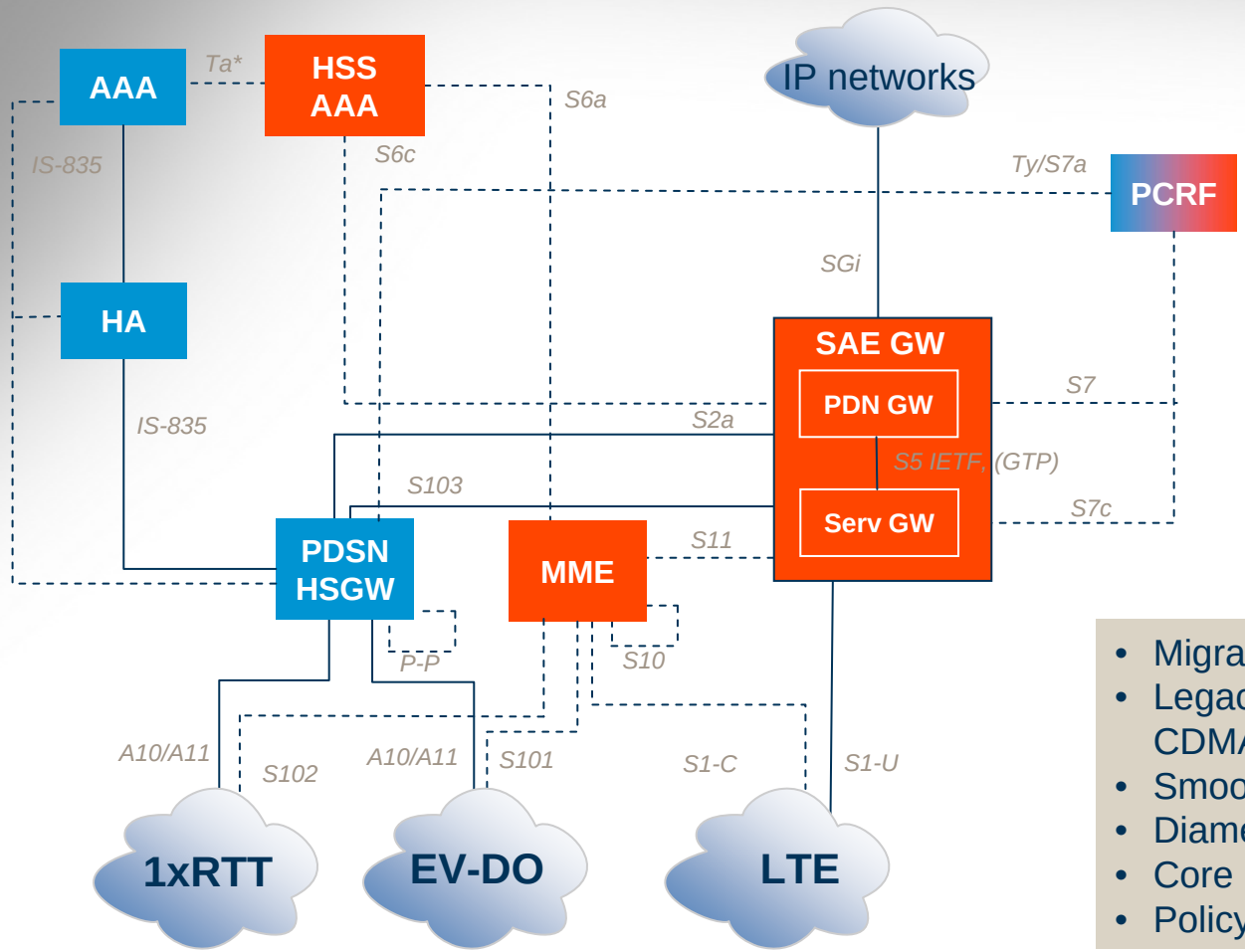
Detailed view, non-roaming case, 3GPP accesses



- Common GW for all accesses
- Core network pooling for LTE access
- Policy control also supporting LTE
- Diameter for LTE user management
- Smooth interworking 2G/3G – LTE
- 3G Direct Tunnel for HSPA

SAE architecture 3GPP2 operator

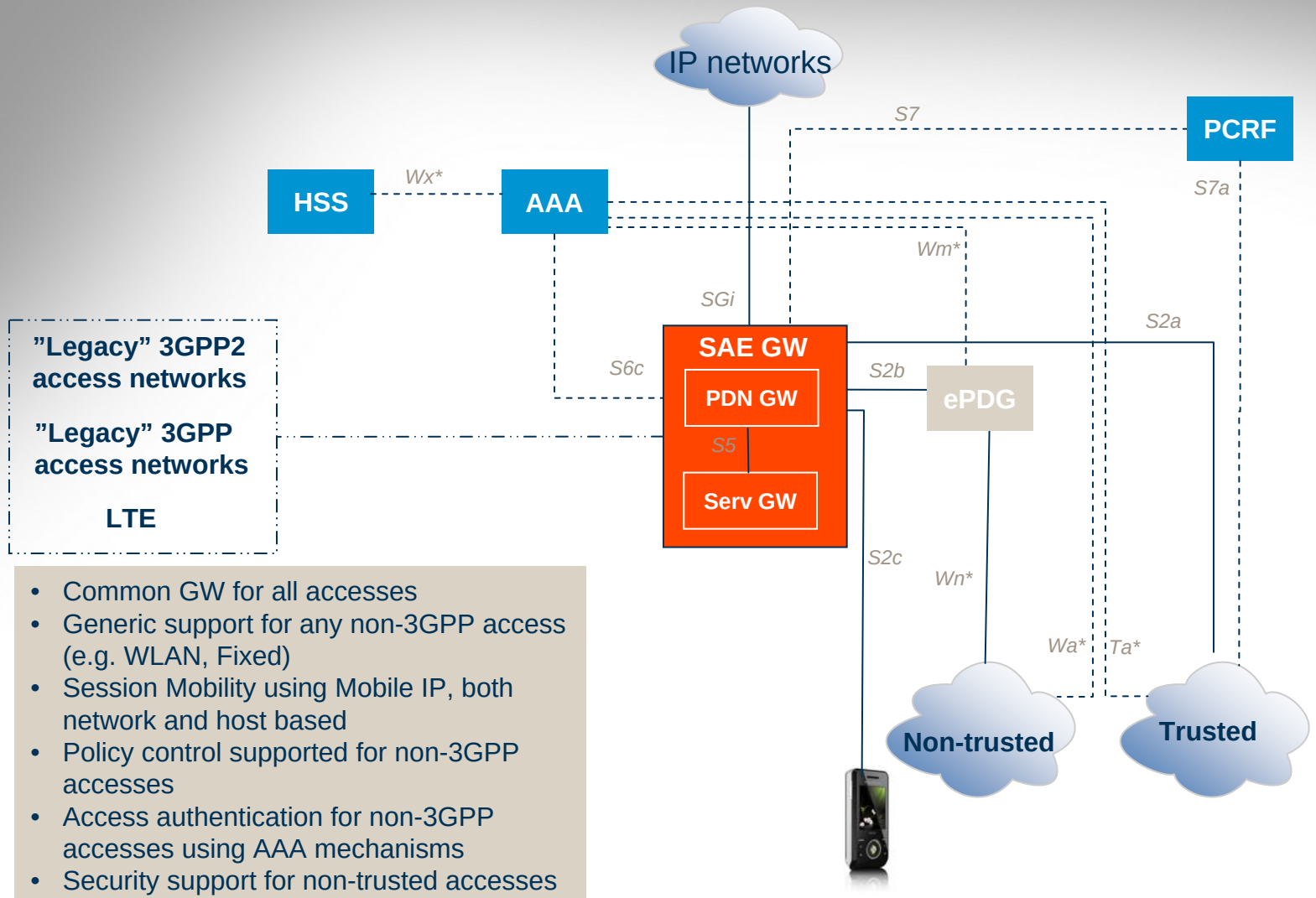
Detailed view, non-roaming case, 3GPP2 accesses



- Migration to 3GPP SAE architecture
- Legacy CDMA terminal support in CDMA PDSN and HA
- Smooth interworking 2G/3G - LTE
- Diameter for SAE user management
- Core network pooling for LTE access
- Policy control for both CDMA and LTE

SAE architecture other accesses

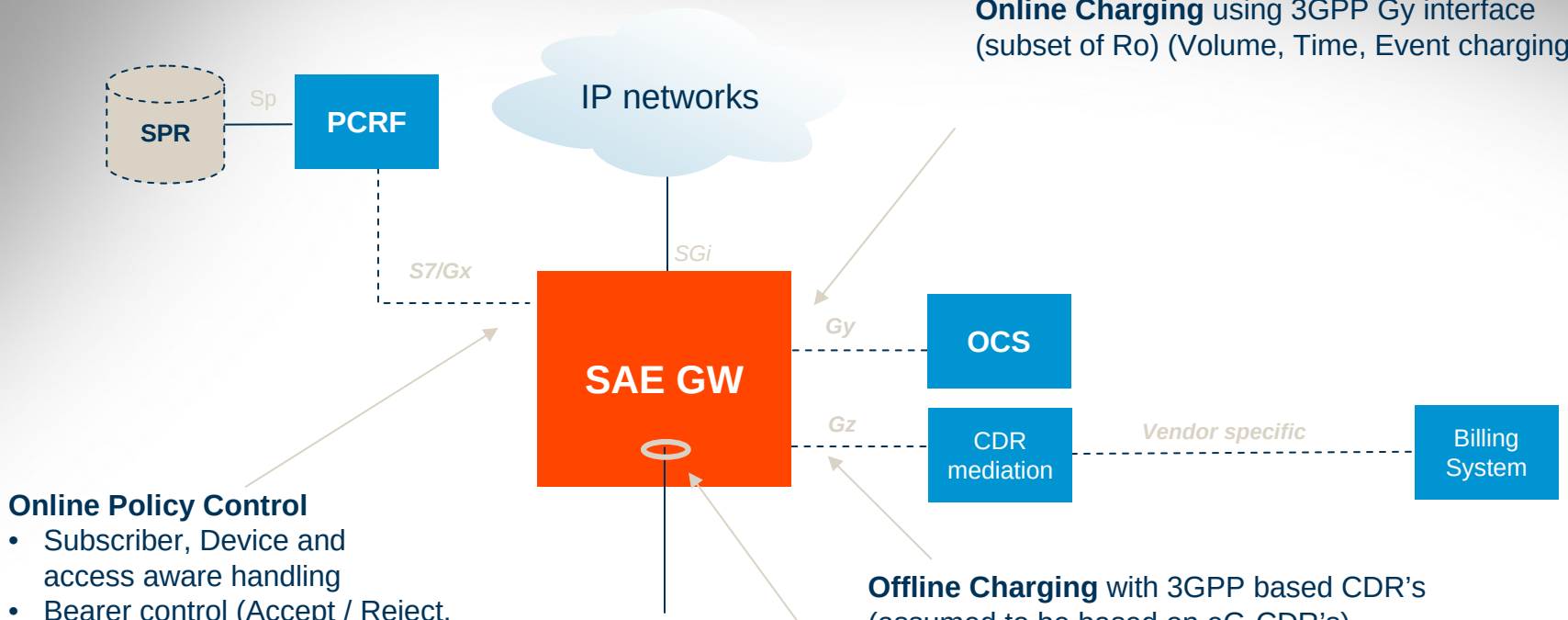
Detailed view, non-roaming case



- Common GW for all accesses
- Generic support for any non-3GPP access (e.g. WLAN, Fixed)
- Session Mobility using Mobile IP, both network and host based
- Policy control supported for non-3GPP accesses
- Access authentication for non-3GPP accesses using AAA mechanisms
- Security support for non-trusted accesses

Policy & Charging Control

Extending today's model



Online Charging using 3GPP Gy interface (subset of Ro) (Volume, Time, Event charging)

Online Policy Control

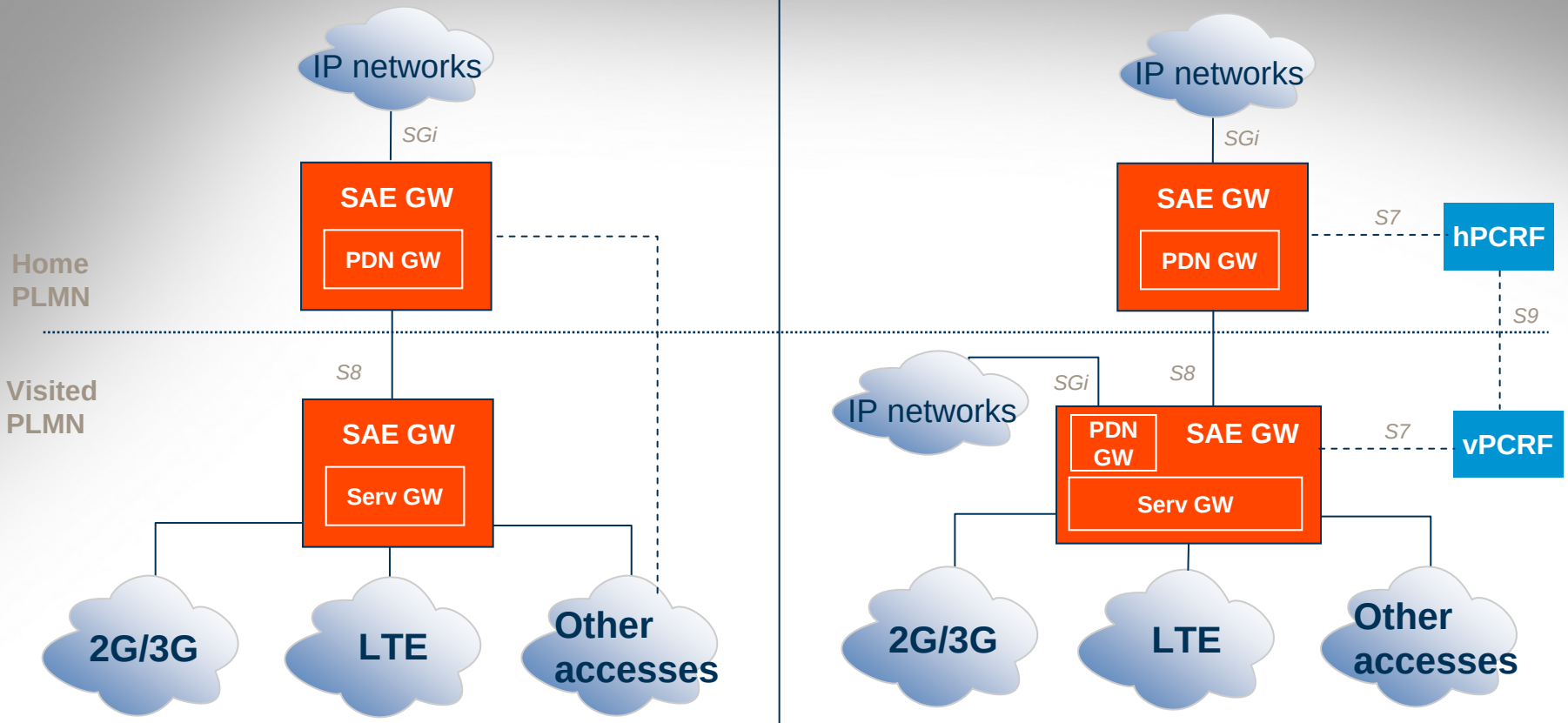
- Subscriber, Device and access aware handling
- Bearer control (Accept / Reject, QoS control)
- Service Data Flow control (Allow/disallow, QoS control)

Offline Charging with 3GPP based CDR's (assumed to be based on eG-CDR's)

Service Awareness

SAE Roaming support

Extending today's successful model



- Basic case: home tunnelling
- Smooth upgrade to support LTE and other accesses
- Support for 3 operator model
- GTP and MIP options for roaming

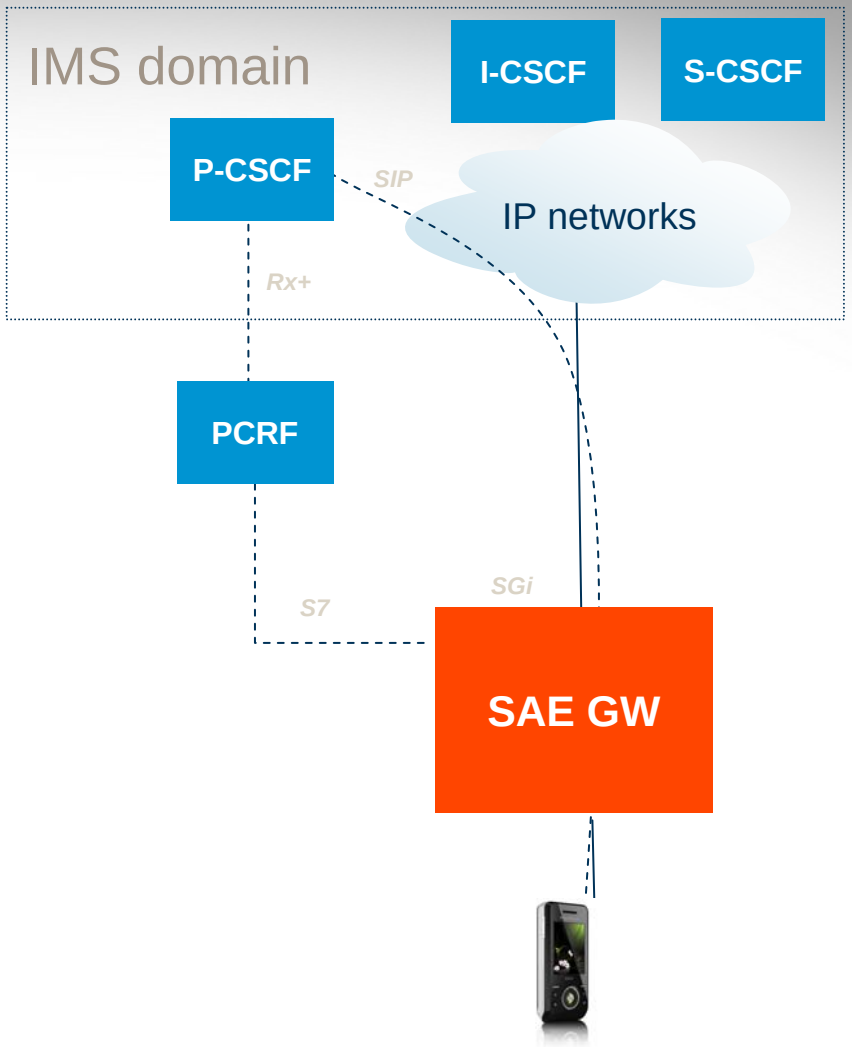
- Advanced case: both home tunnelling and local breakout possible
- Roaming controlled by home network policies
- PCRF-to-PCRF roaming interface
- GTP and MIP options for roaming

Note: HSS and AAA excluded for simplicity

SAE impact on IMS

Overview

- LTE is a packet only access, no CS
  - optimized for IP based services, including telephony (MMTel)
  - HO to CS voice being specified (single-radio VCC)
- The Packet core evolution is largely transparent to IMS
  - including Multi Access mobility and LTE support
- ... but new accesses added
  - impact services with access awareness
  - enhancement of PCRF functionality and Rx for new accesses
- Local usage of IP services when roaming
  - PCRF-PCRF roaming interface
- Emergency call prioritization and Location services



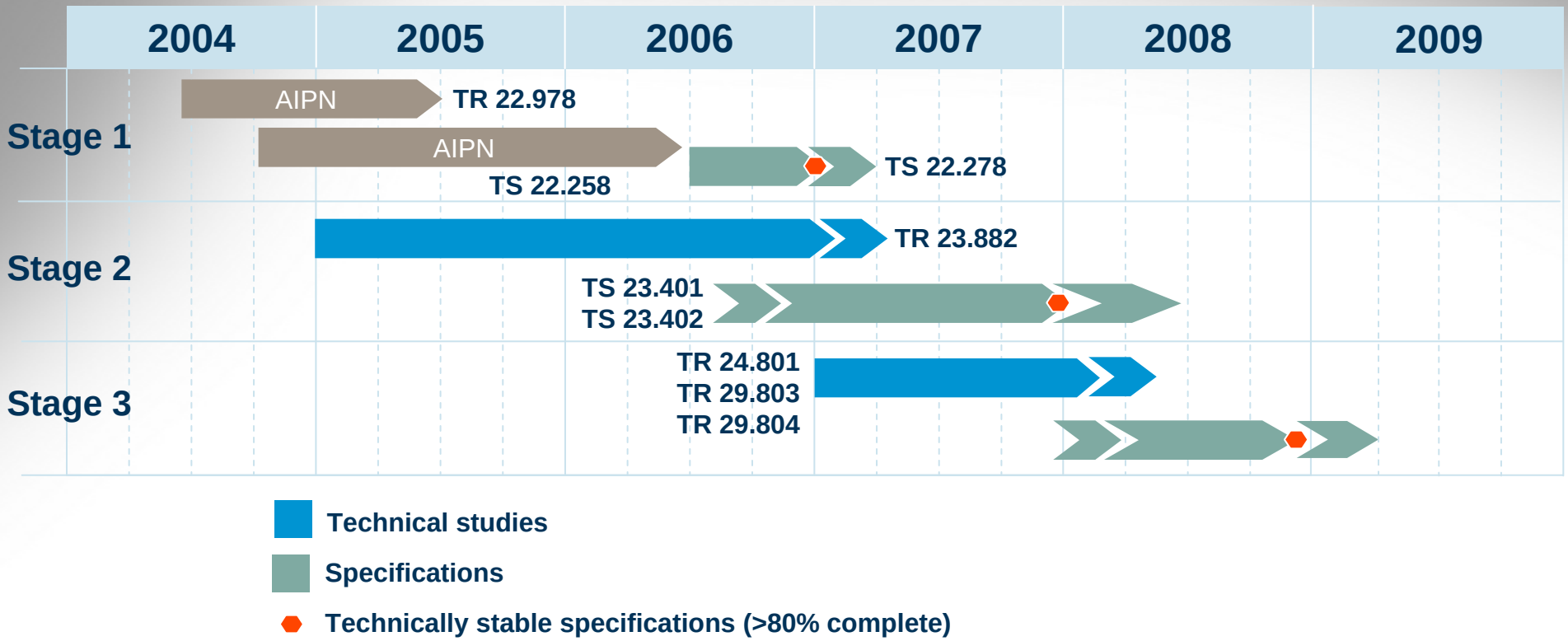
SAE standardization

Large global effort

- Participation from the whole telecom industry
  - More than 20,000 LTE/SAE contributions for 2007
- Companies with more than 50 contributions for LTE/SAE
  - Ericsson, Nokia, Motorola, Samsung, Qualcomm, NokiaSiemensNetworks, NTT DoCoMo, LG Electronics, Alcatel-Lucent, Nortel, NEC, Huawei, Panasonic, Siemens, CATT, Vodafone, ZTE Corporation, Texas Instruments, IP Wireless, Huawei, Orange, Mitsubishi, Marvell, T-Mobile, ETRI, Fujitsu, Intel, Telecom Italia, Sharp, China Mobile, KDDI, Philips, InterDigital, AT&T, Freescale, Starent, Cisco, Nextwave, Verizon Wireless

SAE standardization

Timeline Jan 2008



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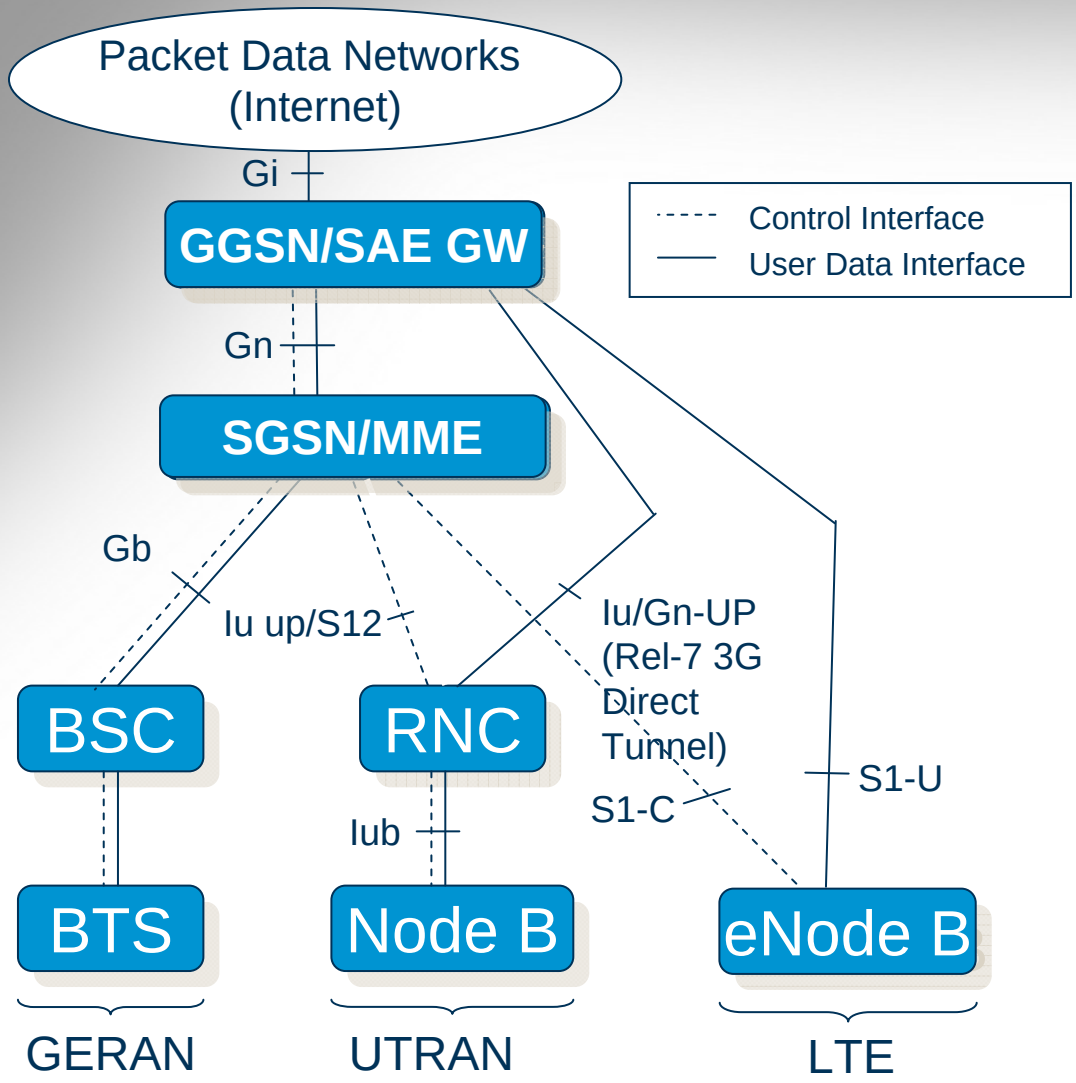
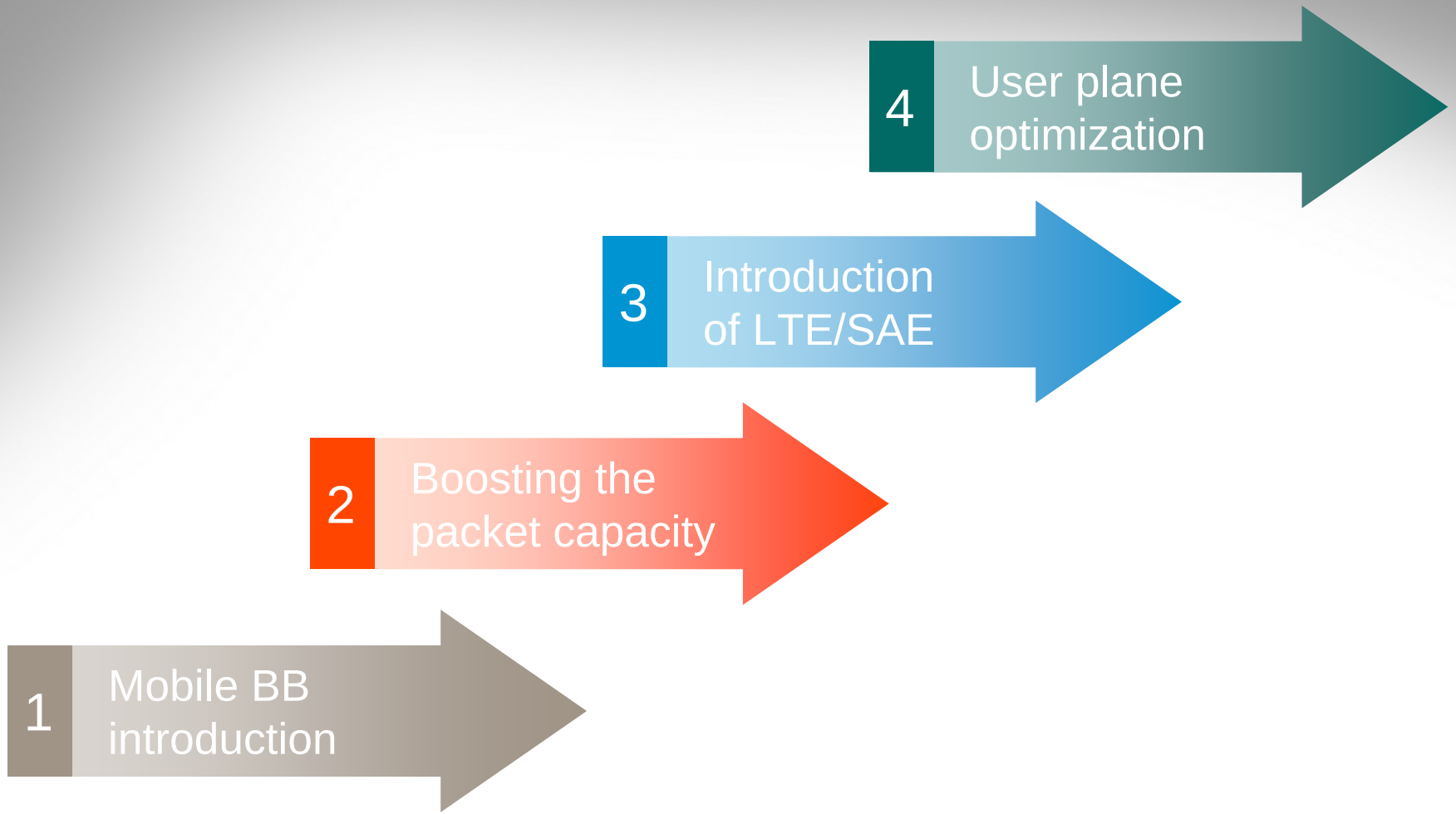
Deployment example of LTE
with GERAN/UTRAN



- 3GPP Rel-7 specifies the feature called “3G Direct Tunnel” where the user plane goes direct between RNC and GGSN
- 3GPP Rel-8 specifies an SAE GW and an MME. SW upgrade of the GGSN gives the SAE GW functionality and the MME functionality in the SGSN
- LTE capable eNode Bs are introduced

3GPP Evolved Packet Core

Smooth / Architecture evolution

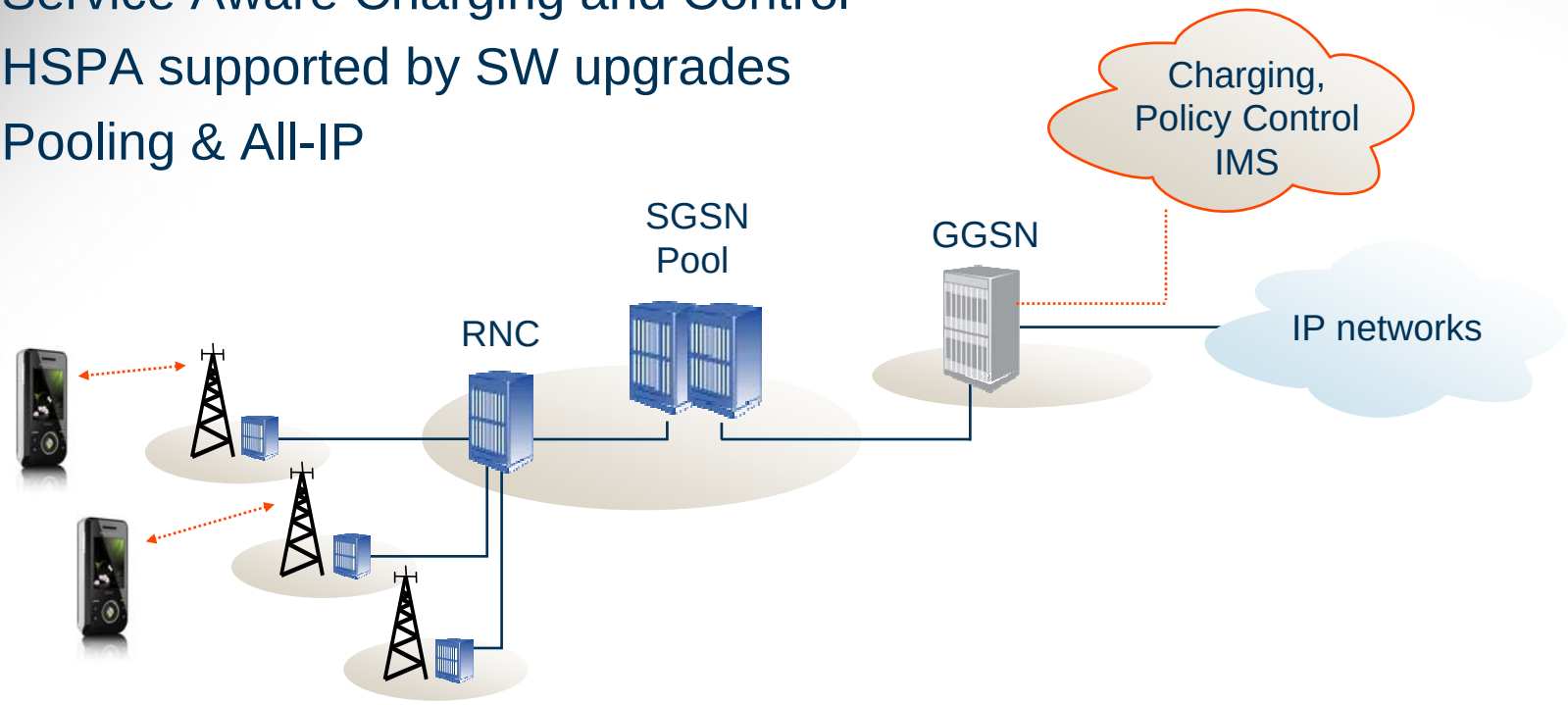


3GPP Evolved Packet Core

1) Mobile broadband introduction

1 Mobile broadband introduction → 2 Boosting the packet capacity → 3 Introduction of LTE/SAE → 4 User plane optimization

- Service Aware Charging and Control
- HSPA supported by SW upgrades
- Pooling & All-IP

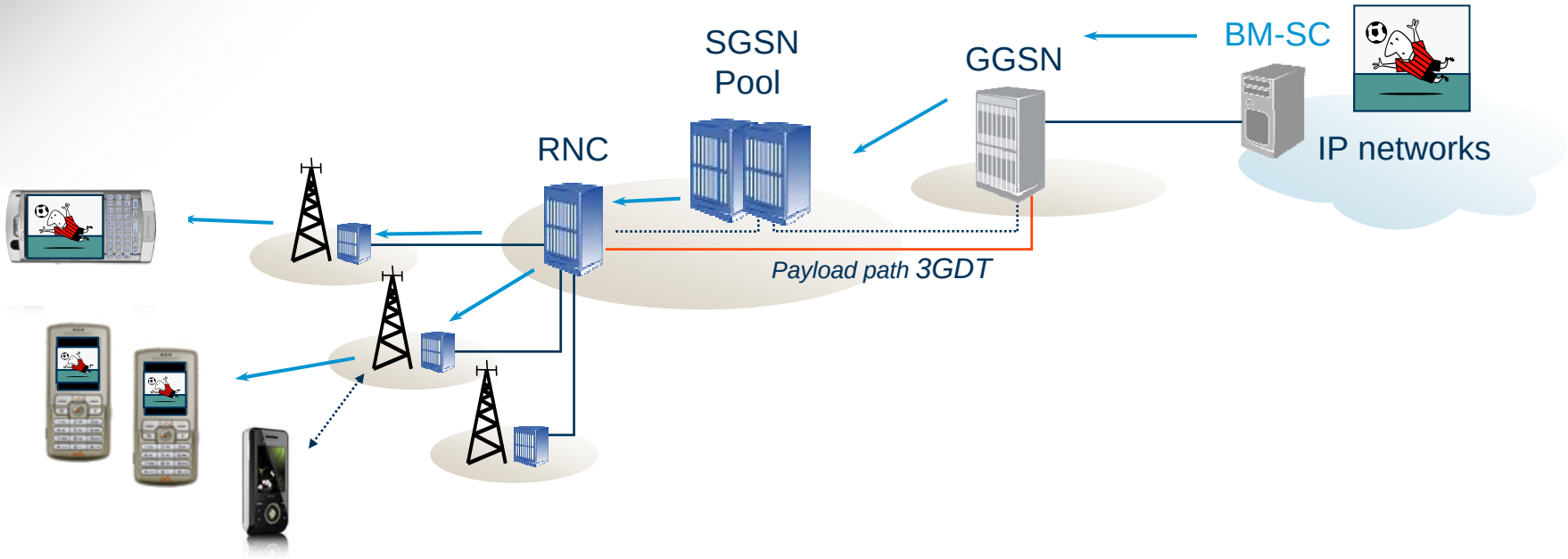


3GPP Evolved Packet Core

2) Boosting the packet capacity

1 Mobile broadband introduction → **2 Boosting the packet capacity** → 3 Introduction of LTE/SAE → 4 User plane optimization

- 3G Direct Tunnel
- MBMS
- HSPA evolution

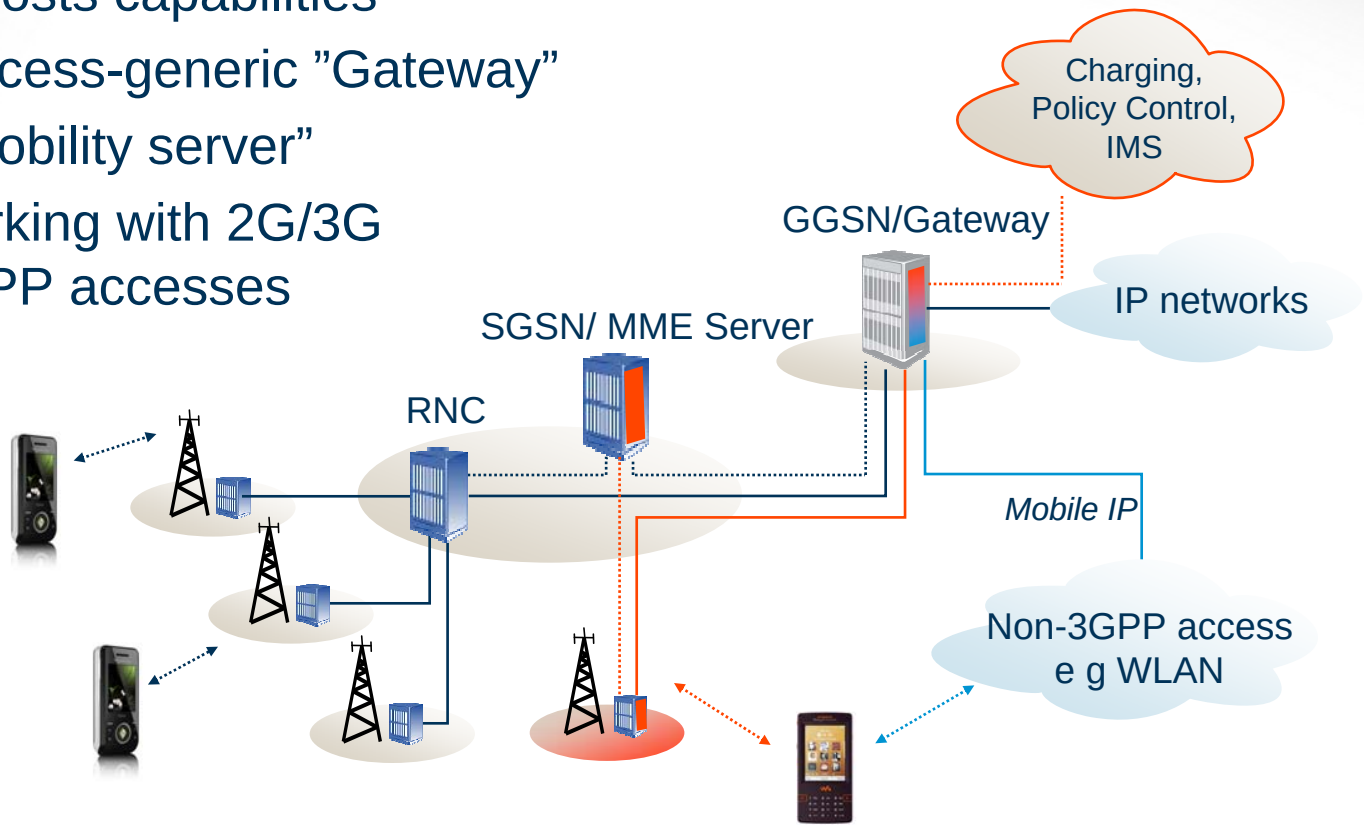


3GPP Evolved Packet Core

3) Introduction of LTE/SAE

1 Mobile broadband introduction → 2 Boosting the packet capacity → **3 Introduction of LTE/SAE** → 4 User plane optimization

- LTE RAN boosts capabilities
- GGSN → access-generic ”Gateway”
- SGSN → ”Mobility server”
- LTE interworking with 2G/3G and non-3GPP accesses

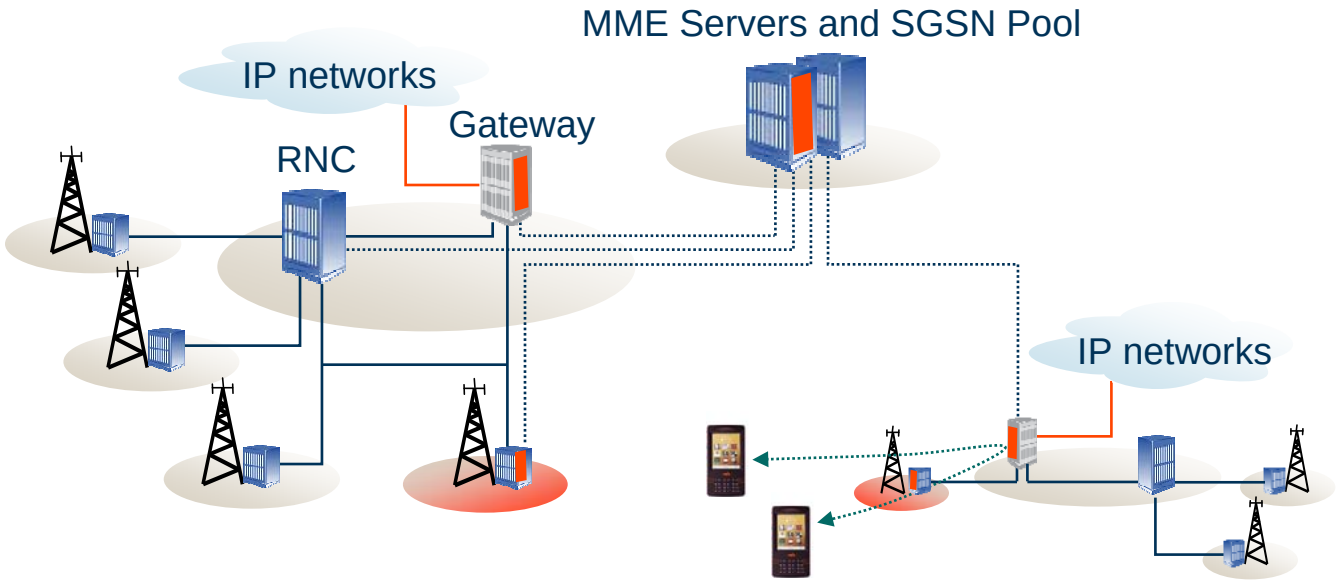


3GPP Evolved Packet Core

4) User plane optimization

1 Mobile broadband introduction → 2 Boosting the packet capacity → 3 Introduction of LTE/SAE → 4 User plane optimization

- Regional/local IP PoPs
- Centralized servers reduce OPEX
- Optimized IP saves transport, reduces delays
- Synergies with fixed access



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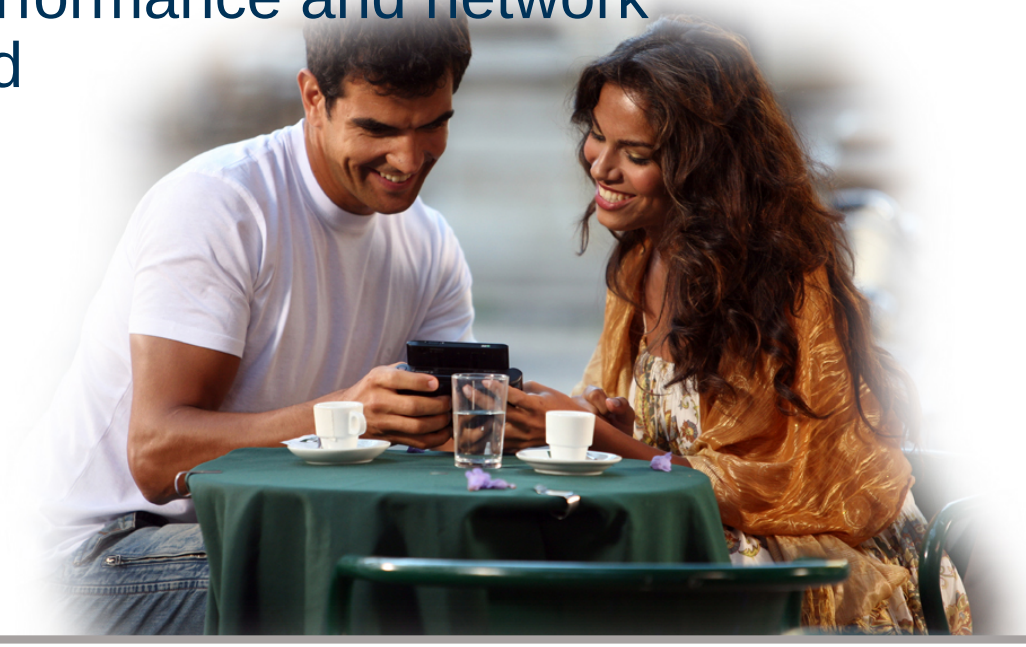
Summary – the Evolved Packet Core

- LTE/SAE provides spectrum flexibility, reduced TCO and high performance for Mobile Broadband networks
- Smooth migration to a flat and optimized 2-node architecture
- Cost efficiency, high performance and network migration being targeted
- Scalable & Robust
- All IP



Mobile Broadband

Even if started as technical evolution,
it has become a business revolution!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