3GPP Release-17 Status

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The Timeline

- RAN#84 (June/2019): Initial presentations from various companies on Rel-17 proposals
- RAN#85 (September/2019): Review of email discussion progress on Work Areas
- RAN#86 (December/2019): Approval of Study Items (Work Items) for RAN1/2/3
- RAN#87 (March/2020): Evaluation of RAN4 impacts of the December-approved package, and approval of RAN4 SIs (WIs)

Summary from RAN#84

- RAN#84 3GPP meeting was held in June/2019
- Views from various companies on R17 is distilled into distinct Work Areas for further email discussion. Goal of each email discussion is to scope out the Objectives for a potential Study ID/Work ID.
- According to RP-191551 “Preparing for Rel-17”, which was endorsed in RAN#84, Work areas are divided into three categories:
  - Set of Work Areas where email consolidation should start in June after RAN#84
  - Set of Work Areas where email consolidation should start in September after RAN#85
  - Other topics that do not need explicit scoping discussion
    - Scope is rather clear based on earlier technical discussions

Work areas where email discussion started in June’19

1. [NR_Light] (moderator: Ericsson)

- The email discussion is divided in two phases:
  - Phase 1 (from now until RAN#85 with a summary presented at RAN#85) focusing use cases and requirements and improvement areas
  - Phase 2 (from RAN#85 to RAN#86) is focused on drafting of SID or WID. The draft SID or WID will be presented in RAN#86.

- Deadline for the company input on Phase 1 is **30th of August 2019** allowing to discuss conclusions before RAN#85.

[NR-Light] - Motivation

- The following features are mandatory for a Rel-15/16 NR UE.
  - Mandatory UE BW: 100MHz(FR1 n41, n77, n78, n79) and 200MHz(FR2) for DL/UL
  - Mandatory UE Rx: 4Rx for above 2.5GHz (FR1); 2Rx for below 2.5GHz
  - UE power class: 23dBm, 26dBm
- Such high requirements on NR UEs is beneficial for differentiating NR UEs and LTE UEs in the initial deployment. However, with the gradual deployment of NR 5G networks around the world, such high UE cost and complexity may become a shortcoming for expanding the market for NR based devices and user penetration.
- NR system at least has to support all types of devices which are already supported in LTE. There are many other use cases and device types, to list but few such as wearable devices, eHealth, smart appliances which require completely different capabilities.

Why introduce NR-Lite instead of reusing LTE?

- No need to support 3 different networks –NR, eMTC/NB-IoT, and LTE
- Operators can migrate their spectrum to NR which can support both URLLC & NR-Lite on the same carrier as well as deploy eMTC/NB-IoT either in-band or in guard-band.
- Better system efficiency with NR compared to LTE
- Utilize NR features like beam-formed operation, higher subcarrier spacing for latency reduction, massive MIMO for coverage, mixed numerology, higher positioning accuracy, low-overhead carriers, etc.
- Deploy URLLC & NR-Lite in also FR2 and new spectrum
- FR2 can be very attractive for private networks due to its limited range and high spatial reuse e.g. each building or floor can have its own network and they will not interfere with each other
- Better integration and benefits from 5G core and architecture –network slicing, service based architecture, flow-based QoS, etc.

[NR_Light] – Use cases

- Based on the RAN#84 contributions and the online discussions, there have been strong support to include “industrial sensors”, “video surveillance,” and “smart wearables”. Note that LPWA use case is not included in the scope as concluded in RAN#84.
- The massive industrial wireless sensor network (IWSN) use cases and requirements described in TR 22.804, TS 22.104 and TS 22.261 do include not only cMTC (Time crictical MTC) services with very high requirements, but also relatively low-end services with the requirement of small device form factors, and/or being completely wireless with a battery life of several years.

[NR_Light]- Objectives

- Identify the various use cases and corresponding requirements for diverse UE types (RAN1)
- Study techniques to reduce UE cost and complexity (RAN1/4)
  - Reduce UE bandwidth for both DL and UL
  - Reduce UE Rx antennas, including 2Rx and 1Rx
  - Other baseband complexity reduction techniques
  - Lower UE Tx power class
- Study techniques to further improve UE energy efficiency (RAN1/2/4)
  - Power saving techniques for RRC IDLE/INACTIVE, including IDLE mode RRM, paging wakeup, etc
  - Further UE power saving techniques for RRC CONNECTED state
  - Study the UE switching between NB-IOT/eMTC (for IDLE mode) and NR (for RRC CONNECTED mode)

NR-Light - References

- RP-191391 Support of NR-Lite Nokia, Nokia Shanghai Bell
- RP-191306 Study on NR diverse UE types vivo
- RP-191305 Motivation for NR diverse UE types in Rel-17 vivo
- RP-191296 Support of low cost and low power consumption IoT devices LG Electronics
- RP-191227 NR-Lite devices and related technical enhancement ZTE, Sanechips
- RP-191175 Motivation for NR-lite: IoT over NR Samsung
- RP-191174 Support of NR-Lite Samsung
- RP-191018 mMTC evolution in Rel-17 Sierra Wireless, S.A.
- RP-191047 NR-Lite for Industrial Sensors and Wearables Ericsson
- RP-191048 New SID on NR- Lite for Industrial Sensors and Wearables Ericsson
- RP-191008 Rel-17 work scope on IoT and MTC Huawei, HiSilicon
- RP-190844 NR-Lite for Rel-17 - Qualcomm views Qualcomm Finland RFFE Oy

2. [Small_data] (moderator: ZTE)

- Small Data and Inactive Data transmission (both UL and DL)
- No LPWA
- In many applications/scenarios, a UE generates only a small amount of data across burst in a data session. This type of traffic is applicable across all verticals including MBB/V2X and IOT services and can have a significant impact on device and system performance.
- In these scenarios it is power inefficient for UE to transition in and out of RRC_CONNECTED state with associated RRC and sometimes NAS signalling.
  - Transitions to and from RRC_CONNECTED have high overhead in terms of C-plane signalling (e.g. RRC establishment/resume, data inactivity timer, etc.).
  - Extra signalling also impacts connection duration and related battery life and network resources wasted
  - Additional connection duration also implies the network supporting more connected UEs simultaneously and strains the network load

[Small_data]- Motivation

- In LTE, 3GPP has already defined mechanisms to enable efficient small data transfer for NB-IoT and eMTC. In Rel-16, similar efficient small data transfer mechanisms have been defined for NB-IoT and eMTC connected to the 5G core network.
- What is needed is a small data solution to reduce signalling overhead and maximize battery savings for small data in RRC_IDLE and RRC_INACTIVE modes in NR, i.e., to enable small data transfer based on current RACH procedures (including 2 and 4 step RACH) without transitioning into RRC CONNECTED state, or with transition to RRC CONNECTED with fast return to RRC_IDLE or RRC_INACTIVE state applicable across all verticals.
- For RRC_INACTIVE, in order to reduce signalling towards the 5G core network, it would also be beneficial to enable small data transfer without changing the last serving gNB node, avoiding N3 path switch.
- In addition, the current RRC state transition is controlled by NW but the UE often has better knowledge when traffic has completed. Therefore, to further improve the efficiency of data transfer, the system should support UE assisted transition to RRC_IDLE and RRC_INACTIVE states.

[Small_data]- Objectives

- To specify solution(s) to enable efficient small data transfer for the following scenarios
  - MO/MT small data in RRC_IDLE leveraging the Rel-16 NB-IoT/eMTC connected to 5GC solutions.
  - MO/MT small data in RRC_INACTIVE with/without anchor relocation
- To specify solution(s) enable efficient small data transfer including the following considerations
  - Configuration of small data usage and parameters in system information and RRC unicast including maximum size of small data (may be different for 2 step vs 4 step RACH)
  - Potential subsequent data transfer
    - DL data in response to UL data without the UE having to move to RRC_CONNECTED should be considered
    - RAN control to move the UE into RRC_CONNECTED state as part of the small data procedure
  - Release assistance information (RAI) from the UE for small data transfer
  - RRC signaling reduction (including possible small data transfer with no associated RRC signaling)
  - Subsequent small uplink data transmissions (i.e., transmission after the first UL data) in RRC_INACTIVE should be supported.
- Note: Transmission of large data is envisioned to cause a state transition to RRC_CONNECTED. The state transition is a network decision.

[Small_data]- **References**

- RP-191074 Draft new WID on small data transmission, ZTE, Sanechips
- RP-190838, Draft Work Item Description: Small Data for NR, Qualcomm
- RP-191348, Motivation for new WI on Direct data transfer in Inactive, Intel Corporation
- RP 190833, vivo views on NR Rel-17, vivo

3. [Sidelink_enh] (moderator: LG, Oppo)

- RAN#84 endorsed Rel-17 preparation and the following email discussion was included for sidelink enhancements:
  - Includes V2X, Commercial, and Critical Comms, FR2 aspects
  - Relay aspects, architecture aspects, related Uu aspects
  - Focus on common functions across the key use cases
  - Achieve maximum commonality between commercial, V2X, and Critical Communication usage of sidelink while addressing their specific requirements
- Consider spinning off non-sidelink V2X aspects into a separate thread

3. [Sidelink_enh] - Motivation

- Rel-16 sidelink is being designed to support V2X use cases with a note that it can support Critical Communications (i.e., public safety) use cases if the requirement can be fulfilled. The email discussion plan endorsed in RAN#84 also mentions “Focus on common functions across the key use cases” and “Achieve maximum commonality between commercial, V2X, and Critical Communication usage of sidelink while addressing their specific requirements.”
- Based on these, the design principle of Rel-17 sidelink can be to specify the common solution which can cover different use cases including V2X, Commercial and Critical Communications. Meanwhile, design in Rel-17 can focus on introducing enhancements to those specified in Rel-16, instead of re-designing fundamental sidelink functionalities introduced in Rel-16. Companies are invited to provide views on the design principles of Rel-17 sidelink enhancements.

3. [Sidelink_enh] - References

- **RP-191011** Rel-17 work scope on NR sidelink enhancements for V2X and other use case Huawei, HiSilicon
- **RP-191054** NR Rel-17 Sidelink features Ericsson
- **RP-191070** Consideration on post RAN#84 potential email discussion for Release 17 sidelink enhancement items OPPO

4. [NR_above_52.6 GHz] (inlc 60GHz unlicensed) (moderator: Intel)

- As per guidance from RAN chairman from RAN #84, companies are invited to provide views and preferences on NR beyond 52.6GHz.
  - Scoping, including structure of the study to enable waveform decision, and decision cut off point (between waveforms)
- This email discussion is divided in two phases:
  - Phase 1 (from now until RAN#85 with a summary presented at RAN#85).
    - Primary target use cases and deployment scenarios
    - Scope and structure of the study
  - Phase 2 (from RAN#85 to RAN#86)
    - Further discussion on the scope/structure as necessary
    - Drafting of the SID that will be presented in RAN#86 for approval
- Please note that deadline for the company input on Phase 1 is **6th of Sep 2019**.

[NR_above_52.6 GHz] - Motivation

- Extension of 3GPP core specifications to support NR operation up to the W-band (<114.25 GHz)
- Foundation for NR-U in 60 GHz, V2X in the ITS extension band, IIoTand more
- New use case: NR Proximity radio for 60 GHz –NR radio for CE-Type applications similar to 802.15.3c/e
- NR > 52.6 GHz more than doubles the accessible BW for NR when compared to FR1 & FR2

[NR_above_52.6 GHz] – Objective

- Company's opinions invited on following questions:
  - Generic use cases and deployment scenarios for NR above 52.6GHz are being studied under the Rel-16 RAN Plenary SI, *NR beyond 52.6GHz* and they include eMBB, IIOT, Uu, sidelink, licensed/unlicensed spectrum, backhaul, NTN, etc. The question here is if the Rel-17 SI should consider all use cases and deployment scenarios identified under the RAN Plenary SI, or should focus on a subset of them during the Rel-17 study, and if so, what are the primary target use cases and deployment scenarios for the Rel-17 study.
  - What is the potential scope of the Rel-17 study that may include all or some of evaluation methodology, waveform(s) & applicable frequency ranges, channelization, physical channels/signals, frame structure, beam management, operations in unlicensed spectrum, etc.
  - is how to structure of the 15-month Rel-17 study, including the cut off point for waveform decision (e.g., waveform decision after 6/9/12/15 months). Please feel free to provide any comment on other aspects w.r.t. the study structure.
  - if the candidate waveforms for the Rel-17 study need to be defined in the SID to be approved in Dec/19 and the Rel-17 study should focus on the candidates, and if so, what are the candidate waveforms defined in the SID, or if they are left up to the Rel-17 study (i.e., open for the study in Rel-17).

[NR_above_52.6 GHz] - References

- RP-190837 NR above 52.6GHz - Qualcomm views
- RP-190975 On Use Cases and Deployment Scenarios for NR beyond 52.6 GHz AT&T
- RP-191004 NR use cases and scenarios in frequencies above 52.6 GHz Huawei, HiSilicon
- RP-191005 NR functional requirements for frequencies above 52.6 GHz Huawei, HiSilicon
- RP-191050 Views on NR operation beyond 52.6 GHz Ericsson
- RP-191067 Considerations on design requirements for NR beyond 52.6GHz ZTE, Sanechips
- RP-191101 Rel-17 >52.6GHz MediaTek Inc.
- RP-191160 New SID: Study on supporting NR above 52.6GHz Intel Corporation
- RP-191186 Design considerations and requirements beyond 52.6 GHz Samsung
- RP-191185 Use cases and deployment scenarios beyond 52.6 GHz Samsung
- RP-191307 Use cases and deployment scenarios for NR above 52.6GHz vivo
- RP-191306 New Rel-17 SID proposal: Study on NR diverse UE types vivo
- RP-191318 NR beyond 52.6 GHz design requirements Ericsson
- RP-191322 TP for TR 38.807 – Updates on regulatory requirements for bands beyond 52.6 GHz Ericsson
- RP-191407 System design requirements for spectrum above 52.6GHz Intel Corporation
- RP-191408 Status report for SI: Study on NR beyond 52.6 GHz Intel Corporation
- RP-191412 Report on NR beyond 52.6GHz workshop Intel Corporation
- RP-191540 TR 38.807 v0.2.0 on Study on NR beyond 52.6 GHz Intel

5. [Multi_SIM] (moderator: Vivo)

- Increasing number of UE vendors begin to provide Multi-SIM devices
  - Apple, Huawei, Lenovo, OPPO, Samsung, vivo, Xiaomi, ZTE ……
- Multi-SIM device to address the following use cases
  - One SIM card for private communication and another one for business purpose
  - One SIM card for local operator and another one for home operator while roaming
  - Different SIM card for different service
    - E.g. SIM A with “family circle” plan for voice service and SIM B with “mobile data” plan for data service

[Multi_SIM] - Motivation

- Multi-SIM is currently supported in implementation-specific manner
- Common radio and baseband components shared among multiple SIMs is widely used
  - UE communicates with multiple systems in TDM manner, e.g. via UE autonomous gap
  - No coordination between UE and NW
- Implementation-specific manner may lead to
- Messed up NW statistics
  - Short UE autonomous gaps (tens of ms) in system 1 due to UE switching for paging monitoring in system 2 may be interpreted as radio problem by system 1
  - Long UE autonomous gaps in system 1 due to UE switching to establish connection in system 2 will certainly be classified as erroneous case
- Degraded user experience
  - Paging collision can cause paging missing
  - Service interruption in the first system due to UE communicating with the secondary system
  - Date loss due to paging reception in another system
  - Long latency for cell selection and reselection
- Related ongoing AS study item(SP-181251)
- it is necessary to begin RAN side impact study ASAP in order to speed up full support of Multi-SIM feature

[Multi_SIM]- Objectives

- Identify the paging collision solution, include CN paging and RAN initiated paging
- Identify the issues and potential solutions for delivering paging to UE on SIM A while the UE is actively communicating with SIM B(for both single and dual connectivity configurations)
- Identify the issues and potential solutions for UE enters RRC Connected state in one system from Idle/Inactive while the UE is already in RRC Connected state in another system
- Identify the issues and potential solutions when both SIM A and SIM B are in RRC connection state
- Identify the necessary Cell selection/reselection enhancement for intra-MNO case

[Multi_SIM] - Reference

- **RP-191303** New Rel-17 SID proposal: Study on multi-SIM devices in RAN vivo, China Telecom, Xiaomi, Spreadtrum Communications, AT&T, Charter Communications, Samsung, Lenovo, Motorola Mobility
- **RP-191304** Considerations on multi-SIM study in RAN vivo, China Telecom, CAICT, Xiaomi, CMCC, Charter Communications, China Unicom, Samsung
- **RP-191347** Motivation for RAN level Multi-SIM support Intel Corporation

6. [NR_multicast_broadcast]- Reference

- **RP-190853** Broadcast/multicast in RAN Rel-17 - Qualcomm views Qualcomm Finland RFFE Oy
- **RP-191012** Rel-17 work scope on NR Multicast and Broadcast Services Huawei, HiSilicon
- **RP-191019** Broadcast & Multicast over 5G for Mission Critical in RAN Rel-17 AT&T
- **RP-191169** Introduction of Broadcast/Multicast for NR Ericsson GmbH, Eurolab
- **RP-191211** New SID: Study of mixed mode broadcast/multicasts in NR CMCC
- **RP-191212** Motivation for NR mixed mode broadcast/multicast CMCC

7. [Coverage_enh] (moderator: China Telecom)

- Clarify requirements for all relevant scenarios focusing on extreme coverage (not including LPWA). Data rate target FFS.
- Start from Rel-16 email discussion outcome
- Includes both indoor as well as wide area
- The extensive link budget performance has been evaluated and summarized in R1-191521 embedded in RP-191533. It shows that the coverage of DL and UL is unbalanced and the coverage of control and data channel is unbalanced either. In addition, PUSCH is the limited factor in terms of coverage, especially for O-2-I scenario. That’s why more than 20 companies proposed to enhance NR coverage in RAN#84.

[Coverage_enh] - Motivation

- **Challenging “deep indoor” penetration for new NR bands**
  - Majority of additional NR spectrum in High-Frequency bands: C band (3-6GHz) and mmW
  - Challenging propagation and wall penetration for C-Band
  - Extremely challenging outdoor->indoor penetration for mmW
- **Low-Frequency bands below 2GHz deliver NR deep indoor coverage, but not NR data rates**
  - Limited spectrum availability limits end user data rates
  - Similar user experience as for 4G devices
- **“Deep Indoor” coverage in higher bands essential to deliver NR eMBBdata rates**

[Coverage_enh] - Objectives

- Identify deployment scenarios for evaluation, including both licensed and unlicensed spectrum <= 52.6 GHz [RAN1/2]
  - Study and evaluate potential physical-layer enhancements on sidelink, including at least the following aspects [RAN1]
  - Physical layer channel/signals
  - Physical layer procedures
  - Resource allocation including interference management under operator control
  - Operation in unlicensed spectrum
- Study a relaying architecture for coverage extension over PC5 [RAN2]
  - Study sidelinkrelaying scenarios e.g. CP/UP split
  - Study PC5 for relay, e.g. potential re-use from FeD2D study
  - Study Uu/PC5 relay, e.g. CA/DC, U-plane, and mobility
  - gNB awareness of the remote UEs is beneficial: e.g. allows reuse of RRC states/procedures
- Work item in Rel-17
  - Specify the lower-impact solutions
  - One example could be the CP/UP split assuming available low data

[Coverage_enh] - Reference

- **RP-191010** Rel-17 work scope on uplink coverage enhancements for NR and LTE Huawei, HiSilicon
- **RP-191076** Draft new WID on coverage enhancement ZTE, Sanechips
- **RP-191097** Rel-17 NR Coverage Enhancement MediaTek Inc.
- **RP-191213** New SID proposal- Study on Hierarchical coverage in NR CMCC
- RP-191234 Coverage and Capacity enhancements for 5G NR Reliance Jio

Work areas where email discussion to start in September

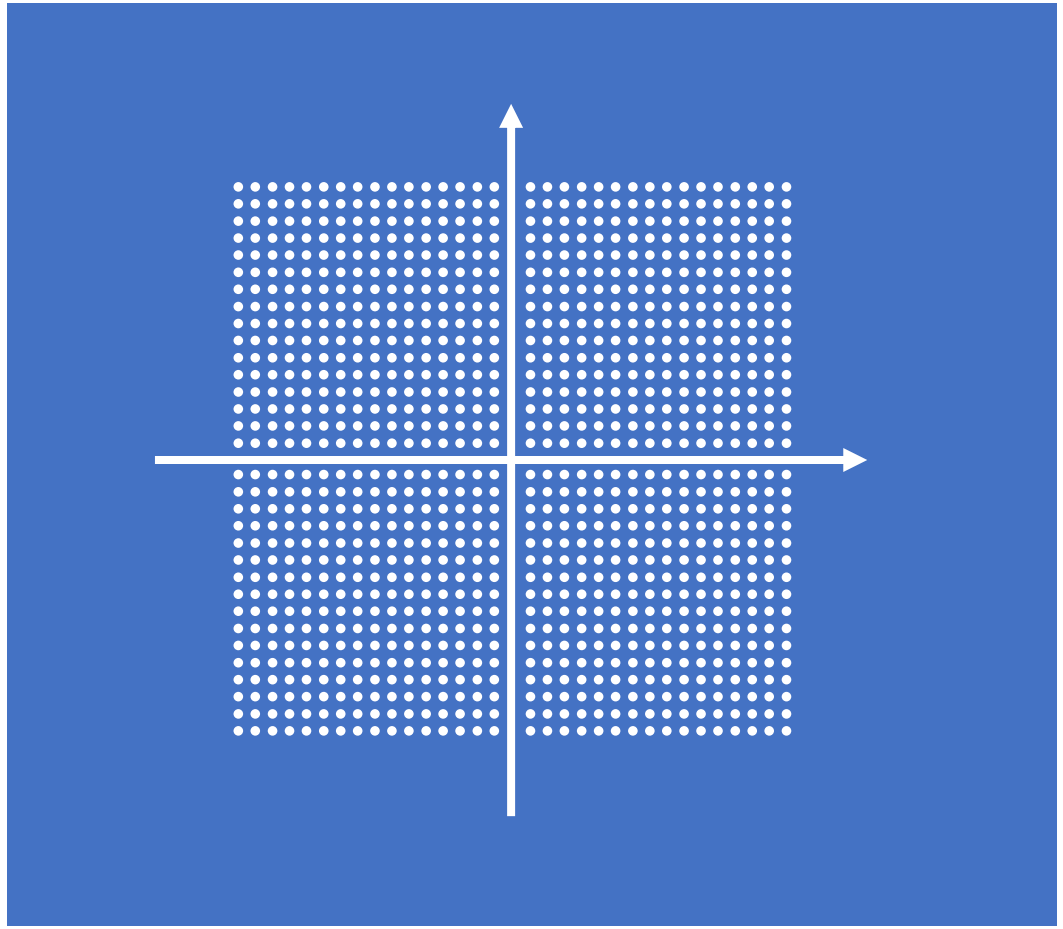
Details will come-up in September

- [IIoT_URLLC_enh] (moderator: Nokia)
- [MIMO_enh] (moderator: Samsung)
- [Non_Terrestrial_Networks] (moderator: Thales)
- [NB_IoT_eMTC_enh] (moderator: Huawei)
- [IAB_enh] (moderator: Qualcomm)
- [Unlicensed_enh] (moderator: Nokia)
- [Powersaving_enh] (moderator: Mediatek)
- [RAN_datacollection_enh] (moderator: CMCC)
- [Positioning_enh] (moderator: Qualcomm)

Other topics with no need for explicit email discussion

1024QAM -Motivation

- Rel-15 NR supports downlink modulation order up to 256QAM for PDSCH.
- LTE has introduced even higher order modulation order of 1024QAM for PDSCH in Rel-15.
- NR should be competitive to LTE with regard to the spectral efficiency especially on refarmed operating bands and mid-bands, i.e., FR1
- Even for NR, high SNR conditions supporting DL 1024QAM can be achievable in FR1 with:
  - Small cell / indoor cell / non-sectorized cells
  - Beamforming (in mid-bands 3-6 GHz)
- It is expected that meeting EVM and demodulation requirements in the FR1 range should be the same as LTE from an implementation perspective and feasible.



1024QAM- Summary of objectives

- Specify high order modulation for PDSCH [RAN1]
  - Introduce new modulation mapping and signaling
  - Introduce new MCS index table
  - Introduce CQI feedback
- Define RRC signaling and UE capabilities [RAN2, RAN1]
- Introduce corresponding RF requirements to support DL 1024QAM in FR1 [RAN4]
- Specify the necessary UE performance requirements [RAN4]