Managing the HetNet

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Introduction

- 3GPP continues to expand the LTE platform to new services, while improving its efficiency to meet the increasing mobile broadband demand

- At the same time 3GPP has started to work on the standardization of next generation cellular technology, aka 5G, to address the expanded connectivity needs of the future

- This presentation discusses the main features being defined for the evolution of LTE, and the initial plans for 5G
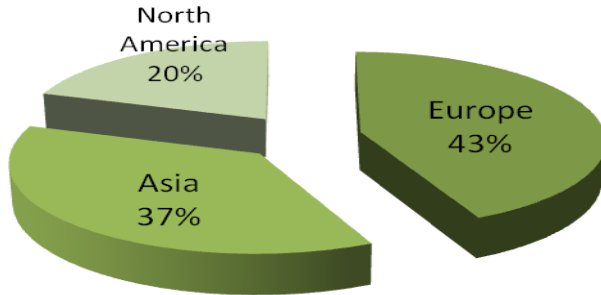
3GPP stats and facts
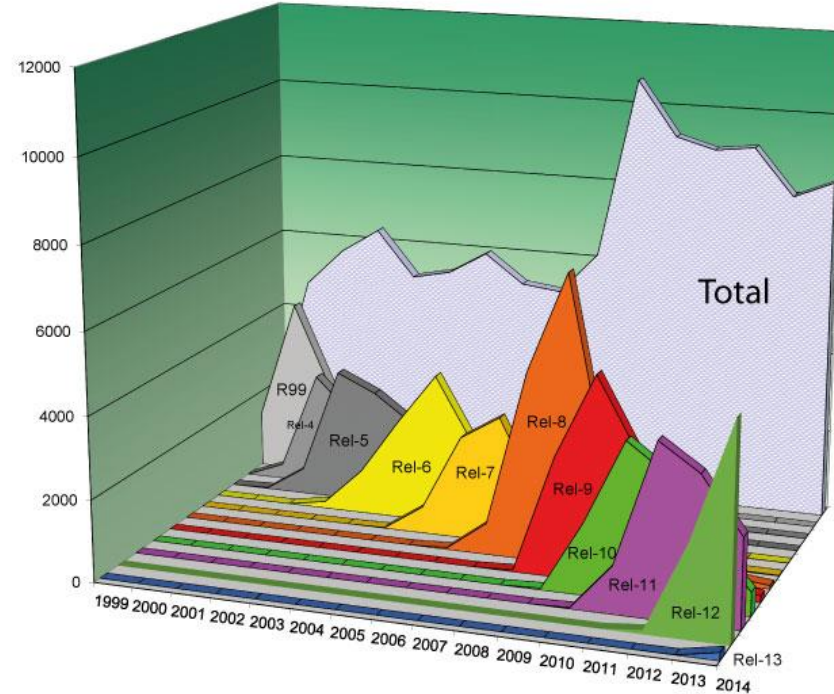
3GPP Facts and Figures

- ~400 Companies from 39 Countries
- 50.000 delegate days per year
- 40.000 documents per year
- 1.200 specs per Release
- New Release every ~18 months

Participation by Region

North America 20%
Asia 37%
Europe 43%

Approved CRs per Release per year

Partnership

Organizational Partners (SDOs)

- Regional standards organizations:

  - ARIB (Japan),
  - ATIS (USA),
  - CCSA (China),

  - ETSI (Europe),
  - TTA (Korea),
  - TTC (Japan),
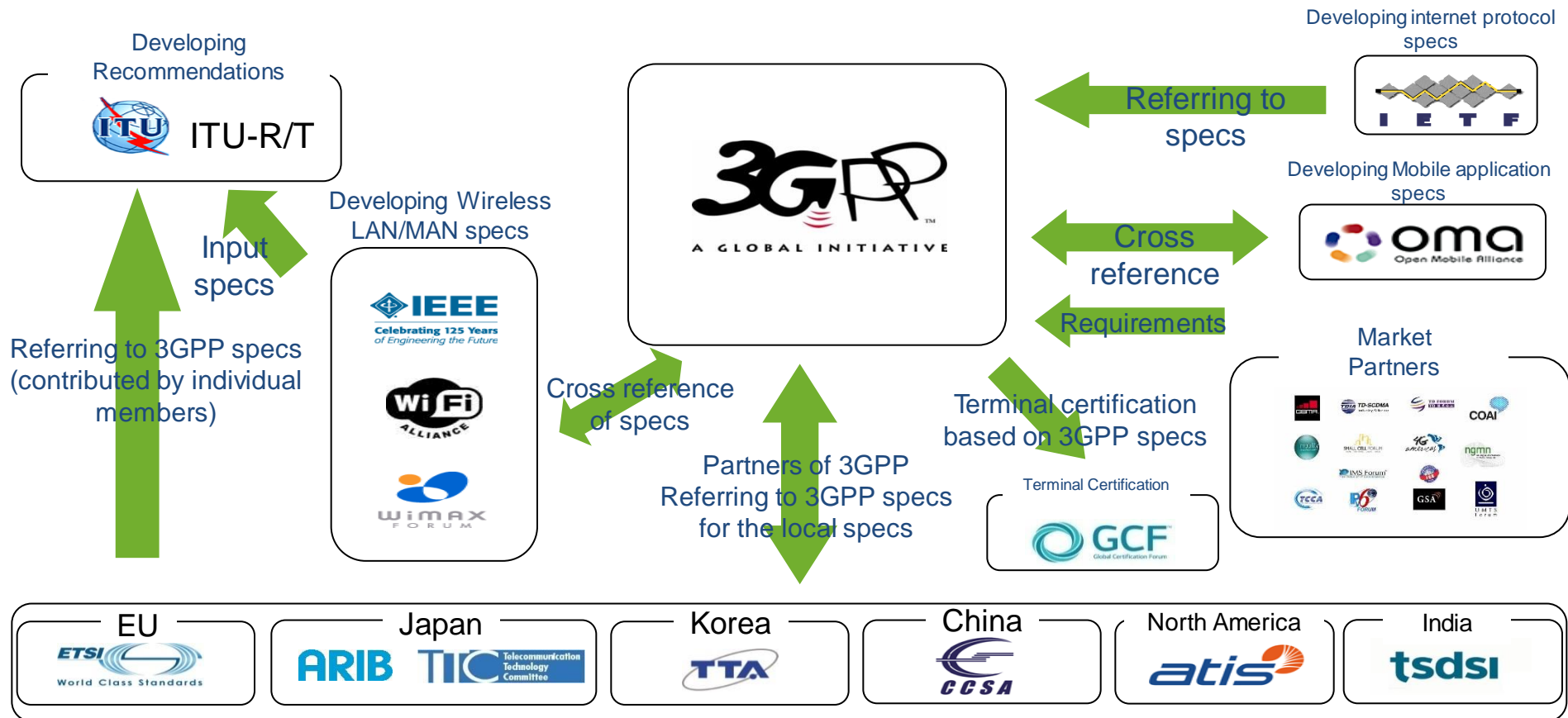 - TSDSI (India)

Market Representative Partners

- 14 Market partners representing the broader industry:

  - 5G Americas,
  - COAI (India),
  - CTIA,
  - GCF,
  - GSA,
  - GSMA,
  - IPV6 Forum,

  - MDG (formerly CDG),
  - NGMN Alliance,
  - Small Cell Forum,
  - TCCA,
  - TD Industry Alliance,
  - TD-Forum,
  - UMTS Forum

The 3GPP Eco-system

Developing Recommendations

ITU-R/T

Developing internet protocol specs

IETF

Referring to specs

Developing Wireless LAN/MAN specs

IEEE Celebrating 125 Years of Engineering the Future

WiFi ALLIANCE

WiMAX FORUM

3GPP A GLOBAL INITIATIVE

Developing Mobile application specs

oma Open Mobile Alliance

Cross reference

Requirements

Input specs

Referring to 3GPP specs (contributed by individual members)

Cross reference of specs

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

Terminal certification based on 3GPP specs

Terminal Certification

GCF Global Certification Forum

Market Partners

GSMA, TD-SCDMA Industry Alliance, TD Forum, COAI, mobile, SMALL CELL FORUM, 4G americas, ngmn, IMS Forum, TCCA, P3 FORUM, GSA, UMTS Forum

| EU	Japan	Korea	China	North America	India
ETSI World Class Standards	**ARIB** **TTC** Telecommunication Technology Committee	**TTA**	**CCSA**	**atis**	**tsdsi**

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LTE evolution

Focus on areas significantly expanding LTE platform capability and opportunities

Key Features in Release 10

Wider bandwidth (carrier aggregation)
- To improve peak data rate and spectrum flexibility
- To meet ITU-R requirements for bandwidth (>=40 MHz)
- Spectrum/carrier aggregation based on component carrier (CC) concept to maintain backward compatibility and allow smooth network migration
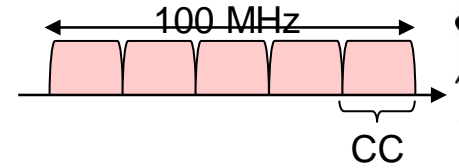
Advanced MIMO techniques
- To improve peak data rate and cell/cell-edge spectrum efficiency
- To meet ITU-R requirements for DL cell spectrum efficiency
- SU-MIMO with up to 8-layers for DL and 4-layers for UL
- MU-MIMO with enhanced CSI feedback
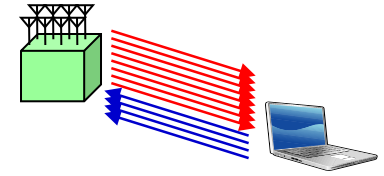
Enhanced inter-cell interference coordination (eICIC)
- To improve cell-edge user throughput, coverage, and deployment flexibility
- Interference coordination for layered cell deployment with different Tx power levels
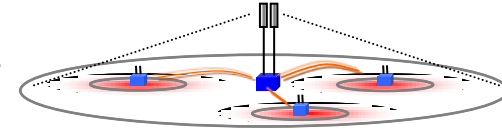
Relaying
- To improve coverage and cost effective deployment
- Type 1 relay node terminating up to layer 3, which can be seen as Release 8 eNodeB from Release 8 LTE terminal
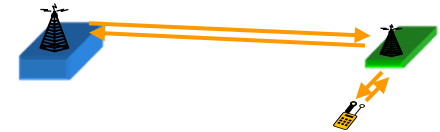
LTE Self Optimizing Network (SON) enhancements

HNB and HeNB mobility enhancements

Key Features in Release 11 Physical-layer aspects

- **Carrier aggregation (CA) enhancements**
  - Different TDD UL/DL configuration on different band
  - Multiple timing advance (TA) for UL CA

- **Enhanced downlink control channel (EPDCCH)**
  - Enhanced DL control channel to support increased control channel capacity, freq. domain ICIC, beamforming and/or diversity

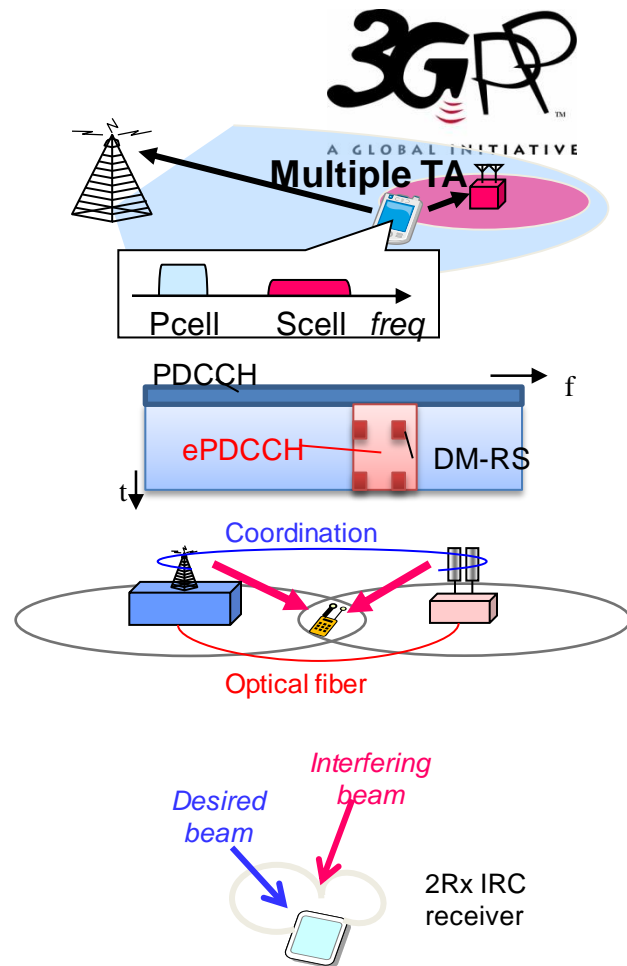- **CoMP transmission and reception**
  - CoMP for Homogeneous/Heterogeneous NW
    - Enhancement on DL/UL reference signal, control signal
    - Channel state information feedback and measurement

- **Further enhanced inter-cell interference coordination (FeICIC)**
  - Interference cancelation technique for UE (e.g., CRS canceller from Macro-cell)

- **Improved minimum performance requirements for E-UTRA: Interference rejection**
  - Interference rejection combining (IRC) UE receiver

Multiple TA

Pcell Scell *freq*

PDCCH

ePDCCH DM-RS

Coordination

Optical fiber

Interfering beam

Desired beam

2Rx IRC receiver

Key Features in Release 11
Higher-layer aspects

- **Enhancement of Minimization of Drive Tests (MDT)**
  - Intention is to provide mechanisms to collect radio measurements together with location information from eNB/UE to reduce operator costs for performing manual drive tests
  - QoS measurements (e.g. throughput, traffic volume) added in Rel-11 specs
- **RAN overload control for Machine-Type Communications (MTC)**
  - Intention is to protect the NW from potentially very large number of MTC terminals
  - CN/RAN overload avoidance specific to MTC terminals added in Rel-11 specs
- **Further self optimizing networks (SON) enhancements**
 - Procedures for inter-RAT MRO added in Rel-11 specs
- **Network Energy Saving**
  - Procedures for inter-RAT energy saving added in Rel-11 specs
- **LTE RAN Enhancements for Diverse Data Applications**
  - Intention is to specify RAN improvements considering various data traffic, e.g. those generated by smartphones
  - Signaling for optimization of terminal battery consumption specified in Rel-11

Key Features in Release 12
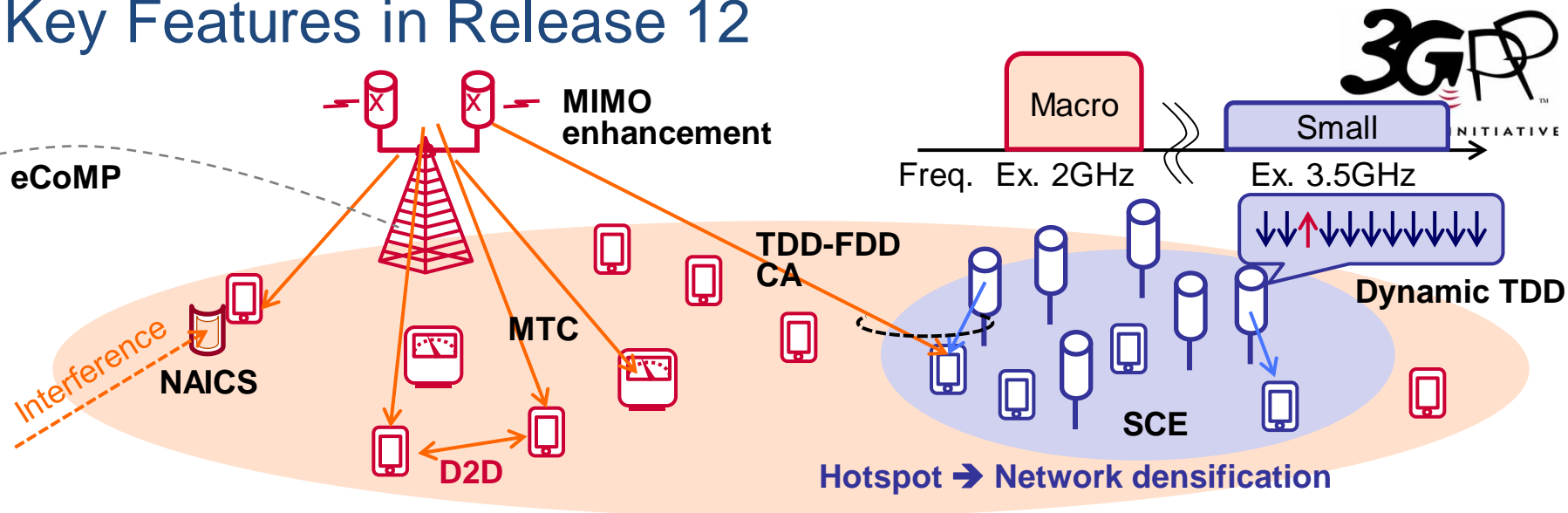
Service oriented enhancements
- **D2D (Device to Device) communication/discovery**
- MTC (Machine Type Communication)

Enhancements for higher spectrum efficiency
- NAICS (Network Assisted Interference Cancellation and Suppression)
- MIMO enhancement
- eCoMP

Small cell
- High capacity
- High traffic fluctuation
- Low Tx power node
- (TDD with higher frequency band)

Small cell related enhancements
- TDD-FDD CA (Carrier aggregation)
- SCE (Small cell enhancement)
- Dynamic TDD

Release 13/14 Licensed Assisted Access (LAA)

- **Modified LTE radio to operate in unlicensed spectrum (5GHz)**
  - Includes features such as Listen-Before-Talk (LBT), Discontinuous TX, Dynamic Frequency Selection, Carrier selection, Transmit Power Control…
  - Key objective: fair coexistence between LTE and Wi-Fi as well as between LTE operators

- **License-Assisted Access operation, aggregating**
  - A primary cell operating in licensed spectrum to deliver critical information and guaranteed Quality of Service
  - A secondary cell operating in unlicensed spectrum to opportunistically boost datarates

- **In Release 13 3GPP defined downlink LAA operation**
  - Feature design is essentially frozen, where only essential corrections are allowed (based on consensus)
  - 3GPP is now defining a set of tests to check LAA coexistence performance

- **LAA Uplink support to follow in Release 14**

- **Extensive and fruitful dialog with other industry stakeholders, including IEEE and WFA**

Release 13/14 Cellular IoT

- In Release-13 3GPP made a major effort to address the IoT market by defining:

    1. **eMTC**   Further LTE enhancements for Machine Type Communications

    2. **NB-IOT**   New radio added to the LTE platform optimized for the low end of the market

    3. **EC-GSM-IoT**   EGPRS enhancements which make GSM/EDGE markets prepared for IoT

- In Release-14 3GPP is enhancing the above technologies
    - Positioning enhancements [*eMTC, NB-IOT, EC-GSM-IOT*]
    - Multicast, mobility enhancements for [*eMTC, NB-IOT*]
    - New power classes, access/paging enhancements [*NB-IOT*]
    - Higher data rates and VoLTE support for [*eMTC*]

Release 14 LTE-based V2X

- In Release 14 3GPP is expanding the LTE platform to support V2X applications

- V2X will include two complementary transmission modes
  - Direct communication:
    - Building upon LTE D2D with enhancements for high speeds, high density, improved synchronization and low latency
  - Network communication:
    - Enabling broadcast of messages from a V2X server to vehicles and beyond; Vehicles can send messages to server via unicast

- The initial features needed to support V2V safety applications are being finalized in September 2016

- The broader V2X framework will be finalized in March 2017

Pedestrian

Vehicle

Network

V2P

V2V

V2I

Vehicle

5G

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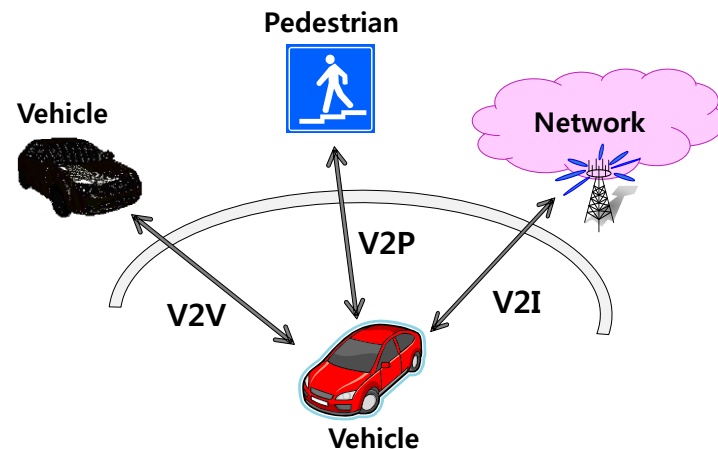
3GPP submission to IMT-2020

- 3GPP submission to IMT 2020 (aka 5G) will include
  - "New Radio of 5G", aka NR
  - LTE

- It is for later discussion whether this will be done in a single or two RITs (formal submissions) and how the evaluation process will be organized
  - This will also depend on the criteria defined by WP5D for IMT-2020 technologies

- NR shall eventually address all identified requirements and use cases

Timeline & phasing

- There will be **two phases** for the normative work
  - The first release of the 5G specification will be completed by Sep. 2018/Release-15, addressing the more urgent subset of the commercial needs
  - The second release of the 5G specification to be completed by Mar. 2020/Release-16, for the IMT 2020 submission and to address all identified use cases & requirements

- With the following, tentative, release timing

Jun-17   **Sep-18**   **Mar-20**

| Rel-14 | Rel-15 | Rel-16 |

Note: dates above refer to official 3GPP release freeze (ANS.1 freeze)

- Key requirement: NR design should be **forward compatible** at its core so that features can be added in later releases in an optimal way

Release-15 workplan

2. TSG-SA#74, Dec/2016:
NexGen TR completion
Approval of SA2 WID

7. TSG#80, June 2018: Release 15 stage 3 freeze for NR and NexGen, including Standalone.

6. RAN#78/RAN#79: Stage-3 freeze for Non-Standalone higher layers (including components common with standalone). Completion target TBD.

1. TSG-RAN#73, September 2016:
5G NR Requirements TR completion

4. TSG-SA#77 or TSG-SA#78:
NexGen stage-2 freeze.

2016	2017	2018

3. CHECKPOINT: TSG#75: March 2017:
- Completion of NR SI with corresponding performance evaluation and concepts;
- Approval of RAN WID(s);
- Report from RAN1/RAN2/RAN3/RAN4/SA2 on fwd compatibility of NSA and SA NR;
- Report from SA2 on migration;
- SA and CT timeline coordination;
- Reconfirmation of NR & NexGen timeplan, including completion target for NSA higher layer components (box 6)

5. TSG-RAN#78, December 2017:
- Stage 3 freeze of L1/L2 for common aspects of NSA (focused on licensed bands) and SA NR;
- Principles agreed for SA-specific L1/L2 components.

Note: SA: Standalone
NSA: Non-Standalone

Release-15 targets

- Two main deployment scenarios:
  - Non-Standalone (NSA) NR deployment
  - Standalone (SA) NR deployment

  NSA NR in this context implies using LTE as control plane anchor. SA NR implies full control plane capability for NR

- Different architecture options being evaluated ([RP-161266](#))
  - Decisions as to which option will be standardized will be taken in Dec. 2016 or Mar. 2017

- Use cases
  - Enhanced Mobile Broadband
  - Some Low Latency and High Reliability capabilities

- Frequency ranges below 6GHz and above 6GHz

- **Forward compatibility** between scenarios

5G studies in TSG RAN (Radio)

- Scenarios and Requirements for Next Generation Access Technologies
  - Target completion on Sep. 2016
  - Latest progress in TR 38. 913 (*draft*)

- Channel model for frequency spectrum above 6 GHz
  - *Completed on Jun. 2016*
  - New channel model described in TR 38.900

- New Radio Access Technology
  - Target completion on Jun. 2017
  - Working Groups have started evaluating technology solutions for NR

5G studies in TSG SA (System Aspects)

- SMARTER (New Services and Markets Technology Enabler)
  - Study concluded on Jun. 2016
  - Service requirements defined in:
    - TR 22.861 for the Massive Internet of Things use case
    - TR 22.862 for the Critical Communications use case
    - TR 22.863 for the Enhanced Mobile Broadband use case
    - TR 22.864 for the Network Operation uses case
  - Normative work targeting completion in Mar. 2017

- Architecture and Security for Next Generation System
  - Target completion on Sep. 2016
  - Latest progress in TR 23.799 (*draft*)

Thanks