3GPP Standards Update

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Outline

- The role of 3GPP
  - Membership
  - Structure
  - Systems Approach
  - Releases
- Main technical areas:
  - RAN
  - System and Core Network Evolution
- Summary

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The Role of 3GPP

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- Partnership Consists of
  - **Regional standards organizations**

    (Asia, Europe & North America):

    

  - **Market partners representing the broader industry**:

    IMS Forum, GSA, GSMA, IPv6 Forum, UMTS Forum, 4G Americas, TD SCDMA Industry Alliance, InfoCommunication Union (ICU), Small Cell Forum, CDMA Development Group (CDG), Cellular Operators Association of India (COAI), NGMN Alliance

- Radio Technologies;

  GSM/EDGE, GPRS/EGPRS, UMTS/W-CDMA/HSPA and LTE

- Systems Architecture, Core Network and Services

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3GPP Membership

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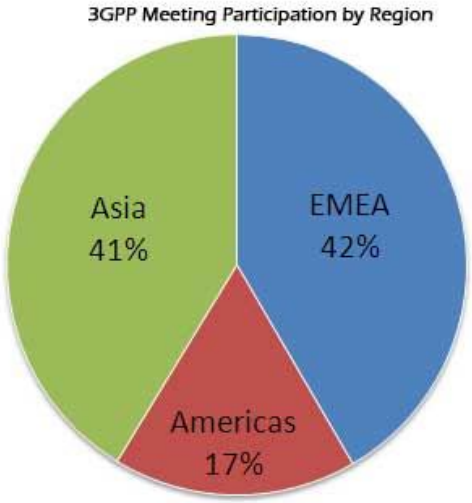
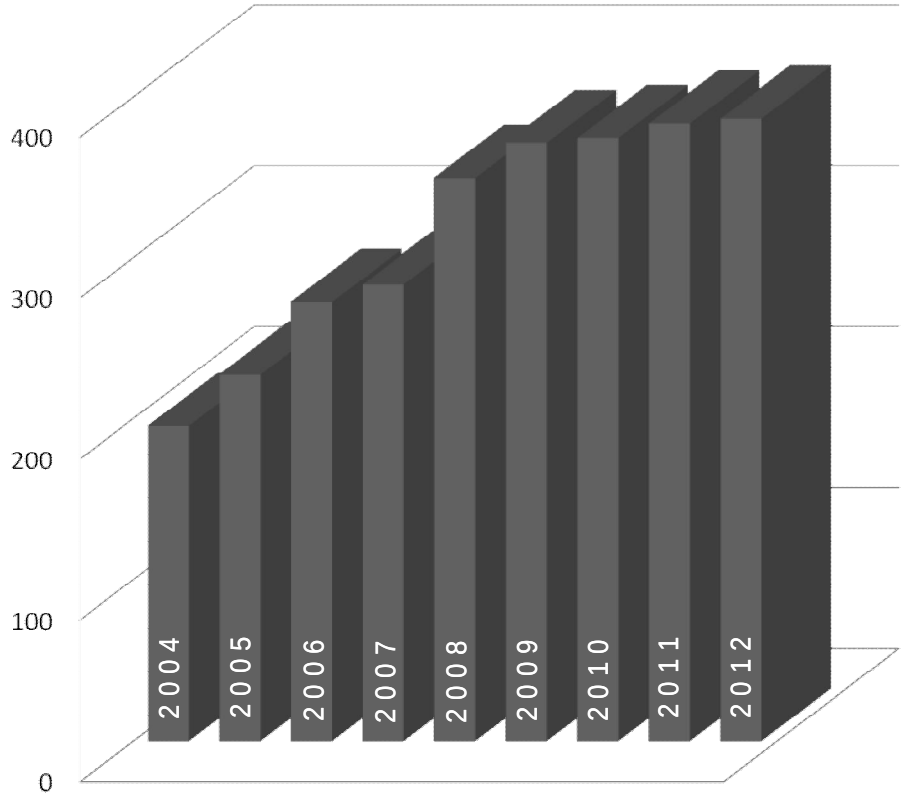
3GPP Membership is now at an all-time high, with 387 Individual members. In addition, there are 17 companies having Guest Status, which are potential IMs of the future.

- Growth in 3GPP Company Membership:

- 380 Companies
- 150 meetings/year (incl. W/Gs)
- 39 Countries





Source: 3GPP MCC (December 2010)

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3GPP Group Structure

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TSG GERAN

GSM EDGE
Radio Access Network

GERAN WG1
Radio Aspects

GERAN WG2
Protocol Aspects

GERAN WG3
Terminal Testing

TSG RAN

Radio Access Network

RAN WG1
Radio Layer 1 spec

RAN WG2
Radio Layer 2 spec
Radio Layer 3 RR spec

RAN WG3
Iub spec, Iur spec, Iu spec
UTRAN O&M requirements

RAN WG4
Radio Performance
Protocol aspects

RAN WG5
Mobile Terminal
Conformance Testing

TSG SA

Service & Systems Aspects

SA WG1
Services

SA WG2
Architecture

SA WG3
Security

SA WG4
Codec

SA WG5
Telecom Management

TSG CT

Core Network & Terminals

CT WG1
MM/CC/SM (Iu)

CT WG3
Interworking with external networks

CT WG4
MAP/GTP/BCH/SS

CT WG6
Smart Card Application Aspects

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Whole System Approach

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Radio Interface

- Higher data thoughput
- Lower latency
- More spectrum flexibility
- Improved CAPEX and OPEX

Core network

- All-IP network
- Support of non-3GPP accesses
- Improved security
- Greater device diversity

Services

- More IMS applications
- Greater session continuity

Legacy

- Interworking (Incl. GELTE)

3GPP systems, Building on Releases

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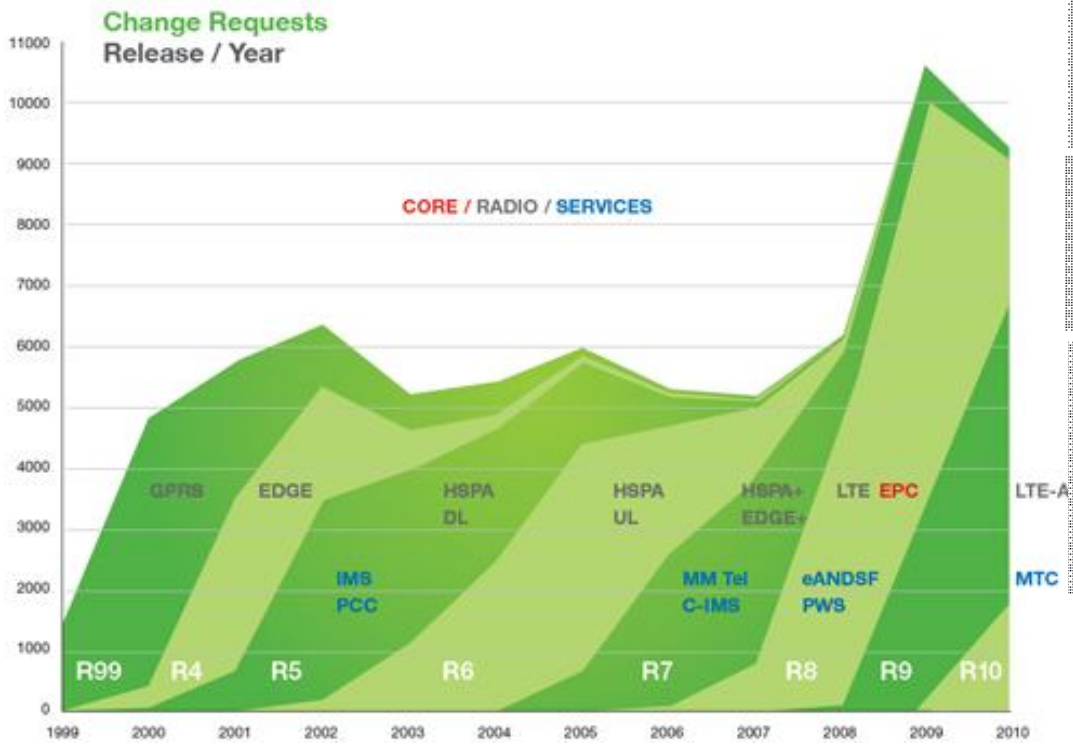
Release 99: Enhancements to GSM data (EDGE). Majority of deployments today are based on Release 99. Provides support for GSM/EDGE/GPRS/WCDMA radio-access networks.

Release 4: Multimedia messaging support. First steps toward using IP transport in the core network.

Release 5: HSDPA. First phase of Internet Protocol Multimedia Subsystem (IMS). Full ability to use IP-based transport instead of just Asynchronous Transfer Mode (ATM) in the core network.

Release 6: HSUPA. Enhanced multimedia support through Multimedia Broadcast/Multicast Services (MBMS). Performance specifications for advanced receivers. Wireless Local Area Network (WLAN) integration option. IMS enhancements. Initial VoIP capability.



Release 7: Evolved EDGE. Specifies HSPA+, higher order modulation and MIMO. Performance enhancements, improved spectral efficiency, increased capacity, and better resistance to interference. Continuous Packet Connectivity (CPC) enables efficient "always-on" service and enhanced uplink UL VoIP capacity, as well as reductions in call set-up delay for Push-to-Talk Over Cellular (PoC). Radio enhancements to HSPA include 64 Quadrature Amplitude Modulation (QAM) in the downlink DL and 16 QAM in the uplink. Also includes optimization of MBMS capabilities through the multicast/broadcast, single-frequency network (MBSFN) function.

Release 11
Interworking - 3GPP EPS and fixed BB accesses, M2M, Non voice emergency communications, 8 carrier HSDPA, Uplink MIMO study

Release 10 LTE-Advanced meeting the requirements set by ITU's IMT-Advanced project.

Also includes quad-carrier operation for HSPA+.

Release 9: HSPA and LTE enhancements including HSPA dual-carrier operation in combination with MIMO, EPC enhancements, femtocell support, support for regulatory features such as emergency user-equipment positioning and Commercial Mobile Alert System (CMAS), and evolution of IMS architecture.

Release 8: HSPA Evolution, simultaneous use of MIMO and 64 QAM. Includes dual-carrier HSPA (DC-HSPA) wherein two WCDMA radio channels can be combined for a doubling of throughput performance. Specifies OFDMA-based 3GPP LTE.

Defines EPC.

Text adapted from 3G Americas White Paper, September 2010

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LTE Release 8
Key Radio Features

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- High spectral efficiency
  - OFDM in Downlink
    - Robust against multipath interference
    - High affinity to advanced techniques
  - DFTS-OFDM("Single-Carrier FDMA") in Uplink
    - Low PAPR
    - User orthogonality in frequency domain
  - Multi-antenna application
- Very low latency
  - Short setup time & Short transfer delay
  - Short HO latency and interruption time
    - Short TTI
    - RRC procedure
    - Simple RRC states
- Support of variable bandwidth
  - 1.4, 3, 5, 10, 15 and 20 MHz
- Reduced CAPEX and OPEX

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Release 9 LTE Features

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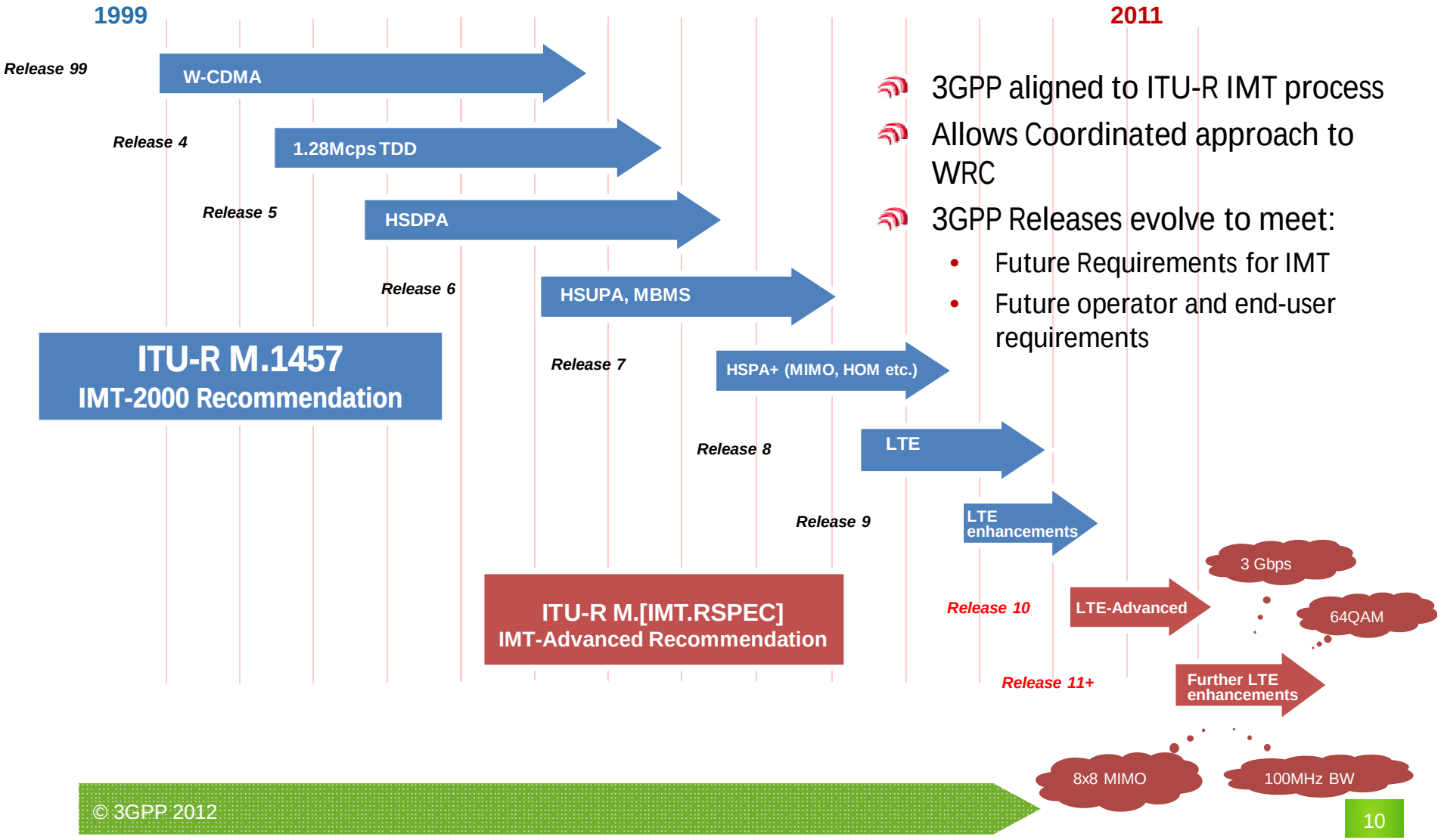
- Small enhancements from LTE Release 8 mainly for higher layer
  - HeNB (Home eNode B)
    - HeNB Access Mode
      - Rel-8: Closed Access Mode
      - Rel-9: Open and Hybrid Mode
    - HeNB Mobility between HeNB and macro
      - Rel-8: Out-bound HO
      - Rel-9: in-bound and inter-CSG HO
  - SON (self-organizing networks)
    - Rel-8: Self configuration, Basic self-optimization
    - Rel-9: RACH optimization, etc
  - MBMS (Multimedia Broadcast Multicast Service)
    - Rel-8: Radio physical layer specs
    - Rel-9: Radio higher layer and NW interface specs
  - LCS (Location Services)
    - Rel-8: U-Plane solutions
    - Rel-9: C-Plane solutions, e.g. OTDOA

Motivation for LTE-Advanced



- 3GPP aligned to ITU-R IMT process
- Allows Coordinated approach to WRC
- 3GPP Releases evolve to meet:
  - Future Requirements for IMT
  - Future operator and end-user requirements

Key Features in LTE-A Release 10

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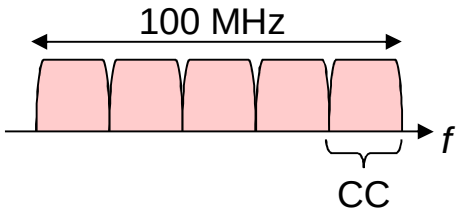
Support of Wider Bandwidth(Carrier Aggregation)

- Use of multiple component carriers(CC) to extend bandwidth up to 100 MHz
- Common physical layer parameters between component carrier and LTE Rel-8 carrier

➔ Improvement of peak data rate, backward compatibility with LTE Rel-8



Advanced MIMO techniques

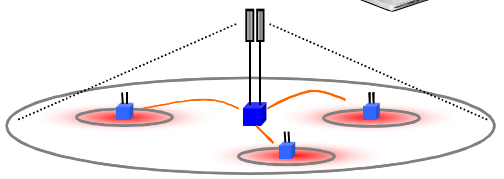
- Extension to up to 8-layer transmission in downlink
- Introduction of single-user MIMO up to 4-layer transmission in uplink
- Enhancements of multi-user MIMO

➔ Improvement of peak data rate and capacity

Heterogeneous network and eICIC(enhanced Inter-Cell Interference Coordination)

- Interference coordination for overlaid deployment of cells with different Tx power

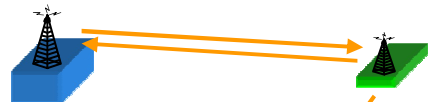
➔ Improvement of cell-edge throughput and coverage



Relay

- Type 1 relay supports radio backhaul and creates a separate cell and appear as Rel. 8 LTE eNB to Rel. 8 LTE UEs

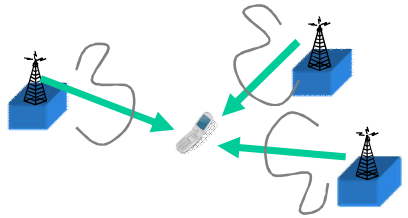
➔ Improvement of coverage and flexibility of service area extension



Coordinated Multi-Point transmission and reception (CoMP)

- Support of multi-cell transmission and reception

➔ Improvement of cell-edge throughput and coverage



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Spectrum Explosion

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LTE operating bands in 3GPP TS 36.101

E-UTRA Operating Band	Uplink (UL) operating band BS receive UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) operating band BS transmit UE receive F_{DL_low} – F_{DL_high}	Duplex Mode
1	1920 MHz – 1980 MHz	2110 MHz – 2170 MHz	FDD
2	1850 MHz – 1910 MHz	1930 MHz – 1990 MHz	FDD
3	1710 MHz – 1785 MHz	1805 MHz – 1880 MHz	FDD
4	1710 MHz – 1755 MHz	2110 MHz – 2155 MHz	FDD
5	824 MHz – 849 MHz	869 MHz – 894MHz	FDD
6[1]	830 MHz – 840 MHz	875 MHz – 885 MHz	FDD
7	2500 MHz – 2570 MHz	2620 MHz – 2690 MHz	FDD
8	880 MHz – 915 MHz	925 MHz – 960 MHz	FDD
9	1749.9 MHz – 1784.9 MHz	1844.9 MHz – 1879.9 MHz	FDD
10	1710 MHz – 1770 MHz	2110 MHz – 2170 MHz	FDD
11	1427.9 MHz – 1447.9 MHz	1475.9 MHz – 1495.9 MHz	FDD
12	699 MHz – 716 MHz	729 MHz – 746 MHz	FDD
13	777 MHz – 787 MHz	746 MHz – 756 MHz	FDD
14	788 MHz – 798 MHz	758 MHz – 768 MHz	FDD
15	Reserved	Reserved	FDD
16	Reserved	Reserved	FDD
17	704 MHz – 716 MHz	734 MHz – 746 MHz	FDD
18	815 MHz – 830 MHz	860 MHz – 875 MHz	FDD
19	830 MHz – 845 MHz	875 MHz – 890 MHz	FDD
20	832 MHz – 862 MHz	791 MHz – 821 MHz	FDD
21	1447.9 MHz – 1462.9 MHz	1495.9 MHz – 1510.9 MHz	FDD
22	3410 MHz – 3490 MHz	3510 MHz – 3590 MHz	FDD
23	2000 MHz – 2020 MHz	2180 MHz – 2200 MHz	FDD
24	1626.5 MHz – 1660.5 MHz	1525 MHz – 1559 MHz	FDD
25	1850 MHz – 1915 MHz	1930 MHz – 1995 MHz	FDD
…			
33	1900 MHz – 1920 MHz	1900 MHz – 1920 MHz	TDD
34	2010 MHz – 2025 MHz	2010 MHz – 2025 MHz	TDD
35	1850 MHz – 1910 MHz	1850 MHz – 1910 MHz	TDD
36	1930 MHz – 1990 MHz	1930 MHz – 1990 MHz	TDD
37	1910 MHz – 1930 MHz	1910 MHz – 1930 MHz	TDD
38	2570 MHz – 2620 MHz	2570 MHz – 2620 MHz	TDD
39	1880 MHz – 1920 MHz	1880 MHz – 1920 MHz	TDD
40	2300 MHz – 2400 MHz	2300 MHz – 2400 MHz	TDD
41	2496 MHz 2690 MHz	2496 MHz 2690 MHz	TDD
42	3400 MHz – 3600 MHz	3400 MHz – 3600 MHz	TDD
43	3600 MHz – 3800 MHz	3600 MHz – 3800 MHz	TDD

Note 1: Band 6 is not applicable

Recently standardized (Sep. 2011)

- UMTS/LTE 3500MHz
- Extending 850 MHz Upper Band (814 – 849 MHz)

Spectrum to be standardized by Sep. 2012

- LTE-Advanced Carrier Aggregation of Band 3 and Band 7
- LTE Advanced Carrier Aggregation of Band 4 and Band 17
- LTE Advanced Carrier Aggregation of Band 4 and Band 13
- LTE Advanced Carrier Aggregation of Band 4 and Band 12
- LTE Advanced Carrier Aggregation of Band 5 and Band 12
- LTE Advanced Carrier Aggregation of Band 20 and Band 7
- LTE Advanced Carrier Aggregation Band 2 and Band 17
- LTE Advanced Carrier Aggregation Band 4 and Band 5
- LTE Advanced Carrier Aggregation Band 5 and Band 17
- LTE Advanced Carrier Aggregation in Band 41
- LTE Advanced Carrier Aggregation in Band 38
- LTE Downlink FDD 716-728MHz
- LTE E850 - Lower Band for Region 2 (non-US)
- LTE for 700 MHz digital dividend
- Study on Extending 850MHz
- Study on Interference analysis between 800~900 MHz bands
- Study on UMTS/LTE in 900 MHz band

LTE-Advanced (Rel-10 onwards)

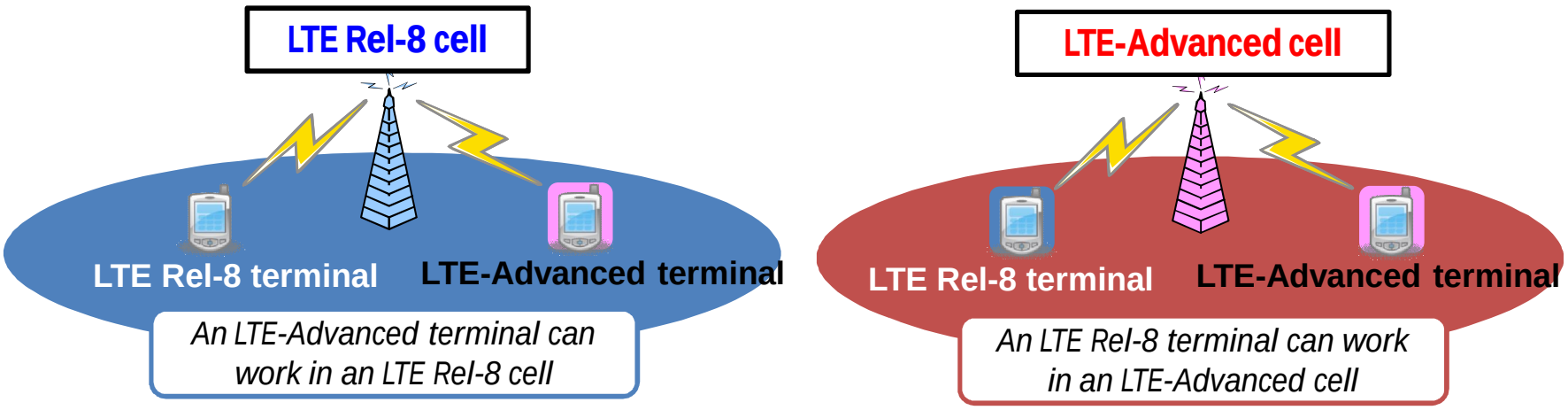
- LTE-Advanced shall be deployed as an evolution of LTE and on new bands

- LTE-Advanced shall be backwards compatible with LTE

➔ Smooth and flexible system migration from Rel-8 LTE to LTE-Advanced

LTE-Advanced backward compatibility with LTE Rel-8

LTE-Advanced contains all features of LTE Rel-8&9 and additional features for further evolution



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Some Key Features in LTE-A Release 11 (Dec/2012)

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- Further Downlink MIMO enhancements for LTE-Advanced
  - Addressing low-power modes, relay backhaul scenarios, and certain practical antenna configurations
- Provision of low-cost M2M UEs based on LTE
- Studying LTE Coverage Enhancements
- Network-Based Positioning Support for LTE
- Further Self Optimizing Networks (SON) Enhancements
  - Mobility Robustness Optimisation (MRO) enhancements
  - Addressing Inter-RAT ping-pong scenarios
- Carrier based HetNet Interference co-ordination for LTE
  - Carriers in same or different bands in HetNet environments with mixture of different BTS types
- Enhancements to Relays, Mobile Relay for LTE
  - RF core requirements for relays
  - Mobile relay: mounted on a vehicle wirelessly connected to the macro cells

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Plans for LTE-A Release-12

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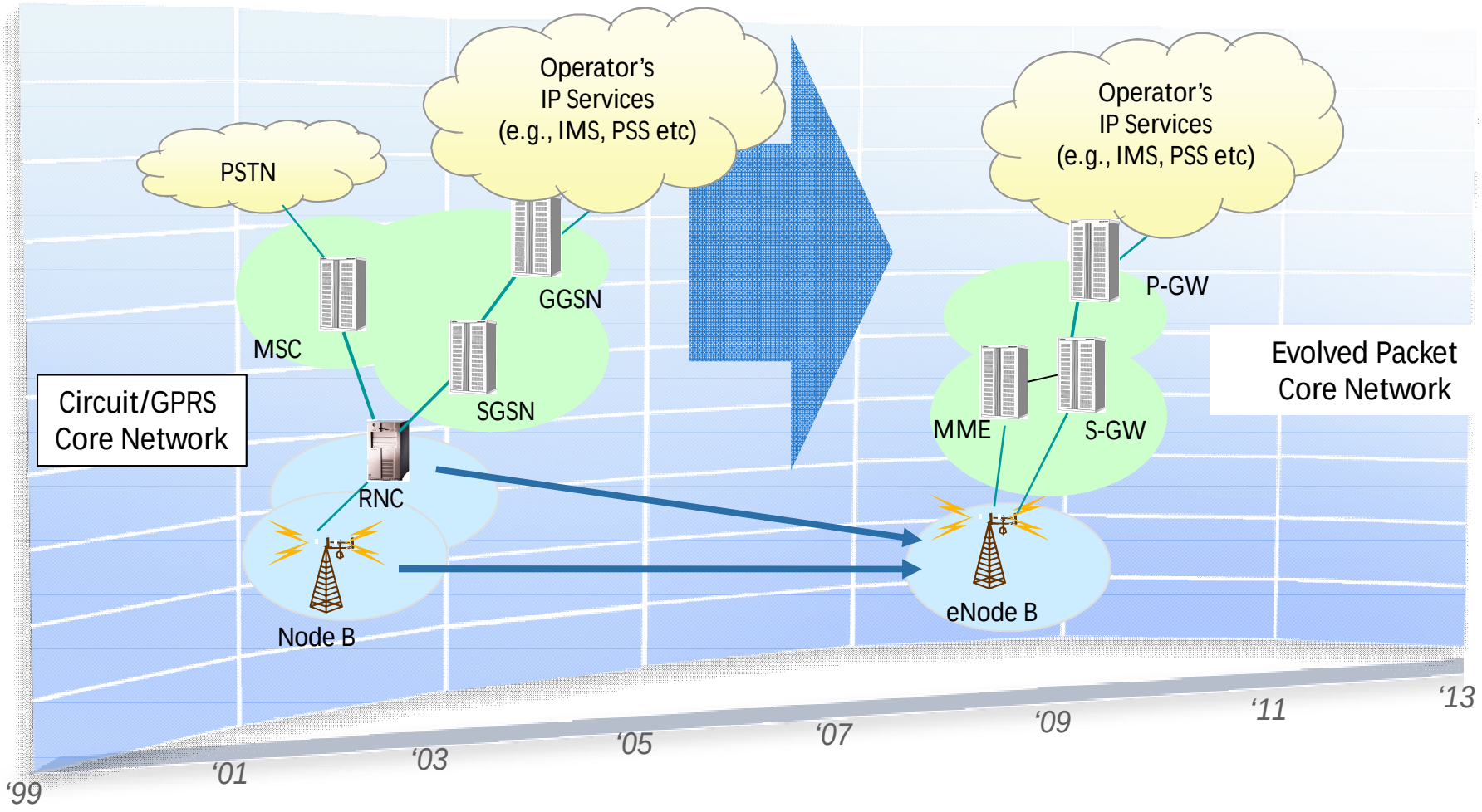
- 3GPP workshop to be held June 14, 2012
  - Main themes and strategic directions to be set, e.g.:
    - Extreme capacity needs and spectrum efficiency (‘challenge Shannon’)
    - Flexibility, efficient handling of smartphone diversity
    - Offloading to unlicensed radio technologies
    - Power efficiency
- Prime areas of interest (examples)
    - More optimized small cell deployments
    - Carrier Aggregation Enhancements (inter-site, LTE/HSPA)
    - Cognitive radio aspects
    - SON enhancements
    - Local Area optimizations

Core Network Evolution



EPS architecture

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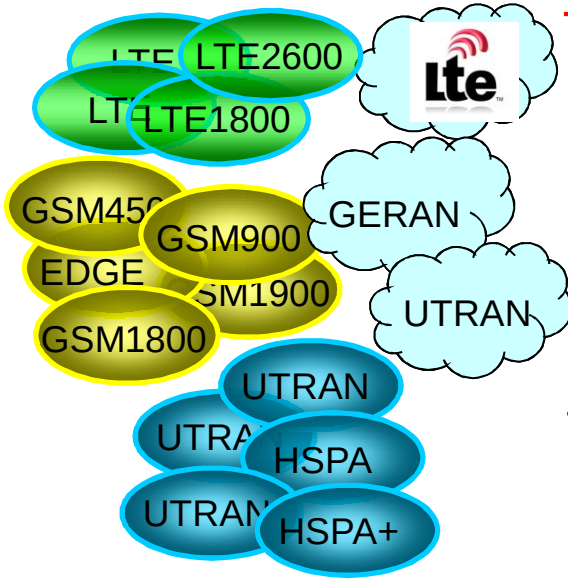
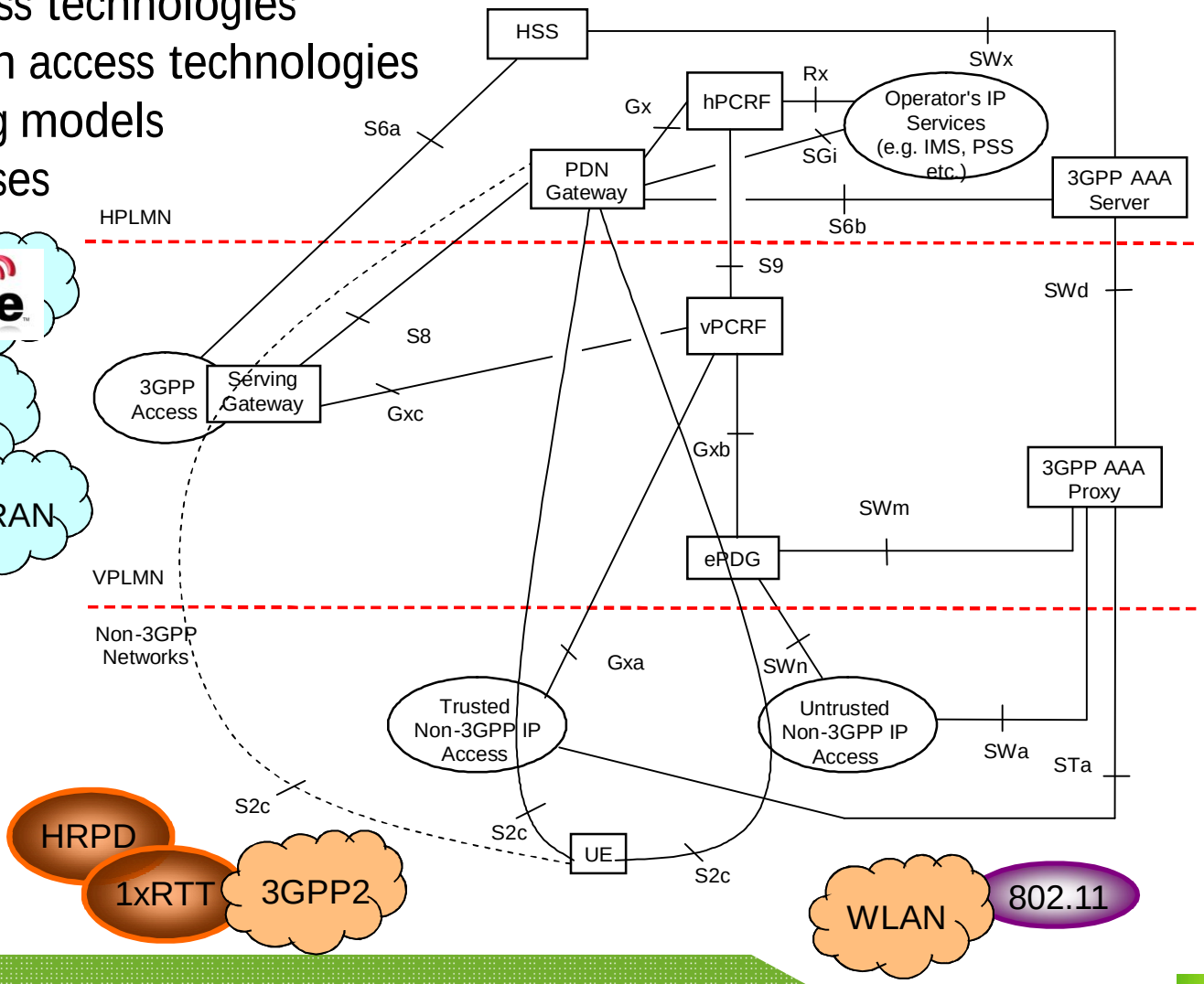
- Many 3GPP access technologies
- Mobility between access technologies
- Multiple roaming models
- Non-3GPP accesses





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Key Systems features of recent Releases

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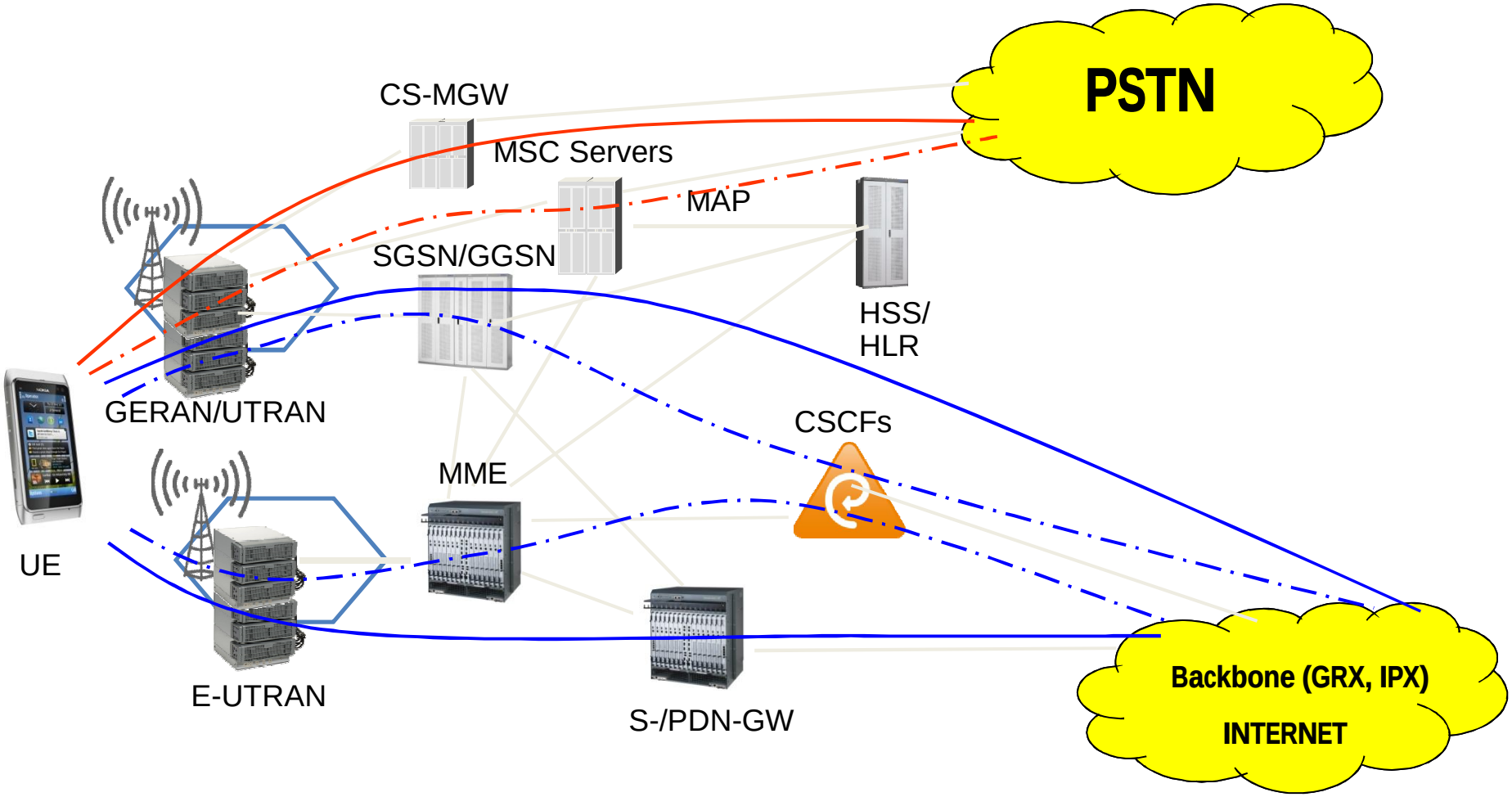
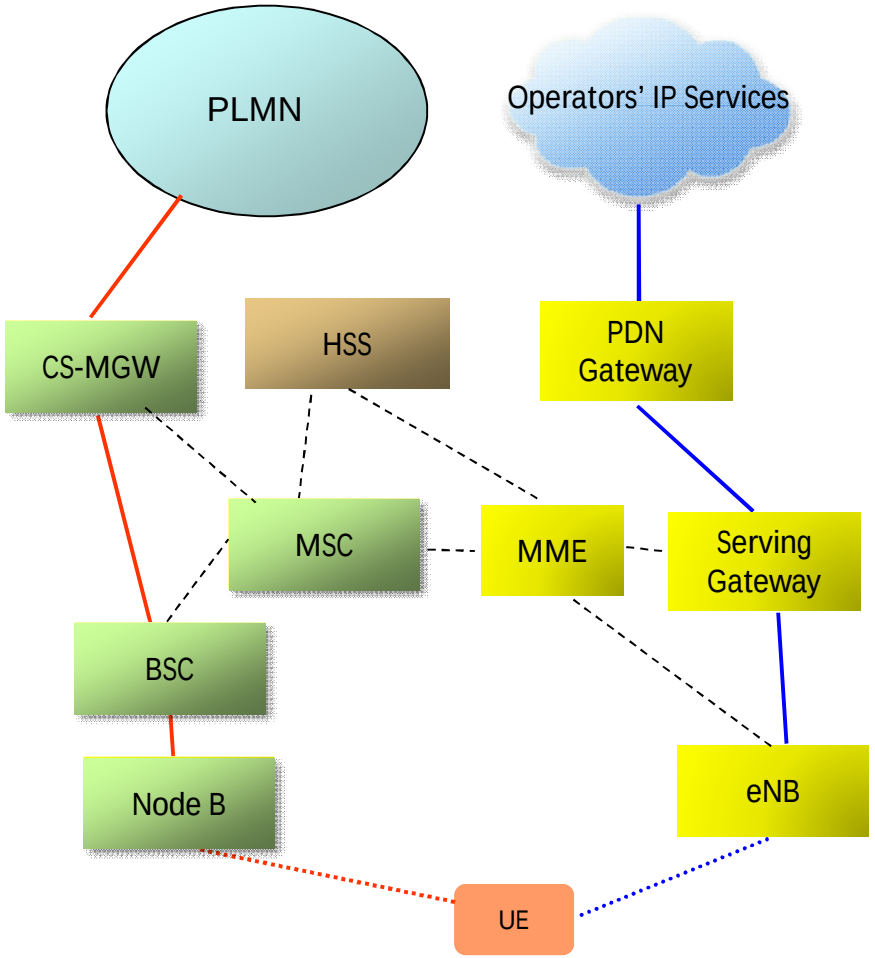
- Multimedia and carrier grade VoIP with IMS
- Multi-access, operators can influence the access selection
- Dual-stack IPv4/v6 connectivity to cater for IPv6 migration
- Various ways to combine or split traffic off inside the network
  - Local IP Access (LIPA)
  - Selective IP Traffic Offloading (SIPTO)
  - WLAN offloading
- Machine Type Communications (M2M)
- Regulatory features

CS and PS voice service architecture



CS Fallback in EPS

- Application of CSFB:
  - CS capable device camping on LTE cell can establish/receive CS services
  - Reuse of existing CS infrastructure for voice service until IMS VoIP is deployed
  - Provide voice roaming support with LTE
  - Can support emergency calls using existing CS infrastructure
- SMS can be delivered to the UE without redirecting to CS Domain
- After CS service the UE returns to LTE, depending on coverage and policy



Single Radio Voice Call Continuity

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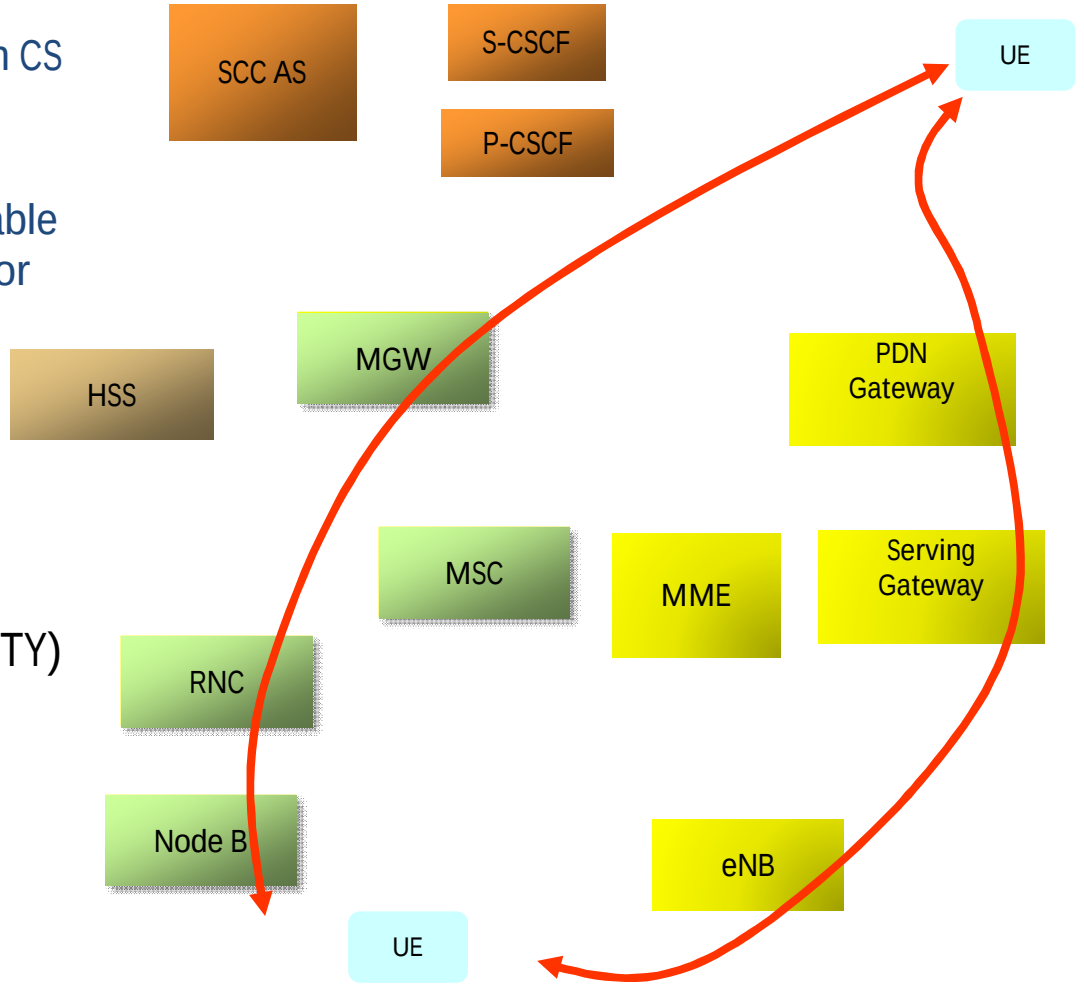
SRVCC use case:

- IMS call initiated in LTE can continue in CS domain after moving outside of LTE coverage area
- SRVCC is invoked if no other VoIP capable PS system (HSPA/eHRPD) is available for VoIP PS-PS HO
- Requires overlapping with GSM/WCDMA/1xRTT coverage



SRVCC improvements:

- Mid-call services (like HOLD & MPTY)
- emergency calls
- video calls

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Access Discovery and Selection (ANDSF)

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- EPC is a multi-access IP core system supporting both native 3GPP cellular radio technologies and other IP access systems (802.x, etc…)
- Legacy selection mechanisms have been available to choose a 3GPP cellular radio and PLMN
- Additional standards were developed to take into account non-3GPP access technologies
  - Access technology policies are uploaded to the device using Device Management procedures
- Further work ongoing to fine-tune the granularity of the policies

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Improved Dual-Stack Support for IPv6 migration

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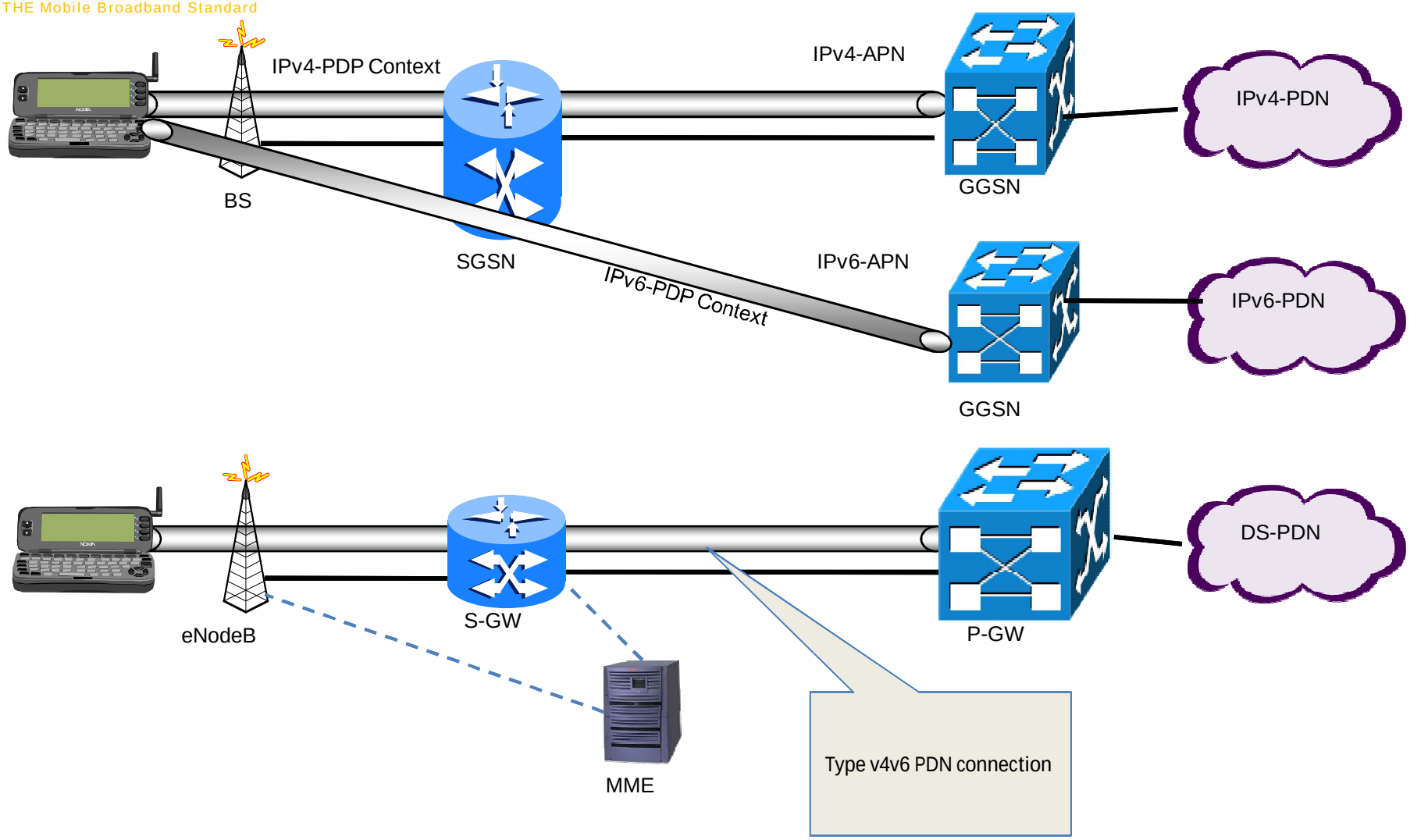
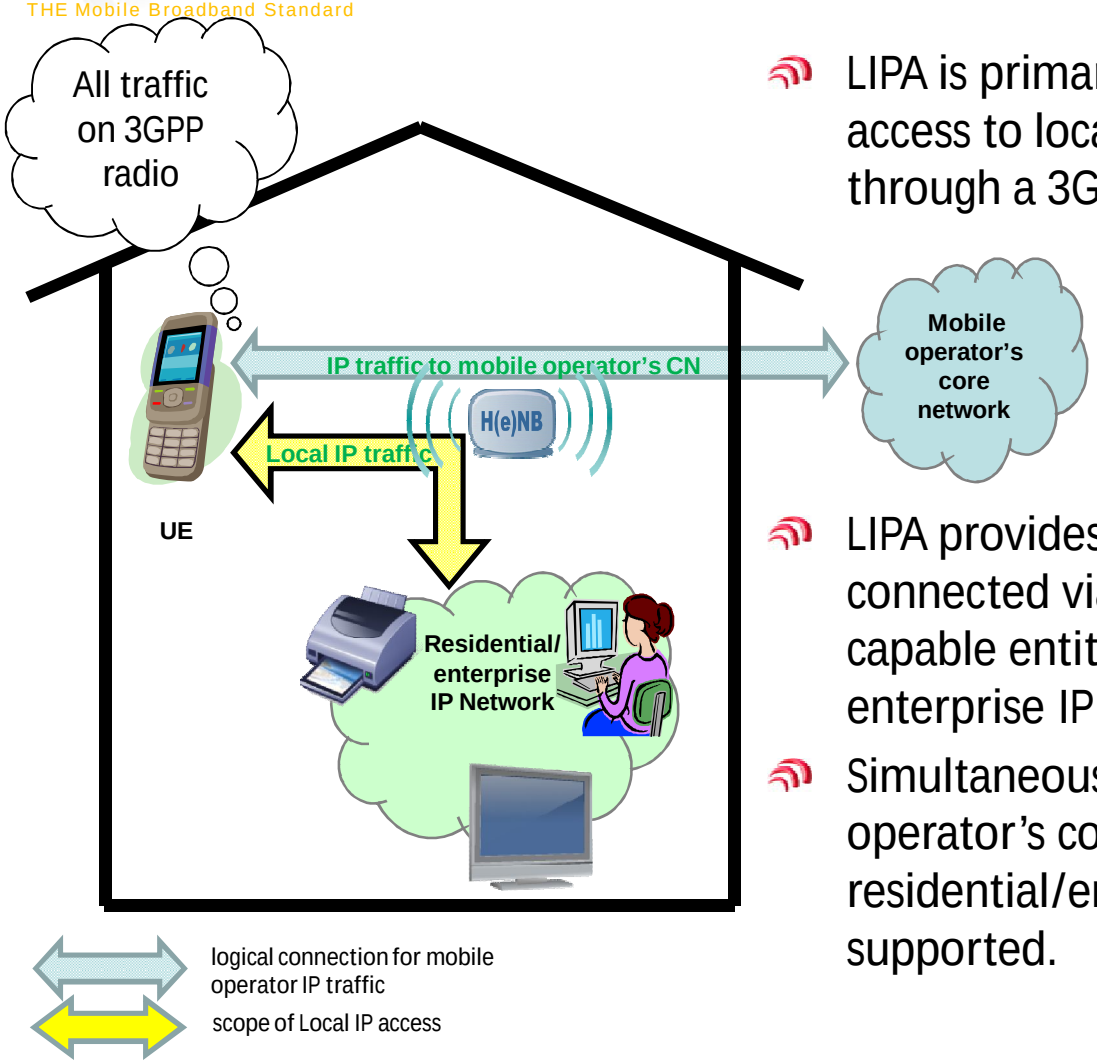
- Networks prior to Release-8 (Dec/2008)
  - Dual-stack connectivity only possible by opening two parallel Bearers: one of each for IPv4 and IPv6
  - Shows up as two separate interfaces to the IP stack
- Networks from Release-8 onwards with the addition of LTE
  - Always-on…
  - A single IPv4v6 PDN Connection
  - Shows up as one interface with both IPv4 and IPv6 addresses to the IP stack (with v4v6 type)
  - Does not lower the needed number of v4 addresses, but helps v6 uptake by optimizing resource usage

Improved Dual-Stack Support



Local IP Access (LIPA)



- LIPA is primarily for end user's benefit, to allow access to local residential or corporate network through a 3GPP device
- LIPA provides access for IP capable UEs that are connected via a H(e)NB subsystem to other IP capable entities in the same residential/ enterprise IP network.
- Simultaneous access from a UE to the mobile operator's core network and Local IP Access to a residential/enterprise IP network will be supported.

Selective IP Traffic Offloading (SIPTO)

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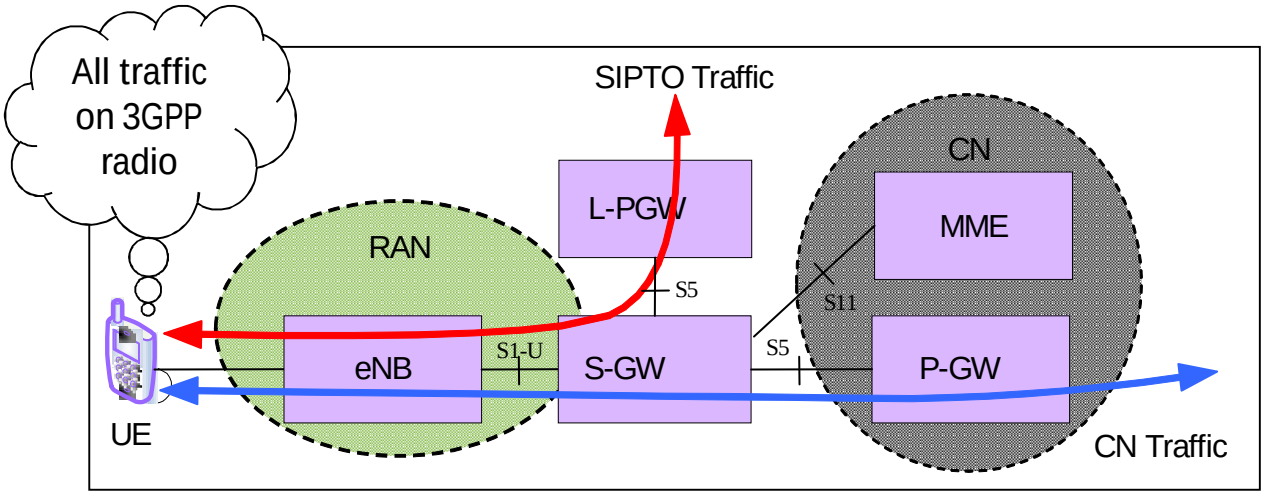
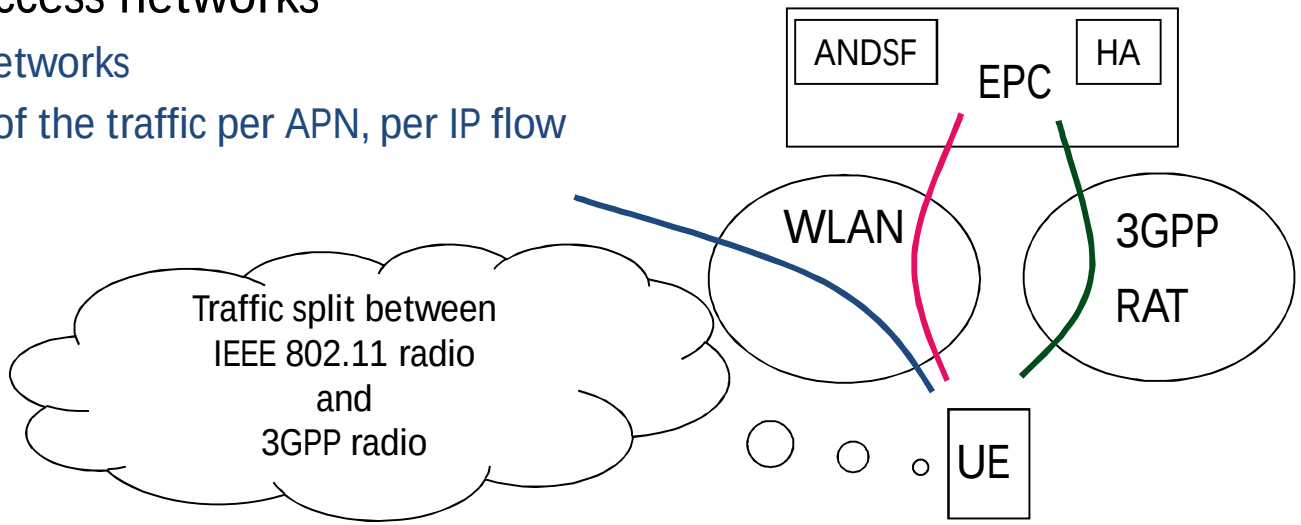
- Optimizing “cost per bit” is becoming essential in the “flat rate” era
- SIPTO is a specific routing scenario within the operator’s network, allowing *selective* offloading of the traffic away from the Evolved Packet Core network
- SIPTO benefits the cellular operator and it is transparent for the end user
- SIPTO is intended for allowing cost optimized handling of the internet traffic that is not intended for the operator’s core network
- Local GW is selected for the traffic to be offloaded



WLAN Offloading

- WLAN offloading refers to the dual radio scenario where part of the traffic is routed via WLAN access and part via 3GPP access
- WLAN offloading covers both the scenario where the traffic via WLAN radio is anchored in the EPC (i.e., seamless offloading) and the scenario where it is not anchored (i.e., non-seamless offloading)
- Access Network Discovery and Selection Function (ANDSF) is there to provide the UE with the access network discovery information and the policy on how to use the available access networks
  - Available access networks
  - Preferred routing of the traffic per APN, per IP flow



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Machine-to-Machine (M2M)

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- M2M is recognized as a key segment in future packet networks
- Initial 3GPP efforts have focused on the ability to differentiate machine-type devices
  - This allows the operator to selectively handle such devices in overload situations
    - Low priority indicator has been added to the relevant UE-network procedures
    - Overload and Congestion control is done on both core network and radio access network based on this indicator
- Functions for device triggering and small data transmission have been added
- Still a lot to do…

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Regulatory features – disaster response

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- Recent events have brought the different disaster response functions of the 3G/4G networks to the forefront

  - Public Warning System (PWS) provides a secure framework for delivering Warning Messages to the devices
  - Priority Services
    - Mechanisms have been standardized to allow priority access to the network services (voice calls, Internet, multimedia calls, etc…) for e.g. government officials in the event of a mass disaster

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Proximity Services and Public Safety

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- Proximity-based applications and services represent a recent and enormous social-technological trend
  - These applications and these services are based on the awareness that two devices or two users are close to each other
  - Awareness of proximity carries value, and generates demand for an exchange of traffic between them
- Direct device-to-device communication is also essential for **Public Safety services**
  - Necessary LTE enhancements to support Public Safety functions are expected to be added in Rel-12/Rel-13
  - Regional regulators need to progress the spectrum band aspects

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Focus

- Providing the industry with timely technology evolution
- Addressing the smartphone challenge with innovative features across radio and core
- Optimizing the network for new business opportunities, e.g. machine-to-machine communications
- Ensuring backwards compatibility to protect existing network investments

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Summary

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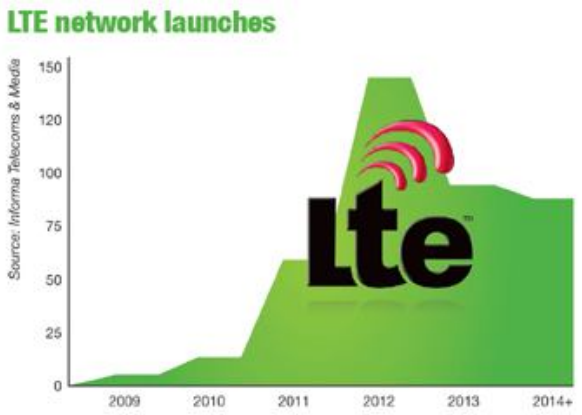
- LTE-(A) is **the viable path** for mobile broadband
- Release 12 will look beyond current work, for a 2020 vision
- 3GPP systems approach ensures **continued evolution** to meet new demands



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Thank You !!

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