



# LTE evolution and 5G

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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

# *LTE evolution*

*Focus on areas significantly expanding LTE platform capability and opportunities*

# Offload to unlicensed spectrum



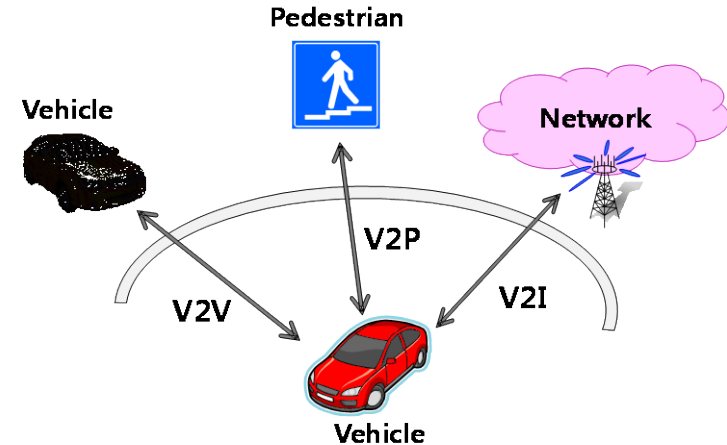
- 📶 Licensed spectrum remains 3GPP operators' top priority to deliver advanced services and user experience
- 📶 Opportunistic use of unlicensed spectrum will be an important complement to meet the growing traffic demand
- 📶 Moving forward 3GPP operators will have two options to offload traffic to unlicensed spectrum:
  1. Wi-Fi (via **LTE/Wi-Fi interworking**)
  2. **Licensed Assisted Access** to unlicensed spectrum, aka **LAA**

# 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*]

# 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 were finalized in September 2016
- The broader V2X framework will be finalized in March 2017



# Low latency LTE

- 📶 3GPP is working on a major enhancement to the LTE air interface to shorten latency over-the-air
- 📶 The goal is to improve performance and user experience of existing services as well as to enable new delay critical services
- 📶 Target enhancements include
  - Shortened processing time
  - Shortened TTI operation (2-symbol, 4-symbol, and 1-slot)

# Others: a lot more going on...

## Work Items

- [RP-160680](#), Downlink Multiuser Superposition Transmission for LTE
- [RP-160623](#), Enhancements on FD-MIMO for LTE
- [RP-160675](#), eMBMS enhancements in LTE
- [RP-160664](#), Uplink Capacity Enhancements for LTE
- [RP-160676](#), SRS Carrier Based Switching for LTE
- [RP-160667](#), L2 latency reduction techniques for LTE
- [RP-160540](#), Signalling reduction to enable light connection for LTE
- [RP-160636](#), Mobility enhancement in LTE
- [RP-160538](#), Further Indoor Positioning enhancements for UTRA and LTE WI
- [RP-161856](#), Voice and Video enhancement for LTE
- [RP-161896](#), Flexible eNB-ID and Cell-ID in E-UTRAN

## Study Items

- [RP-160665](#), Further enhancements to CoMP operation
- [RP-160633](#), Study on Context Aware Service Delivery in RAN
- [RP-160571](#), Study on HSPA and LTE Joint Operation
- [RP-161181](#), SON for eCoMP for LTE



5G

# 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

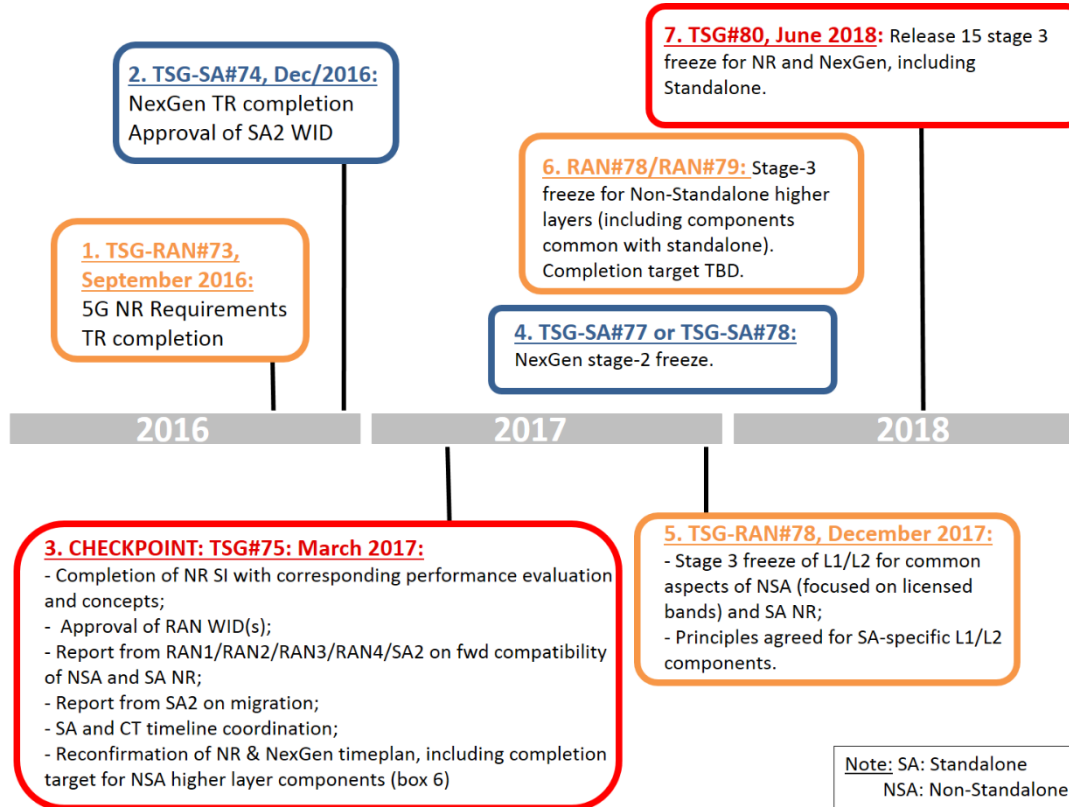
- With the following, tentative, release timing



*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



# 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
- 📶 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

- *Completed on Dec. 2016*
- Latest progress in [TR 38.913](#)

## Channel model for frequency spectrum above 6 GHz

- *Completed on Jun. 2016*
- New channel model described in [TR 38.900](#)

## Study on New Radio Access Technology

- Target completion in Mar. 2017
- Working Groups 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. 2017
- Latest progress in [TR 23.799](#) (*draft*)

Thanks