








Strategies for IMT-Advanced: 3GPP Perspective

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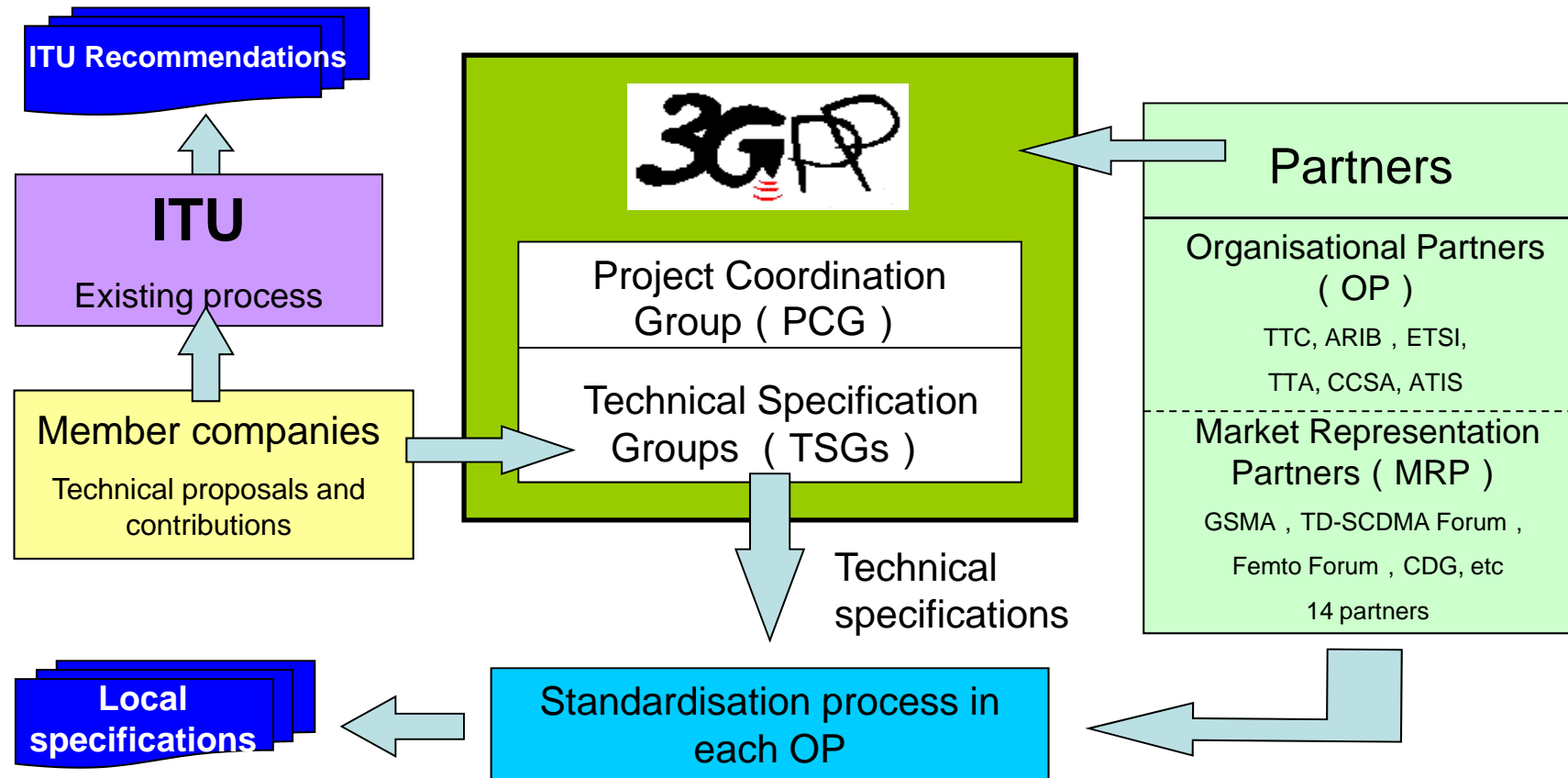
-  3GPP standardisation activities
-  LTE Release 8
-  LTE Release 9
-  LTE-Release 10 and beyond (LTE-Advanced)
-  ITU-R submission



3GPP Standardisation Activities

3GPP Standardisation Process

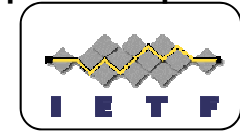
- 3GPP develops technical specifications on 3G **and beyond** mobile communication systems
- 3GPP Organisational Partners (OP) standardize local specifications based on the specifications developed by 3GPP
- The standardisation process in each OP is only a form of transposition and that no technical changes are introduced



Standardisation Organisations Communicating with 3GPP



Developing internet protocol specs



Developing Mobile application specs



MRP



Referring to specs

Cross reference of specs

Requirements

Terminal certification based on 3GPP specs

Terminal Certification



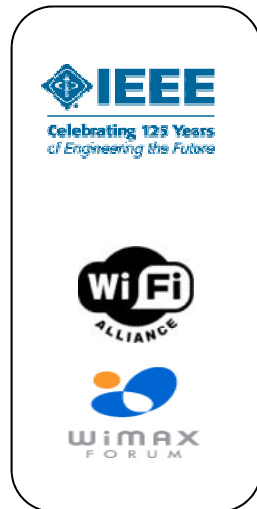
Cross reference of specs

Partners of 3GPP
Referring to 3GPP specs
for the local specs

Developing Recommendations



Developing Wireless LAN/MAN specs



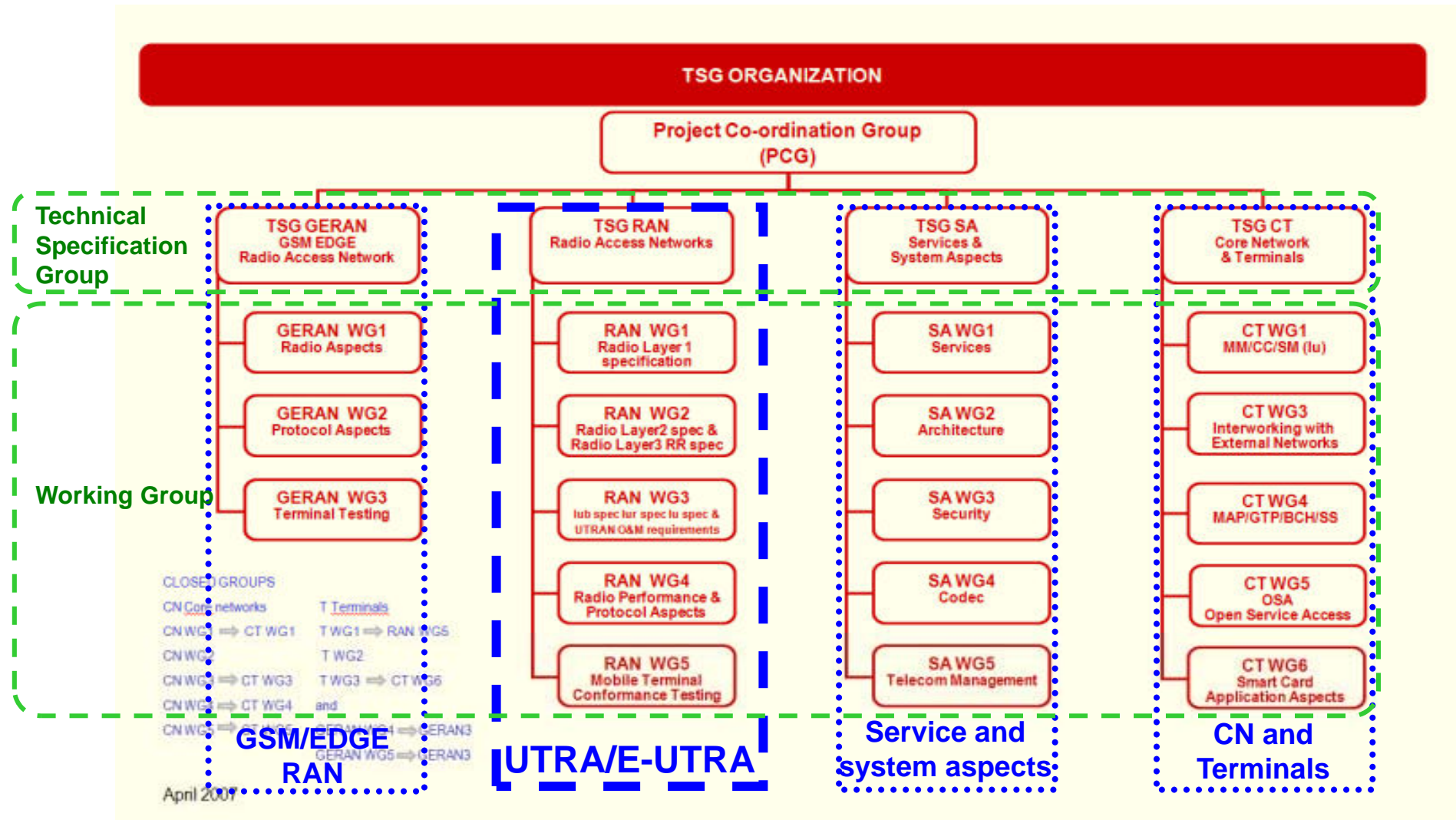
Input specs

Referring to 3GPP specs
(contributed by individual members)

Organisational Partners



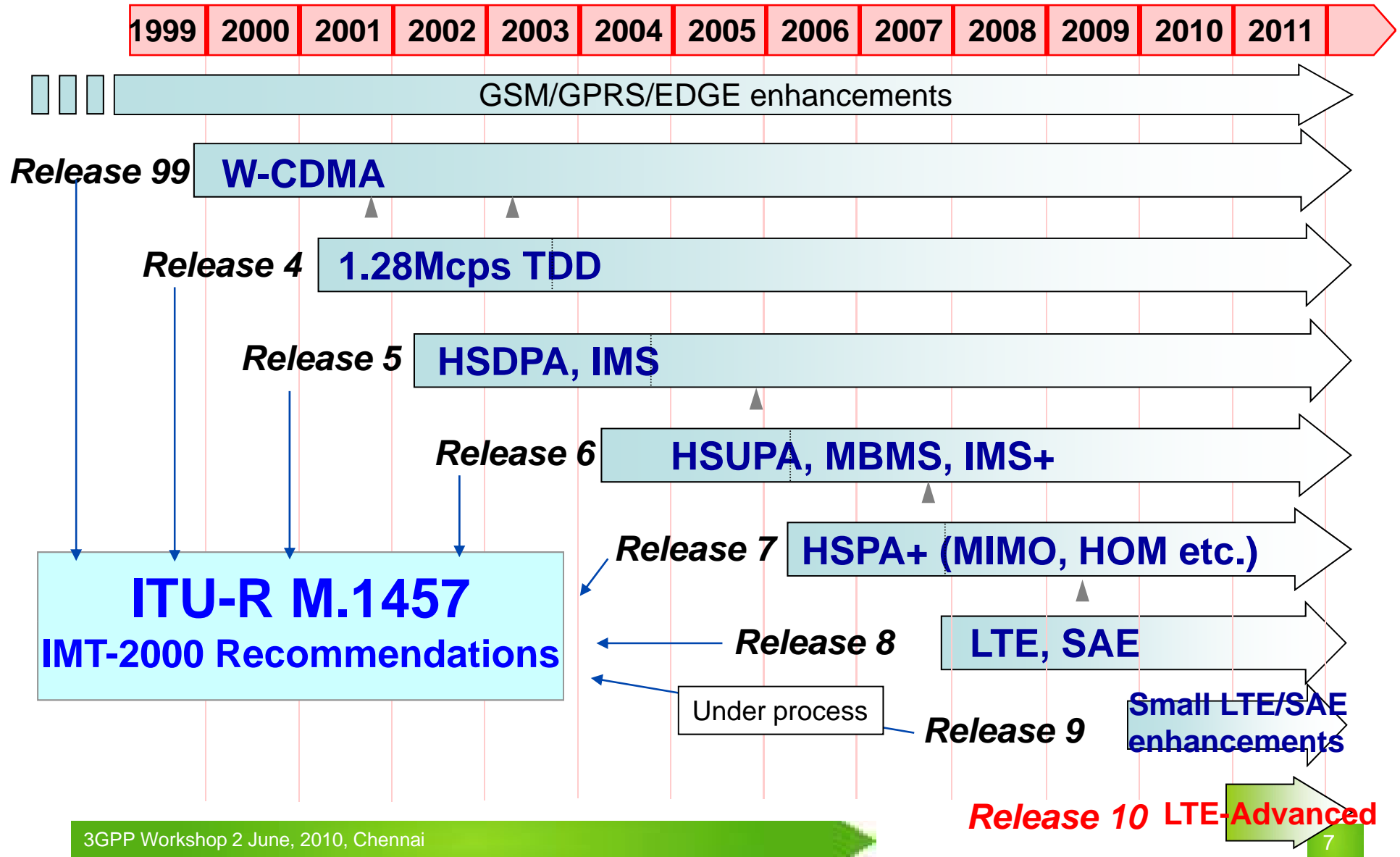
3GPP Structure



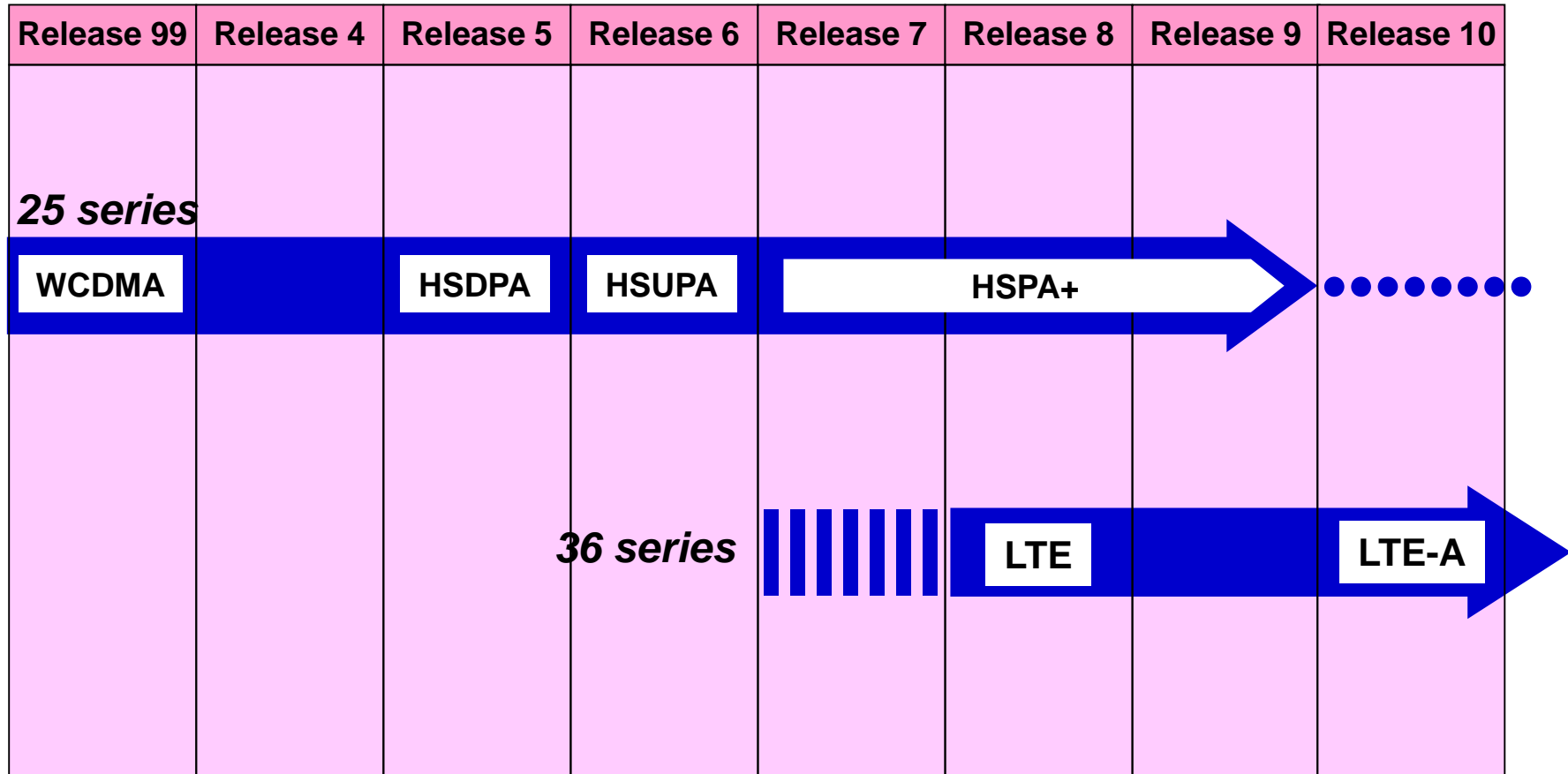


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Release of 3GPP specifications



Technology Evolution path in 3GPP Standards





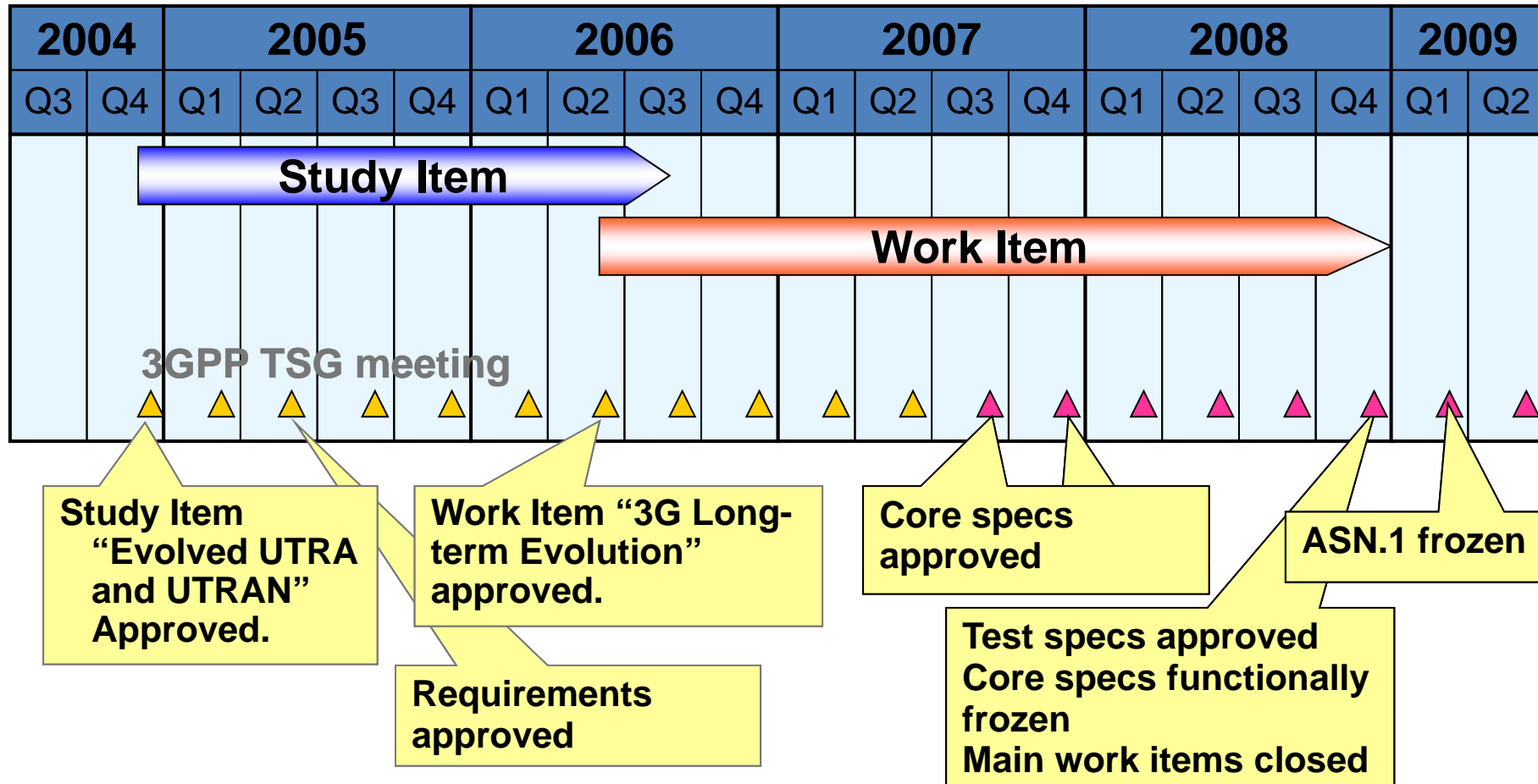
LTE Release 8



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



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 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)

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

Overview of LTE-Advanced (Cont'd)



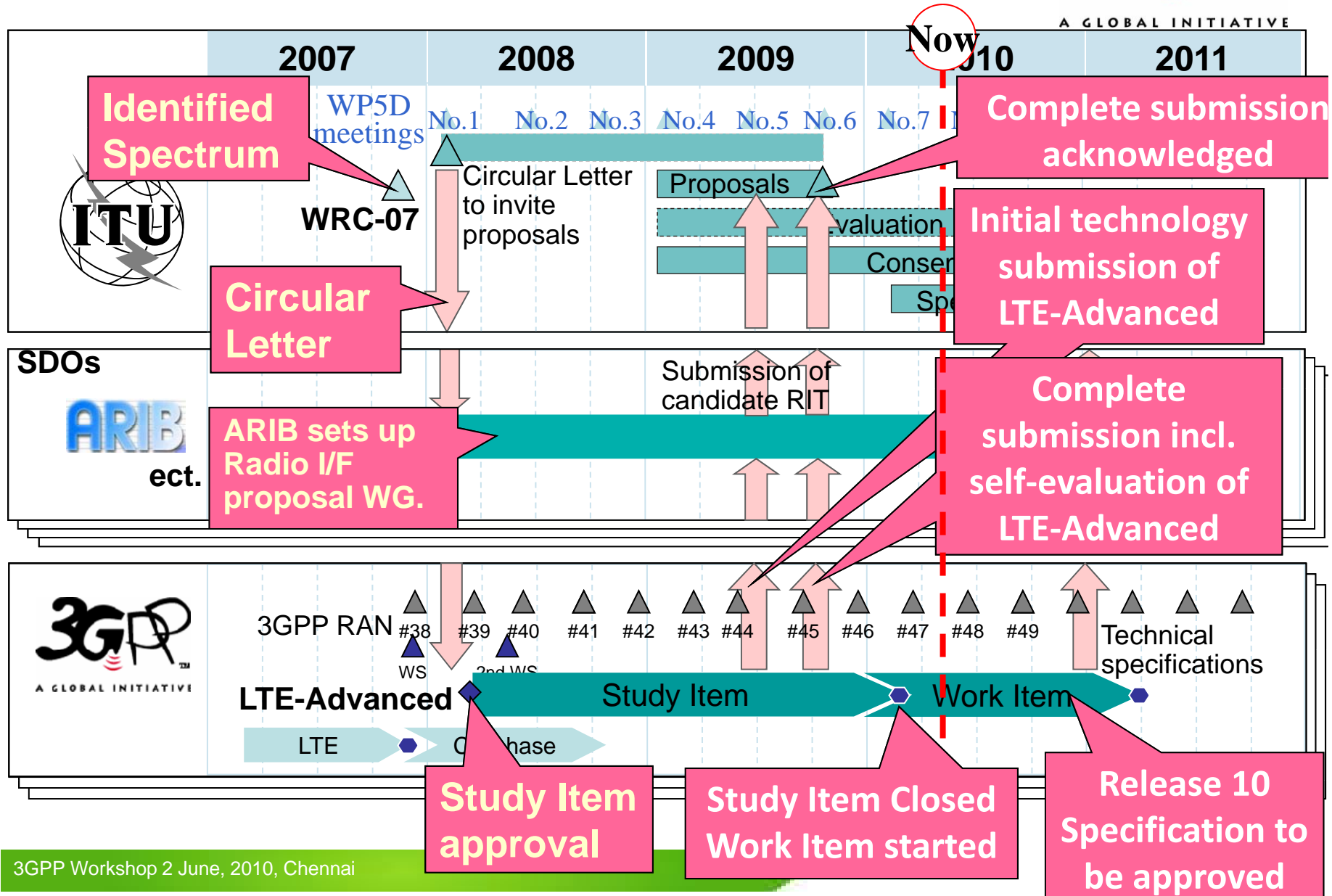
3GPP status

- 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



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Technologies to be included in LTE-Advanced



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(Cont'd)



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

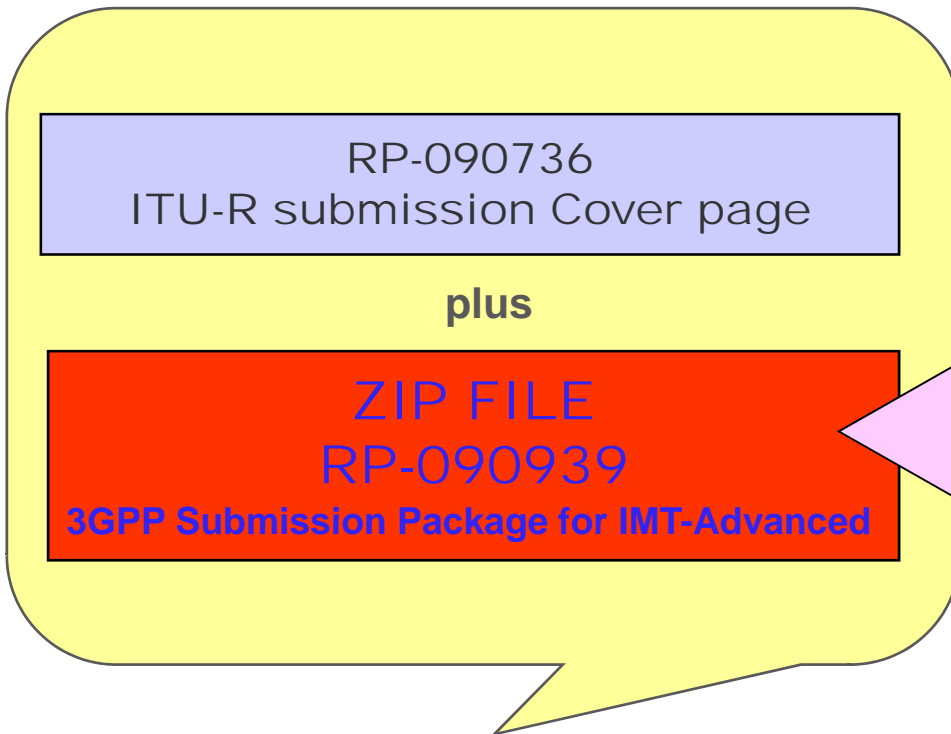
HNB and HeNB mobility enhancements

ITU-R Submission Documents



- 📶 The 3GPP submission to the ITU-R includes the following templates organized as an **FDD Radio Interface Technology component (FDD RIT)** and as a **TDD Radio Interface Technology component (TDD RIT)**. Together the FDD RIT and the TDD RIT comprise a Set of Radio Interface Technologies (SRIT).
- 📶 The 3GPP developed FDD RIT and TDD RIT templates include characteristics and link budget templates and compliance templates for services, spectrum, and technical performance.
- 📶 3GPP provides additional supporting information in document 3GPP TR 36.912 v9.0.0; Feasibility study for Further Advancements for EUTRA(LTE-Advanced) (Release 9).
- 📶 Templates are found in Annex C of Technical Report TR 36.912.

Structure of ITU-R Submission Documents from 3GPP



RP-090743
TR36.912 v9.0.0 Main Body
Additional supporting information on LTE-Advanced
Detailed self-evaluation results in section 16
Following documents are captured in Annex A and C

RP-090744
Annex A3: Self-evaluation results
Detailed simulation results provided from 18 companies

RP-090745
Annex C1: Characteristics template
Update version of ITU-R Document 5D/496-E
Relevant 3GPP specifications listed at the end of this document
Templates for FDD RIT and TDD RIT contained separately

RP-090746
Annex C2: Link budget template
Two Link budget template files for LOS and NLOS
Each file includes link budget templates for five radio environments specified in ITU-R M.2135
Templates for FDD RIT and TDD RIT contained separately

RP-090747
Annex C3: Compliance template
This template shows LTE-Advanced fulfills all requirements of IMT-Advanced in ITU-R
Templates for FDD RIT and TDD RIT contained separately

**Overall ITU-R Submission
ITU-R 5D/564-E
Contributed by individual members of 3GPP**

3GPP Self-evaluation for LTE-Advanced



- ❏ Self-evaluation for LTE-Advanced FDD RIT and TDD RIT was conducted in 3GPP
- ❏ The capabilities addressed here span the capabilities from LTE Rel. 8 and extend through Rel-10 and beyond. As such the capabilities represent a range of possible functionalities and solutions that might be adopted by 3GPP in the work on the further specifications of LTE.
- ❏ The ITU-R report, M.2133, M.2134, M.2135 and IMT-ADV/3 were utilized in the preparation of this self-evaluation report.

Summary of Self-Evaluation Results

 The self-evaluation results shows:


For LTE Release 10,

*FDD RIT Component meets the minimum requirements of all 4 required test environments.
TDD RIT Component meets the minimum requirements of all 4 required test environments.
The complete SRIT meets the minimum requirements of all 4 required test environments.*

Baseline configuration exceeding ITU-R requirements with minimum extension

- LTE release 8 fulfills the requirements in most cases (no extensions needed)
- Extensions to Multi-user MIMO from Release 8 fulfills the requirements in some scenarios (Urban Macro/Micro DL)

More advanced configurations, e.g. CoMP, with further enhanced performance

 Many (18) companies participated in the simulations
⇒ **High reliability**

 Self evaluation reports are captured in section 16 of Technical Report TR 36.912

*See appendix 1-3 in this slide set for detailed information on self-evaluation results

Conclusion



- 📶 Taking into account the IMT-Advanced standardisation process in ITU-R, the project for LTE-Advanced, was started in 3GPP from March 2008 built upon the LTE Release 8 foundation
- 📶 In response to the ITU-R Circular Letter 5/LCCE/2, 3GPP provided a complete submission of LTE Release 10 and beyond (LTE-Advanced) as a candidate technology for IMT-Advanced
- 📶 3GPP conducted a Self-Evaluation under ITU-R guidelines of LTE-Advanced with participation of many companies from across the world
- 📶 The evaluation results show that for LTE Release 10 and beyond (LTE-Advanced),
 - FDD RIT Component meets the minimum requirements of all 4 required test environments.
 - TDD RIT Component meets the minimum requirements of all 4 required test environments.
 - The complete SRIT meets the minimum requirements of all 4 required test environments.