



# LTE Release 13 and road to 5G

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# Introduction



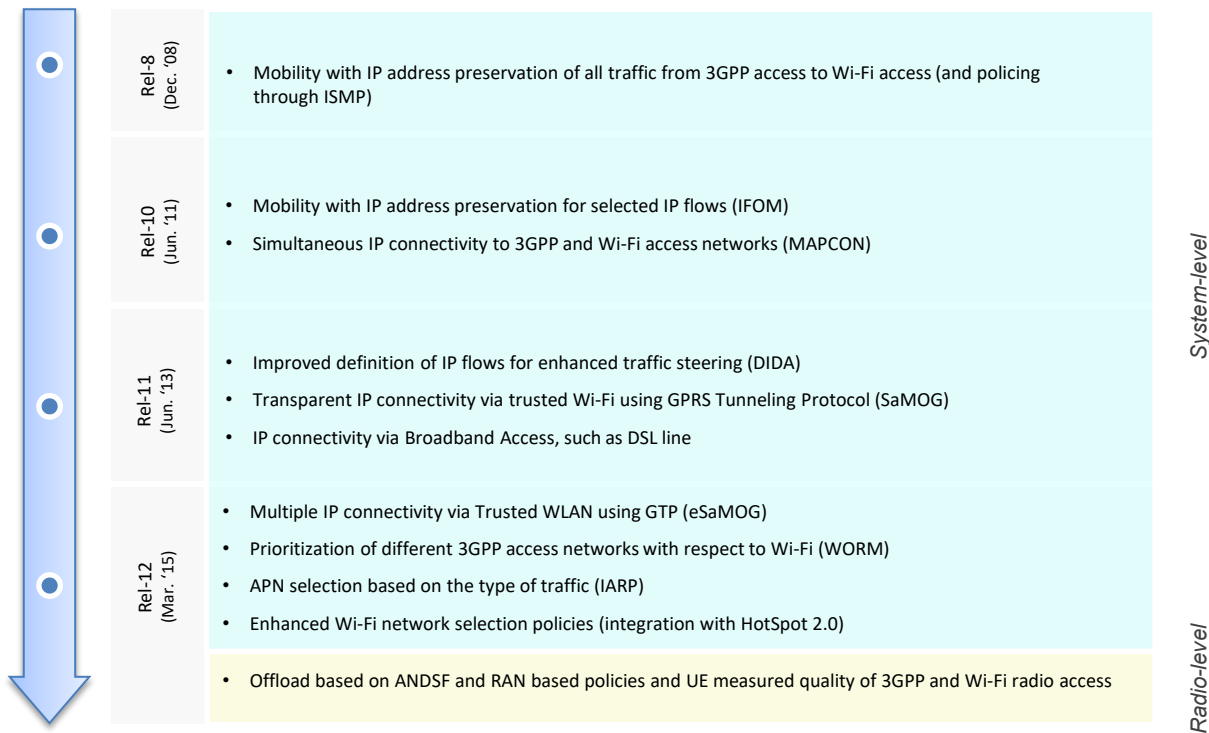
- 📶 3GPP is continuing to expand the LTE platform to new services, while improving its efficiency to meet the mobile broadband demand
- 📶 At the same time 3GPP started to make plans for the standardization of next generation cellular technology, aka 5G, with the goal to address the expanded connectivity needs of the future
- 📶 This presentation discusses the main features being considered for the evolution of LTE in Rel-13 and 3GPP initial plans for 5G

## *LTE Rel-13: addressing the mobile broadband demand*

# Offload to unlicensed spectrum

- 📶 Licensed spectrum remains 3GPP operators' top priority to deliver advanced services and user experience
- 📶 Opportunistic use of unlicensed spectrum is becoming an important complement for operators 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. LTE over unlicensed
- 📶 It will then be up to each individual operator to choose which approach to use, which will depend on a number of factors

# Brief history of LTE/Wi-Fi interworking




# LTE/Wi-Fi interworking

- Framework being developed since the first release of LTE
  - With tighter and tighter forms of interworking added in subsequent releases (see previous slide)
- Tighter interworking being specified in Rel-13, including:
  - Aggregation of LTE and Wi-Fi radio links
  - Enhanced network controlled mobility, via enhanced UE measurement reporting and network steering capabilities

# LTE over unlicensed, aka LAA (1)

- 📶 Project studying modifications of the LTE waveform to operate in unlicensed spectrum
- 📶 Focus on the following priorities:
  - 5 GHz unlicensed band
  - Global solution that can work across regions with different regulatory regimes
  - Licensed-Assisted Access (LAA) operation
    - Aggregation of a primary cell, operating in licensed spectrum to deliver critical information and guaranteed Quality of Service, with a secondary cell, operating in unlicensed spectrum to opportunistically boost data rate
    - The secondary cell operating in unlicensed spectrum can be configured either as downlink-only cell or contain both uplink and downlink
  - Fair coexistence between LTE and Wi-Fi as well as between LTE operators
    - Qualitative definition of fairness with Wi-Fi: [...] LAA should not impact Wi-Fi services (data, video and voice services) more than an additional Wi-Fi network on the same carrier; these metrics could include throughput, latency, jitter etc. [...]

# LAA functionalities

 The following functionalities are being studied in order to achieve coexistence with other systems as well as between LTE operators:

1. *Listen-Before-Talk* (LBT)
2. Discontinuous transmission on a carrier with limited maximum transmission duration
3. *Dynamic Frequency Selection* (DFS) for radar avoidance in certain bands/regions
4. Carrier selection
5. *Transmit Power Control* (TPC)



# Others

- Enhancements to the LTE Carrier Aggregation (CA) signaling framework
  - Allowing up to 32 Component Carriers (CCs), providing a major leap in the achievable data rates of LTE as well as in its flexibility to aggregate large numbers of carriers in different bands
  - The enhanced framework will also be useful for LAA operation in unlicensed spectrum where large blocks of spectrum are available
  
- Elevation Beamforming / Full-Dimension MIMO
  - Project studying how two-dimensional antenna arrays can further improve the LTE spectral efficiency by also exploiting the vertical dimension for beamforming and MIMO operations
    - So far 3GPP evaluations of these features mostly considered antenna arrays that exploit the azimuth dimension
  - Study will look into high-order MIMO systems with up to 64 antenna ports at the eNB
    - To become more relevant with the use of higher frequencies in the future
  
- Downlink multi-user transmission using superposition coding
  - Project studying downlink multi-user transmissions using superposition coding, to further increase LTE spectral efficiency
  - Note: normative work (if any) for this item is targeted for Rel-14

## *LTE Rel-13: enablers of new services and connectivity paradigms*




# Addressing the Internet of Things

- 📶 Further LTE enhancements for Machine Type Communications
  - Building on the work that started in Rel-12
    - New UE Category (Cat 0), New power saving state for MO-data
  - 1.4MHz narrowband operation,
  - Multiplexing with broadband operation in wider channel bandwidths
  - Enhanced coverage (15dB better link budget over existing LTE)
  - Simplified PHY/MAC
  - Further power optimization (focusing on MT-data)
  
- 📶 Evaluation of a brand new radio optimized for the low end of the IoT market
  - Focus on very low data rates (~100s bps) applications with limited mobility support
  - 200 KHz narrowband operation, allowing smooth reframing of GERAN channels
  - Long range (20dB better link budget over existing GPRS)
  - Very low cost & power consumption

# D2D enhancements

- Enhancements to the D2D framework (ProSe) standardized in Rel-12 to support more advanced proximity services for Public Safety (PS) and consumer usecases
  - Discovery
    - Restricted Discovery (social-type model)
    - Multicarrier operation, concurrent inter-band D2D and CA combinations
  - Group Communication (PS only)
    - UE-to-Network relays
- Work to address the additional requirements being identified as necessary by the 3GPP System groups for Mission Critical Push-To-Talk (MCPTT)
  - MCPTT: ongoing project to complete support of PS services in the 3GPP platform (based on the requirements coming from various administrations and industry stakeholders)
- Evaluation to expand the D2D framework to Vehicle-to-Vehicle (V2V) applications

# Others

-  Indoor positioning
  - Study to first determine the performance of already specified positioning methods in indoor environments, and later evaluate improvements to the existing methods or new positioning methods to achieve improved indoor positioning accuracy
  - Initially driven by the [FCC request](#) to improve the positioning accuracy in indoor environments for emergency calls, the work can further expand the capability of the LTE platform allowing operators to address the growing market of indoor positioning
-  Single Cell – Point To Multipoint (SC-PTM)
  - Study to determine any potential benefits and solutions of SC-PTM operation based on the LTE downlink shared channel
  - eMBMS was developed to efficiently deliver multicast services over areas typically spanning multiple cells. But there could be a number of applications that may benefit from efficient multicast service support over a single cell
-  Low latency LTE
  - Study of techniques that can significantly reduce the latency of the LTE air interface, including solutions for fast uplink access, shortening of the Time-Transmission Interval (TTI) and reduced processing time
  - The goal is to improve performance and user experience of existing services as well as to enable new delay critical services
  - Note: normative work (if any) for this item is targeted for Rel-14

## *Getting ready to “5G”*

# Introduction



- 3GPP started to make plans for the standardization of next generation cellular technology, aka 5G
- The objective is address the expanded connectivity needs of next decade
- A tentative timeline for 5G was recently endorsed by 3GPP, including plans for a technology submission to the IMT 2020 process in ITU-R
- This presentation provides an outline of 3GPP plan for 5G

# IMT 2020 submission deadlines

## Initial technology submission

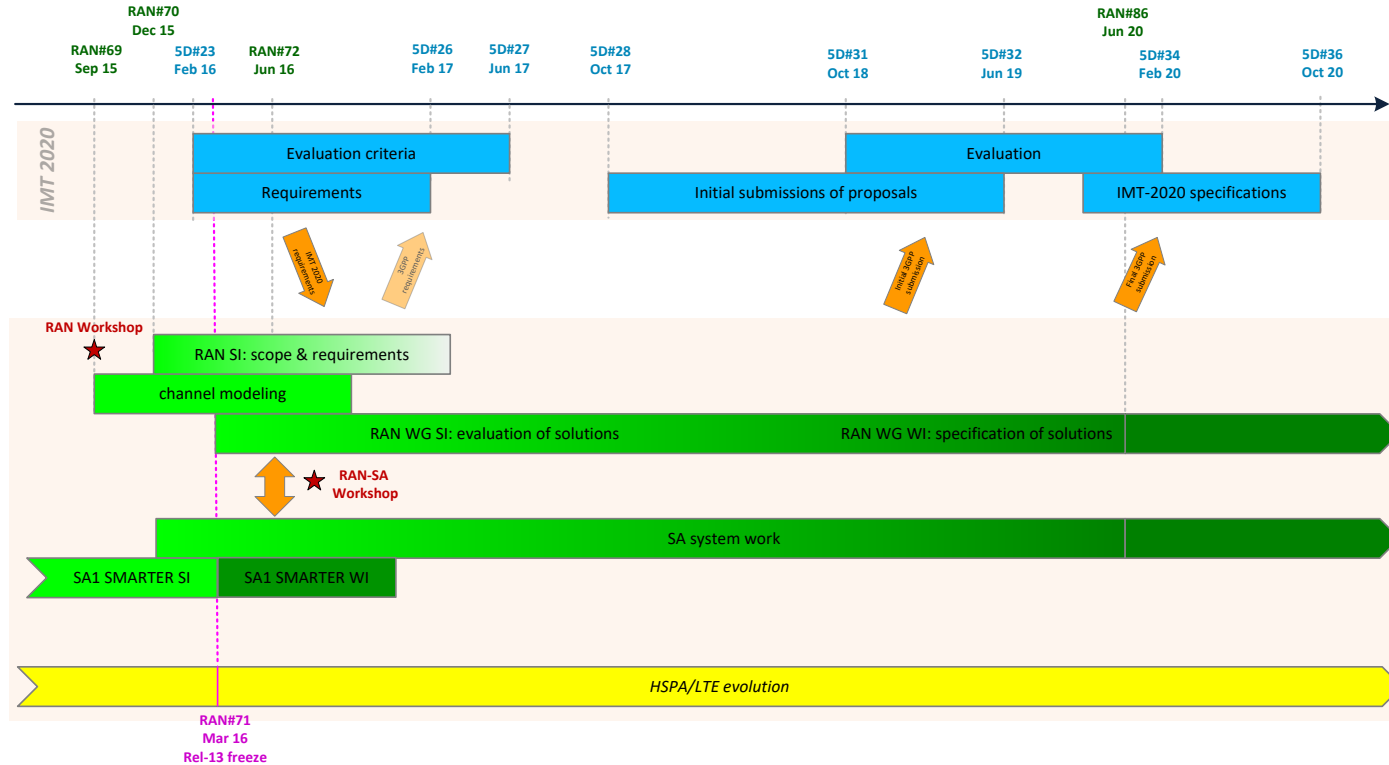
- Deadline: Jun. 2019 (5D #32)
- Expected input: high-level description of the technology
  - Sufficient description of the technology to allow third parties to evaluate the technology against IMT 2020 requirements

## Detailed specification submission

- Deadline: Oct. 2020 (5D #36)
- Expected input: actual stage-3 specifications
- 3GPP will do the final submission at the 5D meeting in Feb 2020, based on specifications functionally frozen by Dec 2019
  - To allow enough time for transposition and checking of the specifications from 3GPP Organization Partners until Oct. 2020



# 5G timeline in 3GPP



# Next generation radio technology



- 📶 One key aspect of the 5G discussion will be the definition of next generation radio technology
- 📶 This is what RAN will start to discuss at the workshop taking place on September 17-18 in Phoenix (Arizona), US
- 📶 RAN will then start in December a new study to define the exact scope and requirements of next generation radio technology
- 📶 These requirements will then guide the technical work in the RAN Working Groups starting from March 2016

*Note: as it was the case with the previous generation, 3GPP does not intend to explicitly use the term “5G” when the work starts. “5G” will remain a marketing & industry term that companies will use as they see fit.*

# Operation above 6 GHz

- 📶 Next generation radio technology will include operation above 6 GHz
- 📶 Because of that 3GPP RAN will start a channel modelling project for higher frequencies from September
  - The goal is to have sufficient progress by the time RAN Working Groups start to evaluate the new radio technologies in 2016
- 📶 Various channel modeling efforts are ongoing in the industry and RAN may leverage some of this work
  - What needs to be developed by RAN vs. imported from external organizations will be decided during the approval of the project

# Service & system aspects

- 📶 Next generation 3GPP platform needs to enable a broad range of new services and connectivity paradigms (besides addressing the future mobile broadband demand)
- 📶 3GPP SA1 has started an effort to articulate the service and connectivity vision for 5G by defining the service requirements of next generation platform
- 📶 3GPP may then need to design a new system architecture for 5G based on two potential streams of requirements
  1. Radio requirements established by 3GPP RAN
  2. Service/system requirements established by 3GPP SA1/SA2
- 📶 A 3GPP workshop on system architecture aspects it is anticipated for H2 2016

Thanks