Radio Access Networks
- LTE progress report

May 24, 2010

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3GPP TSG-RAN Chairman

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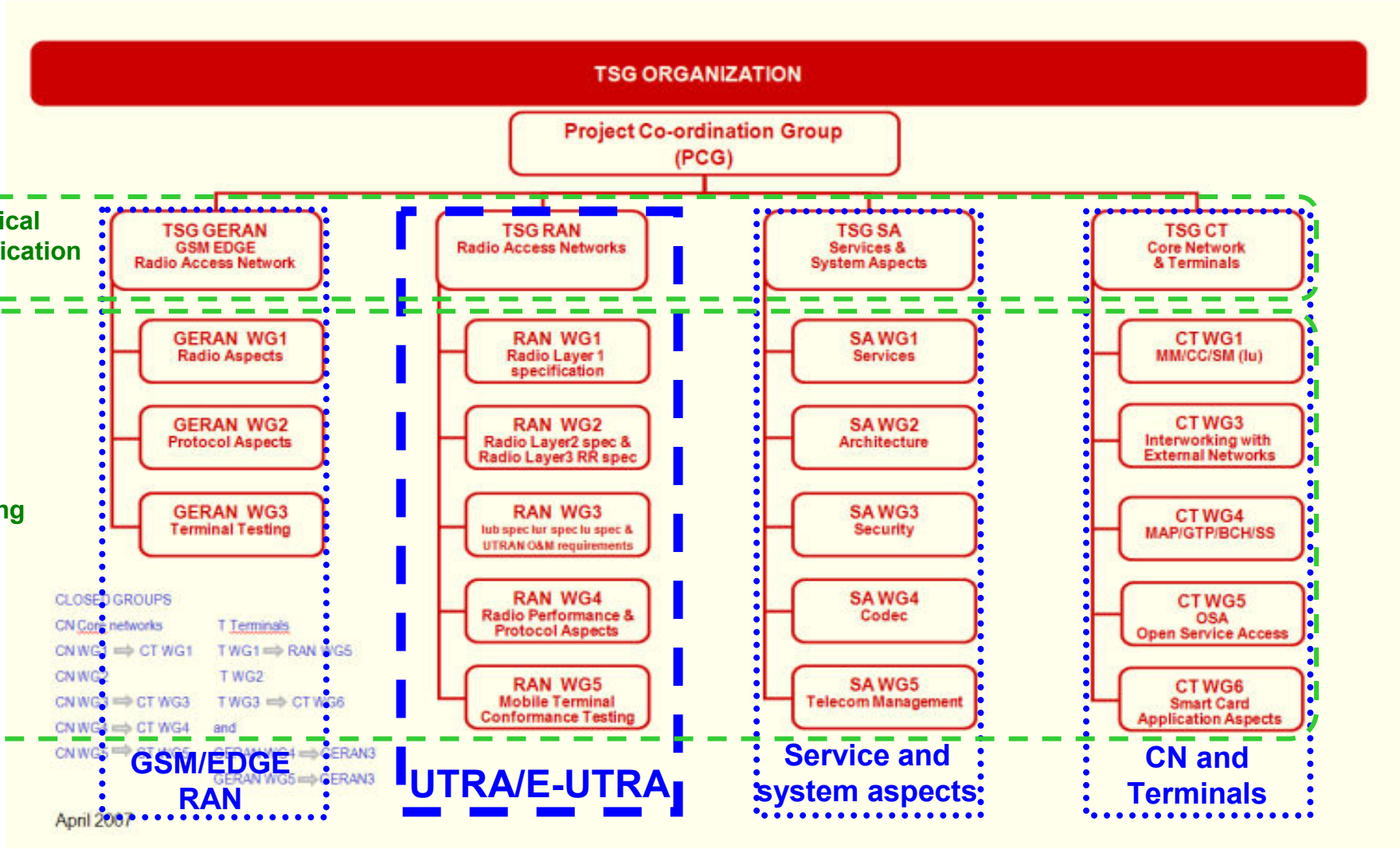
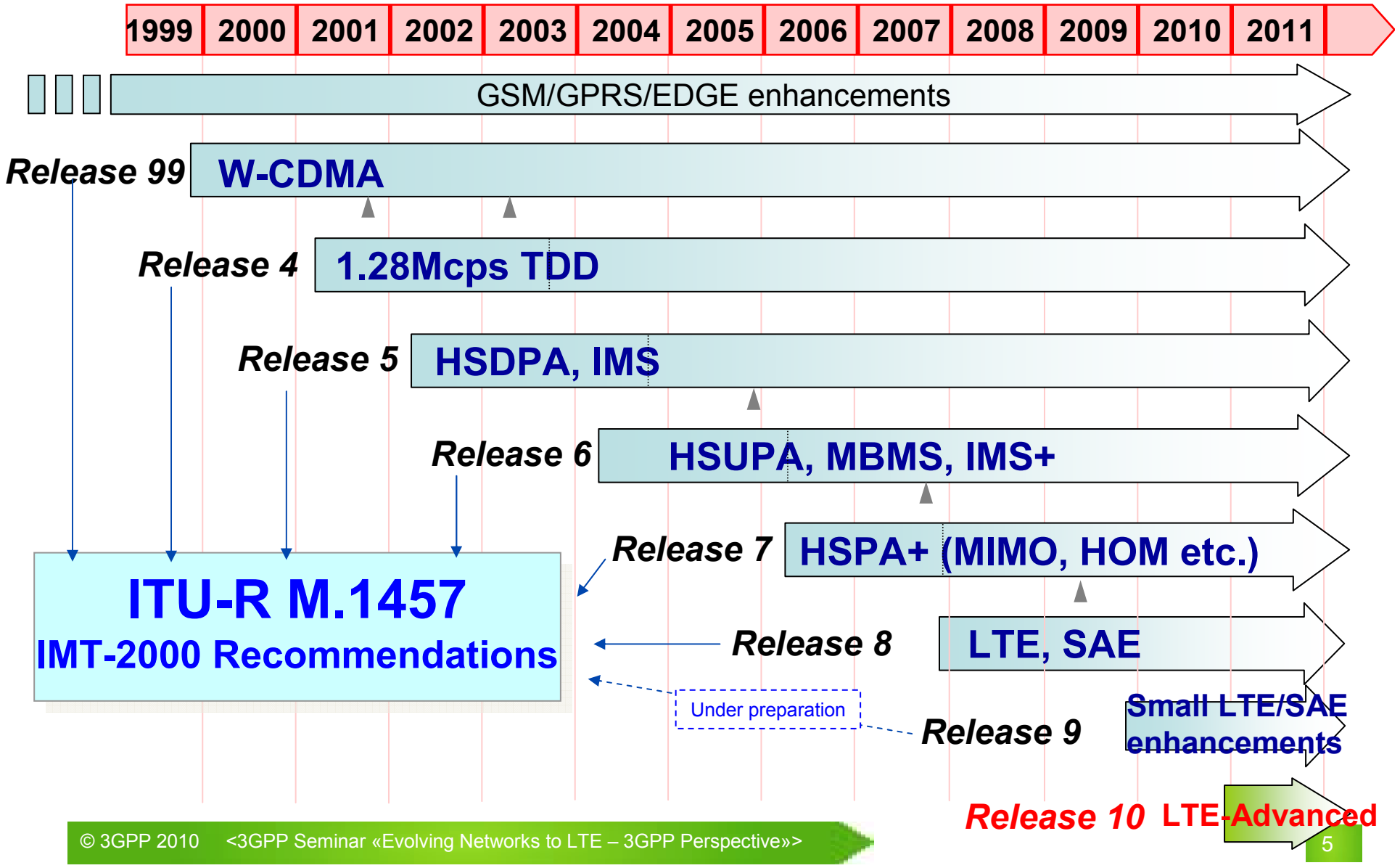
3GPP TSG-RAN
Standardisation Activities

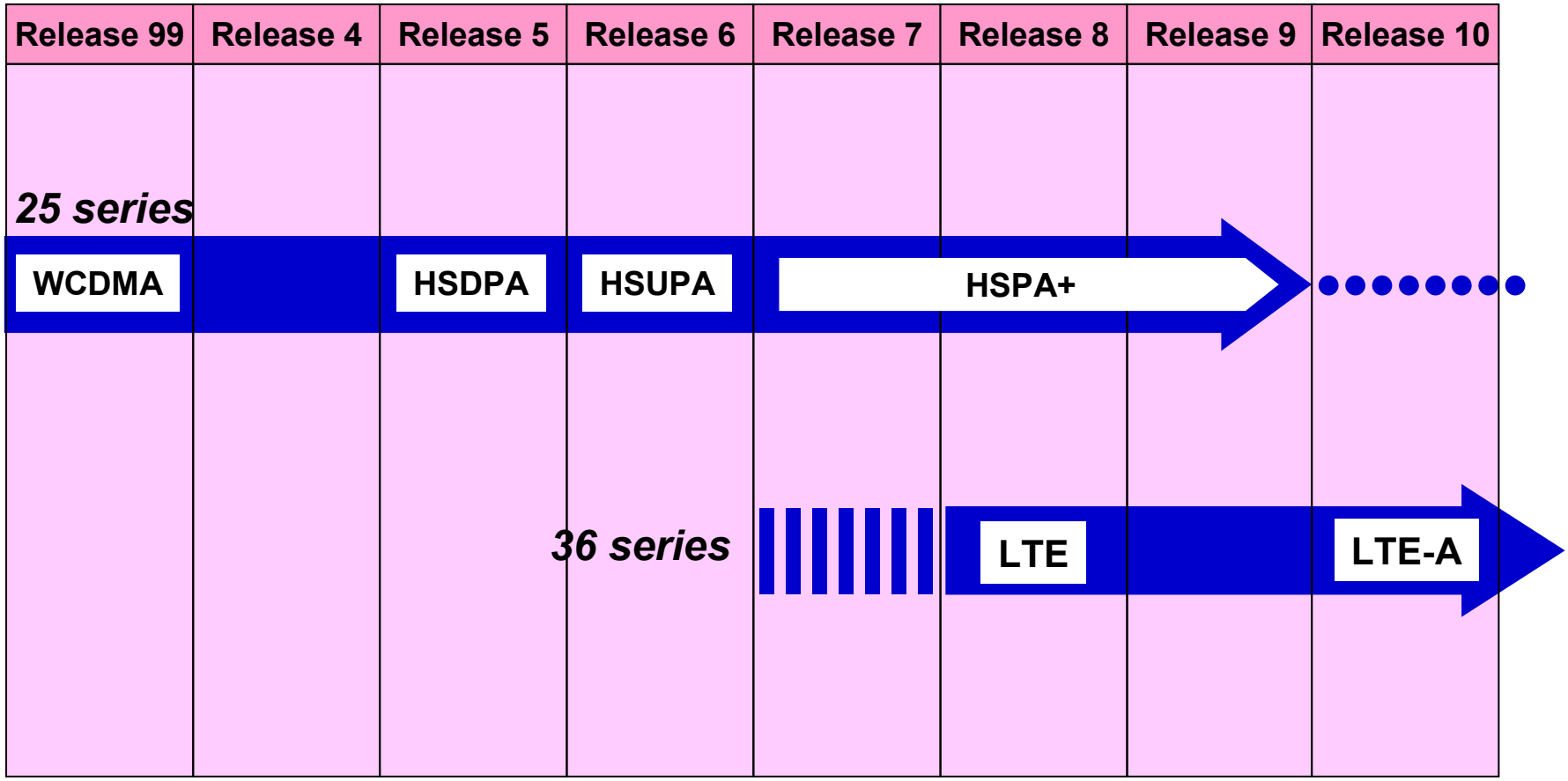
3GPP Structure



Release of 3GPP specifications



Technology Evolution path in 3GPP Standards

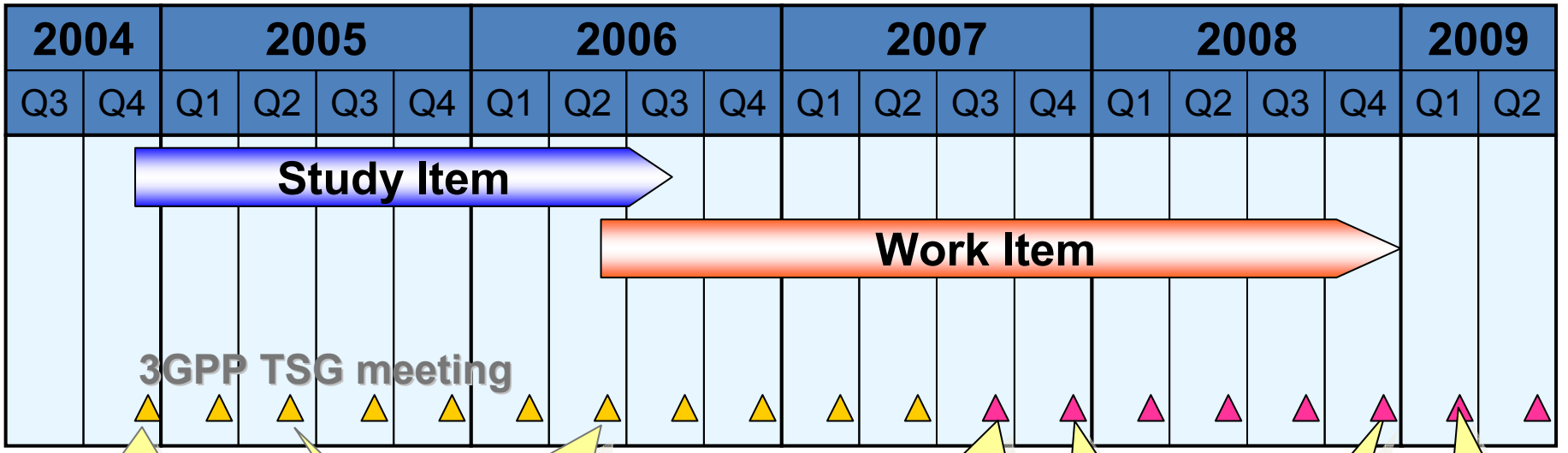


LTE Release 8

Motivation of LTE Release 8

- Need to ensure the continuity of competitiveness of the 3G system for the future
- User demand for higher data rates and quality of services
- PS optimised system
- Continued demand for cost reduction (CAPEX and OPEX)
- Low complexity
- Avoid unnecessary fragmentation of technologies for paired and unpaired band operation

LTE Release 8 Standardisation History



Study Item "Evolved UTRA and UTRAN" Approved.

Work Item "3G Long-term Evolution" approved.

Requirements approved

Core specs approved

Test specs approved
Core specs functionally frozen
Main work items closed

ASN.1 frozen

LTE Release 8 Key Features

- High spectral efficiency
  - OFDM in Downlink
    - Robust against multipath interference
    - High affinity to advanced techniques
      - Frequency domain channel-dependent scheduling
      - MIMO
  - 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

LTE Release 8 Key Features (Cont'd)

- Simple protocol architecture
  - Shared channel based
  - PS mode only with VoIP capability
- Simple Architecture
  - eNodeB as the only E-UTRAN node
  - Smaller number of RAN interfaces
    - eNodeB ↔ MME/SAE-Gateway (S1)
    - eNodeB ↔ eNodeB (X2)
- Compatibility and inter-working with earlier 3GPP Releases
- Inter-working with other systems, e.g. cdma2000
- FDD and TDD within a single radio access technology
- Efficient Multicast/Broadcast
  - Single frequency network by OFDM
- Support of Self-Organising Network (SON) operation

LTE Release 8 Major Parameters

Access Scheme	**UL**	**DFTS-OFDM**
	DL	**OFDMA**
Bandwidth		**1.4, 3, 5, 10, 15, 20MHz**
Minimum TTI		**1msec**
Sub-carrier spacing		**15kHz**
Cyclic prefix length	**Short**	**4.7μsec**
	Long	**16.7μsec**
Modulation		**QPSK, 16QAM, 64QAM**
Spatial multiplexing		**Single layer for UL per UE** **Up to 4 layers for DL per UE** **MU-MIMO supported for UL and DL**

LTE-Release 8 User Equipment Categories

Category		1	2	3	4	5
Peak rate Mbps	DL	10	50	100	150	300
	UL	5	25	50	50	75
Capability for physical functionalities						
RF bandwidth		20MHz				
Modulation	DL	QPSK, 16QAM, 64QAM				
	UL	QPSK, 16QAM				QPSK, 16QAM, 64QAM
Multi-antenna						
2 Rx diversity		Assumed in performance requirements.				
2x2 MIMO		Not supported	Mandatory			
4x4 MIMO		Not supported				Mandatory

LTE Release 8 Specifications

- LTE is specified in 36 series technical specifications
- The latest version of the LTE Release 8 specifications (March 2010 version) can be found in
  - http://www.3gpp.org/ftp/Specs/2010-03/Rel-8/36_series/

LTE Release 9

Rel-9 LTE features

- Small enhancements from LTE Release 8
  - HeNB (Home eNode B)
  - SON (self-organizing networks)
  - E-MBMS (Evolved-Multimedia Broadcast Multicast Service)
  - LCS (Location Services)

HeNB Access Mode

	camp on (idle mode)		Voice call / packet access (active mode)	
	Authorized UE	Unauthorized UE	Authorized UE	Unauthorized UE
Closed access mode	YES	NO	YES	NO
Hybrid access mode	YES		YES	YES **Service limited**
Open access mode	YES			

- Closed access mode **Rel-8**

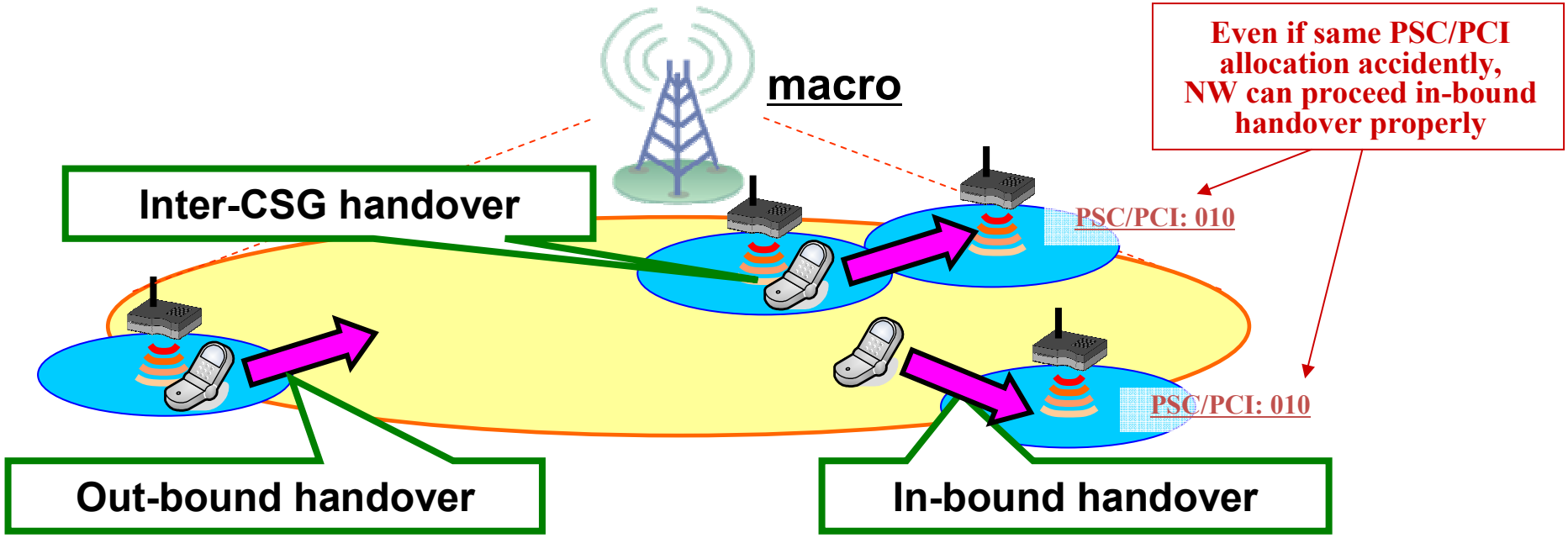
Restrict access at a cell to only registered members (CSG: Closed Subscriber Group)

- Hybrid access mode **Rel-9**

No restrict access, but service prioritized to registered members

- Open access mode **Rel-9**

HeNB
Mobility between H(e)NBs and macro



- Out-bound handover Rel-8

- In-bound handover Rel-9

PSC/PCI confusion at handover has been resolved.
(i.e., handover support when different H(e)NBs neighboring a macro cell are using the same PCI)

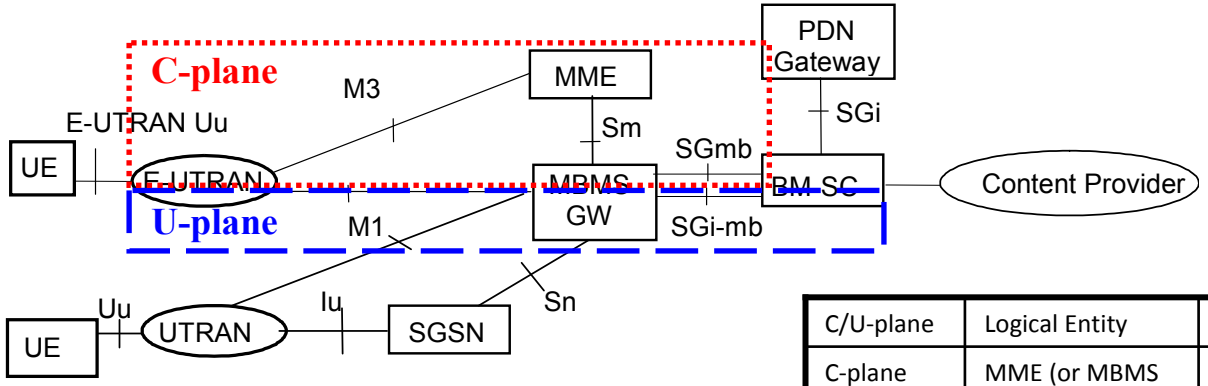
- Inter-CSG handover Rel-9

SON (Self-Organising Networks)

- Release 8
  - Self-configuration:
    - S1 (eNB – core NW) interface dynamic configuration
    - X2 (inter-eNB) interface dynamic configuration
    - Framework for PCI (Physical Cell ID) selection
    - Automatic neighbor cell discovery
  - Self-optimisation:
    - Basic intra-LTE mobility load balancing
      - Resource-related information exchange between eNBs over X2 I/F
    - Interference management
      - UL interference-related information exchange between eNBs over X2 I/F
- Release 9
  - Mobility load balancing
    - Optimisation of cell reselection/ handover parameters to distribute traffic load across the network.
  - Mobility robustness optimisation
    - Optimisation of cell reselection/ handover parameters to minimise radio link failures due to mobility.
  - RACH Optimisation
    - Optimisation for RACH configuration

E-MBMS

- E-MBMS discussion was postponed in Rel-8 due to lack of time and is continued in Rel-9.
- Basic Rel-8 L2/L3 architecture is reused in Rel-9.
- E-MBMS in Rel-9 will support the following functionalities:
  - Broadcast mode and enhanced broadcast mode
  - Static MBSFN area (only)
  - One cell belongs to only one MBSFN area
  - Multiple non overlapping MBSFN areas in a PLMN
  - Broadcast transmission only in a shared carrier deployment (no dedicated carrier)
  - MBSFN without feedback (i.e. no ACK/ NACK or counting)
  - Signalling support, e.g. MCCH over LTE-Uu

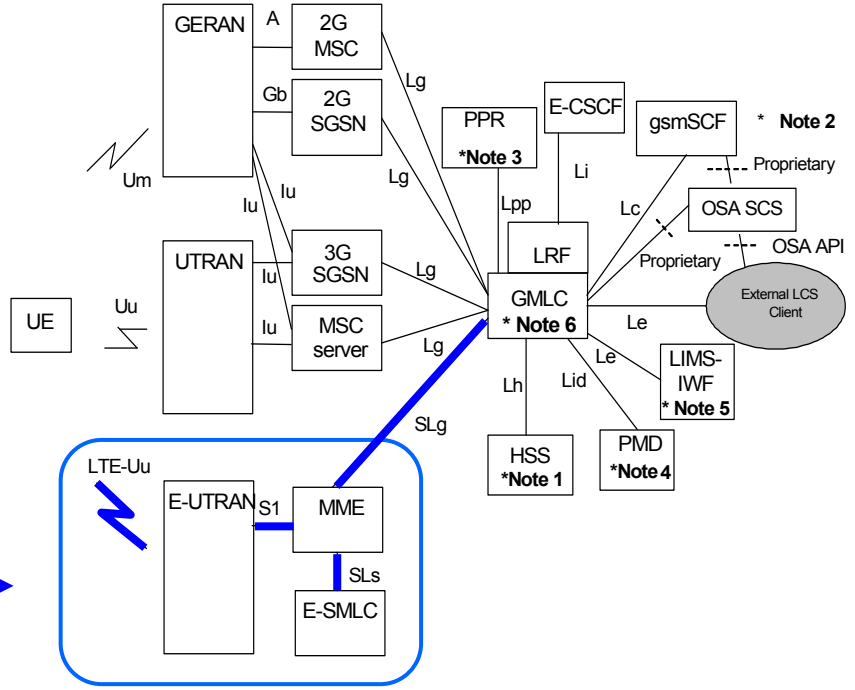


C/U-plane	Logical Entity	Function
C-plane	MME (or MBMS GW C-plane)	▪Session control ▪Session control message filtering for a certain service area (FFS)
U-plane	MBMS GW U-plane	▪U-plane data IP Multicast transmission ▪IP Multicast address allocation for each eNB

LCS (Location Service)

- Location method in LTE:
  - OTDOA positioning method
  - A-GNSS based positioning methods
  - E-CID

Newly defined architecture for LCS support in LTE →



New Protocols for LTE LCS

Interface	New protocols	3GPP specs	Remark
UE - E-SMLC	LPP	36.355	Procedure for UE location measurements
eNB - E-SMLC	LPPa	36.455	Procedure for eNB location measurements

LTE Release 10 and Beyond (LTE-Advanced)

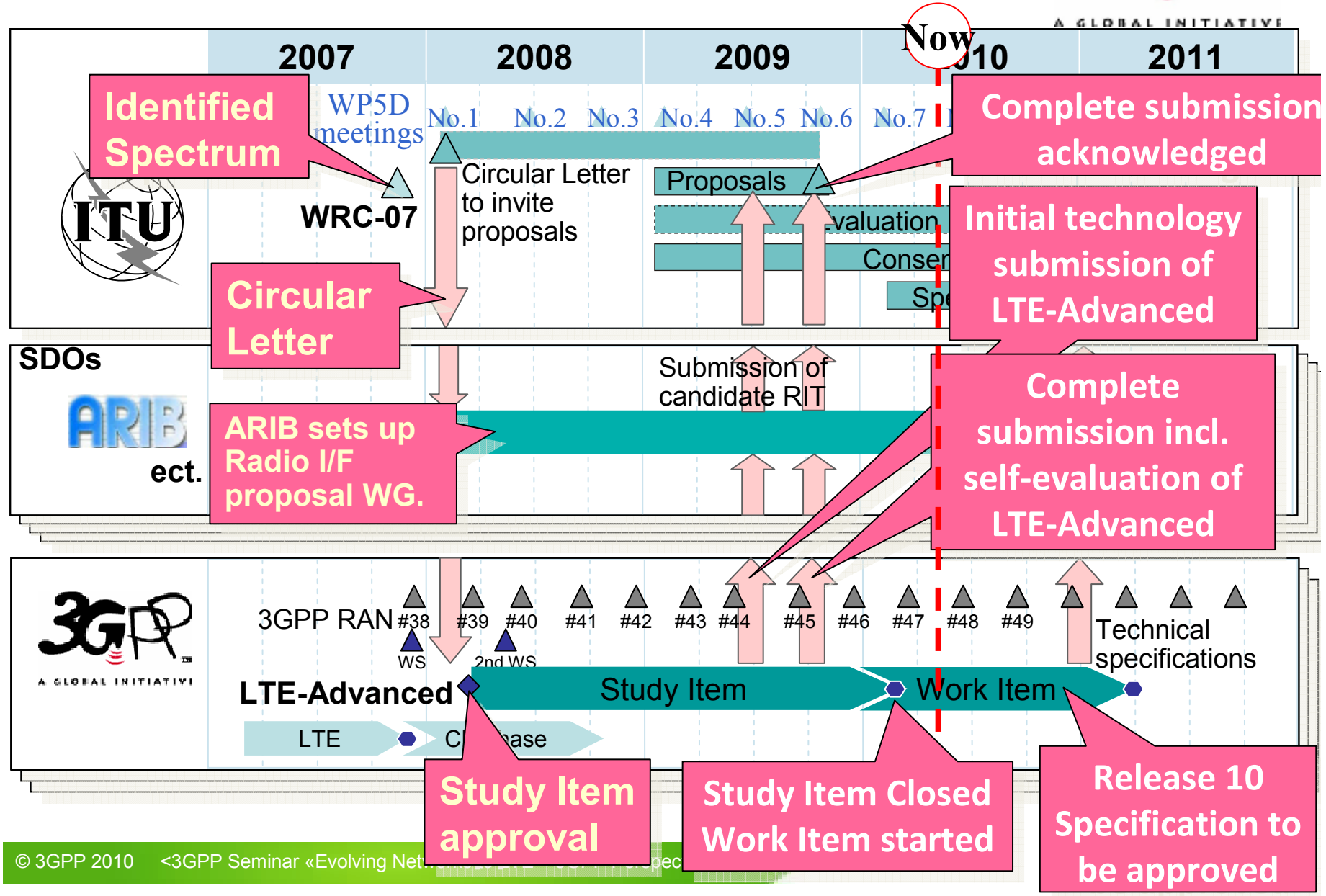
Overview of LTE-Advanced

- Motivation of LTE-Advanced
  - IMT-Advanced standardisation process in ITU-R
  - Additional IMT spectrum band identified in WRC07
  - Further evolution of LTE Release 8 and 9 to meet:
    - Requirements for IMT-Advanced of ITU-R
    - Future operator and end-user requirements

- ITU-R submission
  - As a candidate of IMT-Advanced, 3GPP provided a complete submission of LTE Release 10 & beyond (LTE-Advanced)
  - 3GPP LTE-Advanced proposal is SRIT which includes an FDD RIT component and a TDD RIT component
  - Japan and China provided complete submissions, which are technically identical to LTE Release 10 and beyond(LTE-Advanced). (China proposed TDD RIT component only)
  - The submission of LTE Release 10 & beyond (LTE-Advanced) was acknowledged by ITU-R WP5D as a “complete” submission

- 3GPP status
  - Feasibility study was conducted under study item, “Further advancements for E-UTRA(LTE-Advanced)” and completed in March 2010.
  - Requirements and targets for LTE-Advanced were agreed and possible technologies to meet the requirements and the targets were identified during study item phase
  - Self-evaluations were conducted and confirmed that LTE-Advanced meet the all requirements of ITU-R and 3GPP
  - Work items to develop LTE-Advanced specifications were approved in December 2009 and March 2010.
  - Specifications of LTE-Advanced will be approved in December 2010 and submit to ITU-R WP 5D in March 2011

Standardisation Schedule For IMT/LTE-Advanced



Technologies to be included in LTE-Advanced(1/2)

- LTE Release 8 can meet most of requirements of ITU-R.
- Additional two techniques shown below can improve LTE performance and make LTE Release 10 meet all requirements of ITU-R.

- Wider bandwidth
  - To improve peak data rate and spectrum flexibility
  - To meet ITU-R requirement for bandwidth
  - Spectrum/carrier aggregation based on component carrier(CC) concept to keep backward compatibility and allow smooth network migration
  - To be specified under the work item, “Carrier aggregation for LTE”

- Advanced MIMO techniques
  - To improve peak data rate and cell/cell-edge spectrum efficiency
  - To meet ITU-R requirement for DL cell spectrum efficiency
  - Up to 8-layers for DL and 4-layers for UL
  - To be specified under the work items, “Enhanced Downlink Multiple Antenna Transmission for LTE” and “UL multiple antenna transmission for LTE”

Technologies to be included in LTE-Advanced(2/2)

- Other technologies will be considered for LTE release 10 and beyond to improve LTE performance even though they are not so contributed to ITU-R requirements.

- Heterogeneous network
  - To improve cell-edge user throughput, coverage and deployment flexibility
  - Interference coordination for overlaid deployment of cells with different Tx power
  - To be specified under the work item, “Enhanced ICIC for non-CA based deployments of heterogeneous networks for LTE”
- Relaying
  - To improve coverage and cost effective deployment
  - Type 1 relay node terminating up to layer 3, which can be seen Release 8 eNodeB from Release 8 LTE terminal
  - To be specified under the work item, “ Relays for LTE”
- Coordinated multipoint transmission and reception (CoMP)
  - To improve cell-edge user throughput, coverage
  - To be studied under the study item, “Coordinated Multi-Point Operation for LTE”
- LTE Self Optimising Networks (SON) Enhancements
- HNB and HeNB mobility enhancements