



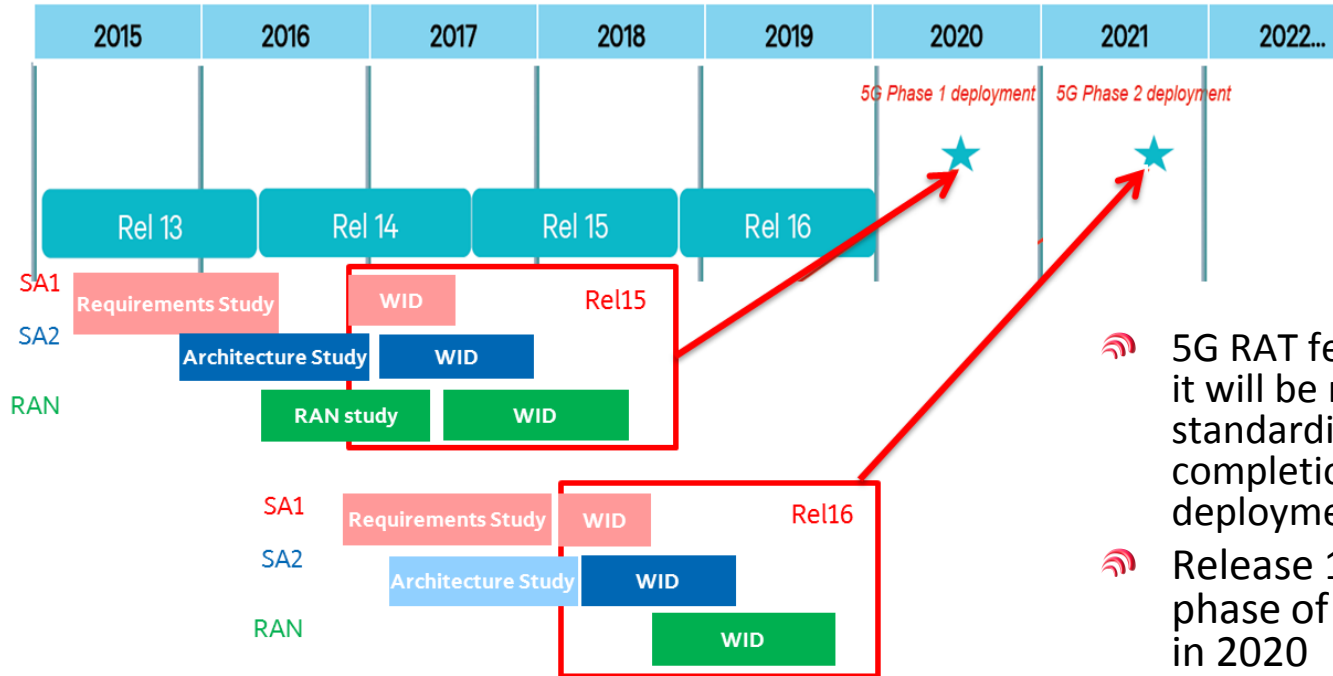
3GPP RAN progress on “5G”

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3GPP Roadmap



- 5G RAT features will be phased as it will be not possible to standardize all in time for Rel-15 completion and early deployments
- Release 15 will aim at a first phase of expected deployments in 2020
- Release 16 will target the ITU IMT-2020 submission Good

RAN-SA coordination

- 📶 Coordination between RAN and SA on Next Generation Architecture being planned, [RP-160671](#)
 - Will result in a series of joint sessions at WG and TSG level starting from H2-16

- 📶 The goal is that by December we should converge on:
 - 1) What are the goals / objectives of the Next Generation Architecture work?
 - 2) Timing for work: e.g. what scenarios and/or architecture(s) (if there are options) need to be developed when (by which release?)

- 📶 Note that the above timeline, driven by SA/SA2, will force some prioritization discussions to happen sooner than the main RAN prioritization discussion

- 📶 One key decision that will have to be made by December is whether we need to support standalone operation in Rel-15

Timeline & phasing

- There will be **two phases** for the normative work
 - Phase 1 to be completed by Sep 2018/Rel-15 to address a more urgent subset of the commercial needs (to be agreed)
 - Phase 2 to be completed by Mar 2020/Rel-16 for the IMT 2020 submission and to address all identified usecases & requirements

- With the following, tentative, release timing



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

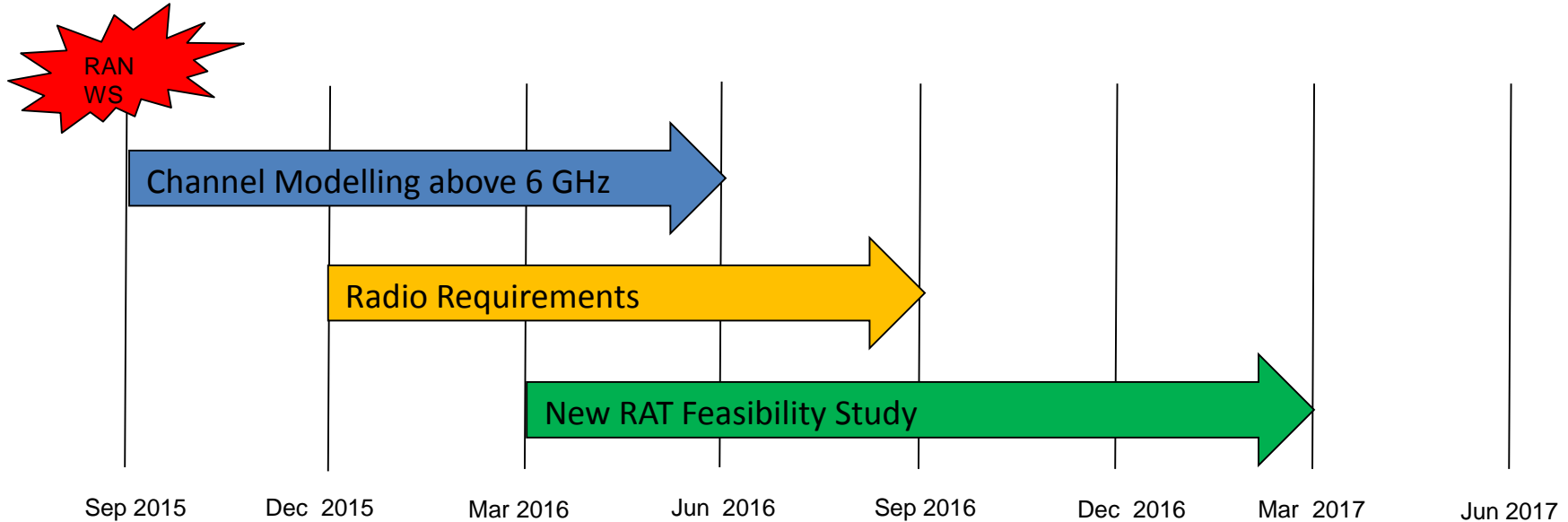
- Key requirement: NR design should be **forward compatible** at its core so that features can be added in later releases in an optimal way



Way forward on 5G/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
 - In case we decide to have two RITs, it may not be necessary that both RITs fulfill all IMT-2020 requirements. This will also depend on the criteria that will be defined by WP5D to be an approved IMT-2020 technology
- 📶 NR shall eventually address all requirements and usecases identified in the RAN SI
 - NR forward compatibility will be key to phase-in the different features in different releases in an optimal way. The Technology SI shall study the best way to achieve that!

Note: NR is a temp term for the “New Radio of 5G”

Ongoing activities in RAN



-  The normative phase on the New RAT will start in Release 15
-  Approval of the activity (Work Item) expected at March 2017)

Channel modelling above 6 GHz

 Good progress on the on channel modelling SI, with preliminary agreements on:

- Skeleton TR, [R1-160587](#)
- Scenarios, [R1-161145](#)
- Requirements, [R1-161145](#)
- Methodology, [R1-161150](#) (working assumption)

Requirements & scenarios

- 📶 Approved RAN SI on requirements and deployment scenarios for Next Generation Radio Access Technologies, [RP-152257](#)
- 📶 Identified the initial bulk of scenarios & KPIs, providing a good basis for the technical work to start in the WGs in Q2-16
 - Few additional scenarios & KPIs will be discussed at next plenary
- 📶 The latest version of the TR 38.913 is available in [RP-160689](#)

Radio requirements for the New Radio: Deployment scenarios



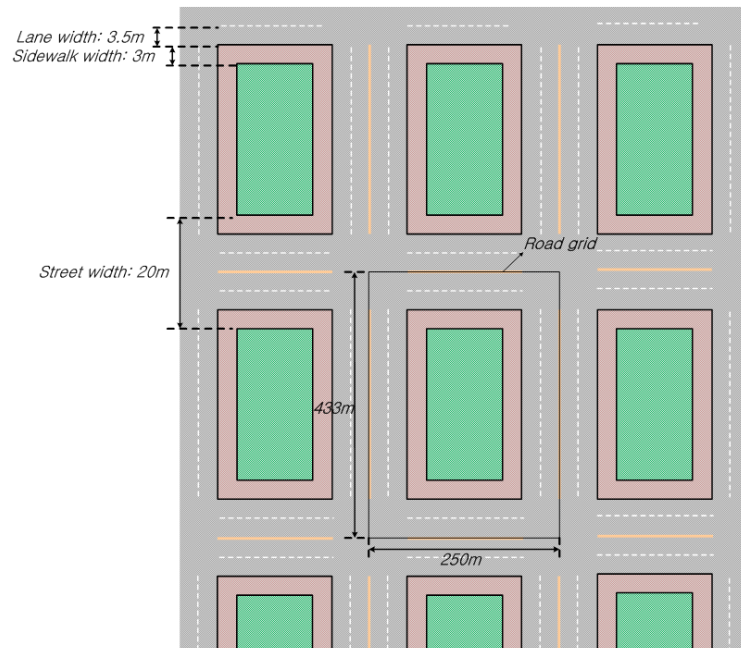
- Environments to be supported and in general to be evaluated to verify if KPIs are met
 - Indoor hotspot, Dense urban, Rural, Urban macro, High speed, Extreme rural for the Provision of Minimal Services over long distances, Extreme rural with extreme Long Range, Urban coverage for massive connection, Highway Scenario, Urban Grid for Connected Car, (others to be defined)

Attributes	Values or assumptions
Carrier Frequency	around 30 GHz or around 70 GHz or Around 4 GHz
Aggregated system bandwidth	Around 30GHz or Around 70GHz: Up to 1GHz (DL+UL) Around 4GHz: Up to 200MHz (DL+UL)
Layout	Single layer: - Indoor floor (Open office)
ISD	20m (Equivalent to 12TRPs per 120m x 50m)
BS antenna elements	Around 30GHz or Around 70GHz: Up to 256 Tx and Rx antenna elements Around 4GHz: Up to 256 Tx and Rx antenna elements
UE antenna elements NOTE4	round 30GHz or Around 70GHz: Up to 32 Tx and Rx antenna elements Around 4GHz: Up to 8 Tx and Rx antenna elements
User distribution and UE speed	100% Indoor, 3km/h, 10 users per TRP
Service profile	NOTE: Whether to use full buffer traffic or non-full-buffer traffic is FFS.

**Example:
Indoor hotspot**

Radio requirements for the New Radio: Deployment scenarios

Parameter	Urban case	Freeway case
Number of lanes	2 in each direction (4 lanes in total in each street)	3 in each direction (6 lanes in total in the freeway)
Lane width	3.5 m	4 m
Road grid size by the distance between intersections	433 m * 250 m.	N/A
Simulation area size	Minimum [1299 m * 750 m]	Freeway length \geq 2000 m. Wrap around should be applied to the simulation area.
Vehicle density	Average inter-vehicle distance in the same lane is 2.5 sec * absolute vehicle speed. Baseline: The same density/speed in all the lanes in one simulation.	
Absolute vehicle speed	15 km/h, 60 km/h, 120 km/h	250 km/h, 140 km/h, 70 km/h



Example:
Urban Grid for Connected Cars

Radio requirements for the New Radio: KPIs



KPI	value
Peak data rate	20Gbps DL 10Gbps UL
Peak Spectral efficiency	30bps/Hz - 15bps/Hz
Control plane latency	10ms
User plane latency	URLLC: 0.5ms UL&DL
Latency for infrequent small packets	TBD
Mobility interruption time	0 ms
Inter-system mobility	With other IMT systems
Reliability	URLLC: P=10-5 in 1ms
Coverage	mMTC 164dB

KPI	value
Extreme Coverage	100-400 km voice/low data
UE battery life	mMTC 15 years
UE energy efficiency	TBD
Cell/Transmission Point/ TRP spectral efficiency	TBD
Area traffic capacity	TBD
User experienced data rate	TBD
5th percentile user spectrum efficiency	TBD
Connection density	mMTC 1M device/km2
mobility	500 km/h
Network energy efficiency	TBD



Radio requirements for the New Radio: Architecture



Some requirements:

- 📶 Support tight interworking between the new RAT and LTE
- 📶 Different options and flexibility for splitting the RAN architecture shall be allowed
- 📶 RAN architecture shall allow for deployment flexibility (e.g. to enable context aware service delivery, low latency services)
- 📶 RAN architecture shall allow for C-plane/U-plane separation
- 📶 RAN architecture shall allow deployments using Network Function Virtualization
- 📶 RAN architecture shall allow for the operation of Network Slicing
- 📶 The design of the RAN architecture shall allow the deployment of new services rapidly and efficiently
- 📶 RAN-CN interfaces and RAN internal interfaces (both between new RAT logical nodes/functions and between new RAT and LTE logical nodes/functions) shall be open for multi-vendor interoperability

Radio requirements for the New Radio: supplementary services and Operational



- 📶 Multimedia Broadcast/Multicast Service
- 📶 Location/Positioning Service
- 📶 Public safety communications
- 📶 Emergency communications
- 📶 Public warning/emergency alert systems
- 📶 Channel bandwidth scalability
- 📶 Spectrum flexibility
- 📶 Duplexing flexibility: allocation of resources flexibly for uplink and downlink for both paired and unpaired frequency bands
- 📶 Spectrum range; up to 100 GHz
- 📶 Self Organization Networks
- 📶 Security and Privacy related requirement relevant for Radio Access
- 📶 Performance monitoring and management
- 📶 Lawful Interception

Example of requirements

New Radio (NR)

Approved SI on NR, [RP-160671](#)

- RAN WGs to start evaluate technology solutions from next quarter

No prioritization at this stage

- At some level all identified requirements and deployment scenarios should be taken into account in the initial NR design
- Main prioritization to take place in RAN during the approval of the Rel-15 WI, with one notable exception because of the SA timeline

Feasibility Study on New Radio: objectives



- 📶 Target a single technical framework addressing all usage scenarios, requirements and deployment scenarios
- 📶 The new RAT shall be inherently forward compatible: to allow standardization in two phases
- 📶 The Study will define
 - The fundamental physical layer signal structure for new RAT
 - The Radio Interface protocol architecture and procedures
 - The Radio Access Network architecture, interface protocols and procedures
 - Study the feasibility of different options of splitting the architecture into a “central unit” and a “distributed unit”, with potential interface in between
 - Study and outline the RAN-CN interface and functional split
 - Study and identify specification impacts of enabling the realization of Network Slicing
 - The fundamental RF aspects
- 📶 The Study will provide performance evaluation of the technologies identified for the new RAT and analysis of the expected specification work
- 📶 The Study will identify relevant RF parameters used to be used for sharing and co-existence studies

Thanks