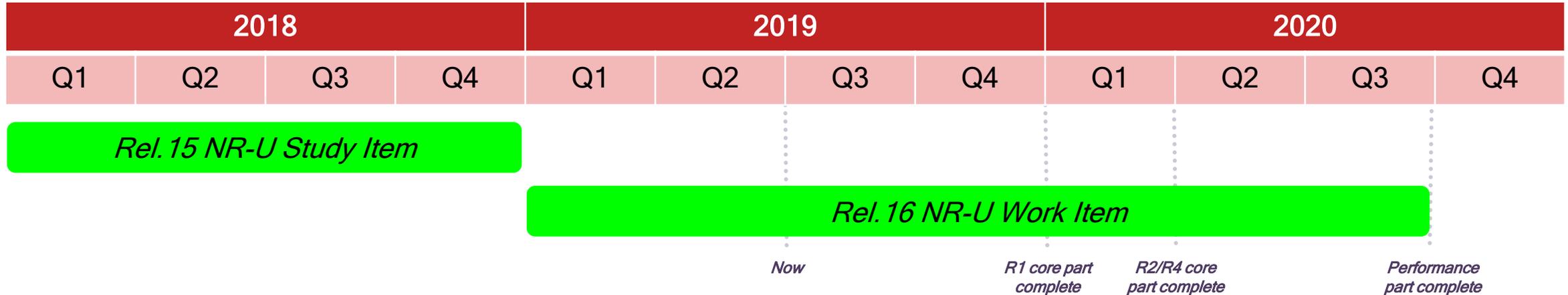


Rel-16 NR-U WI Prioritization

AI: 9.4.3

Document for: Discussion

NR-U schedule



- To ensure timely completion of NR-U work item, **prioritization** is needed
- **Focus** on:
 - Finalizing support of features already agreed in earlier meetings
 - Complete missing **essential** NR-U features critical for **NR-U operation** and, hence, for the completion of the WI
- **Best effort** on:
 - **Non-essential** optimization features

Overview and Proposals

- **Overview:** In this contribution we:
 - review the remaining open issues in RAN1, RAN2 and RAN4 by
 - agenda item at corresponding WGs and
 - provide a classification of items into **Essential** and **Optimization**
- **Proposal 1:** RAN to instruct WGs to focus on completion of essential items leaving optimization items as best-effort from WG time-management perspective.
- RAN4 recently discussed NR-U operation for 10MHz channel bandwidth
 - RAN1 has been assuming 20MHz channelization esp. relevant for SSB/PBCH + RMSI transmission in SA mode
 - **Proposal 2:** 10MHz is supported in NR-U via NR-U/NR-U CA or NR/NR-U CA without air-interface optimizations specific to 10MHz, i.e., 10MHz operation is a subset of 20MHz operation.

RAN1

7.2.2.1.1 Initial access signals and channels

Essential

- Wideband PRACH design (long sequence vs repetition)
- LBT gap between ROs
- Supported PRACH formats (legacy PRACH and new PRACH)

Optimizations

- RMSI PDSCH to SSB rate matching (impacted by RAN4 sync raster decision)
 - Also impact default PDSCH SLIV table configuration
- CSI-RS FDM with SSB (impacted by RAN4 sync raster decision)
- RMSI (PLMN) transmission in Scell
- Additional PRACH numerology
- Multiplexing of PRACH and other channels

RAN1

7.2.2.1.2 DL signals and channels

Essential

- COT-SI indication (time domain)
- COT occupancy indication for FBE
- Dynamic PDCCH monitoring switching
- gNB control for the Cat 4 UL transmission (including CG) switching to cat 2 when fall in gNB COT

Optimizations

- CSI-RS enhancement
 - Behavior when P/SP-CSI-RS fail to transmit due to LBT
 - More opportunities for CSI-RS to compensate the possible LBT failure
 - A-TRS directly QCL with SSB
- Type B PDSCH lengths: Any mandatory ones?
- Power saving with DL burst detection: Any more discussion on spec non-transparent way?
- DMRS sequence generation: Remove (some) time dependency?

RAN1

7.2.2.1.3 UL signals and channels

Essential

- PUCCH EPF0/1/2/3 design
- Interlaced PUSCH resource allocation design in DCI
- Wideband PUSCH interlace waveform (WA confirmation)

Optimizations

- PUSCH multiple starting position
- 60KHz PUSCH interlaced waveform
- SRS waveform enhancement (interlace or stagger)
- P/SP-SRS multiple opportunities
- A-SRS triggering mechanism enhancement

RAN1

7.2.2.2.1 Channel access

Essential

- 16us cat 2 LBT detailed design
- Signaling support for LBT type/priority indication
- CWS adjustment, including reference slot definition, processing timeline, what if no feedback expected or available, CWS adjustment for wideband operation and CG
- FBE: spec impact, assumption on network sync accuracy (move to another agenda item?)

Optimizations

- Max TX duration follow cat 1 LBT
- UE to gNB COT sharing
- Max number of Cat 2 LBT attempts in a 5ms DRS transmission window
- Wideband LBT with common measurement
- Directional LBT
- LBT to facilitate spatial reuse
- Receiver assisted LBT

RAN1

7.2.2.2.2 Initial access procedures

Essential

- Timing recovery from SSB
- Cross SSB QCL relationship by Q and A:
Which A, how to indicate Q, range of Q, RRM Q
- Msg1 enhancements with more opportunities in freq domain (over multiple LBT subbands) and time domain
- RLM enhancement: IS and OOS

Optimizations

- Msg 3 enhancement with multiple Msg3
- RRM enhancement including subband level RSSI and channel occupancy measurement
- Actually transmitted SSB indication (any need to change from NR?)
- 2-step RACH optimizations for NR-U

RAN1

7.2.2.2.3 HARQ enhancements

Essential

- Details for group based HARQ ACK retransmission for dynamic codebook

Optimizations

- Group based HARQ ACK retransmission for semi-static codebook
- One-shot HARQ ACK retransmission
- Larger K1 values
- Multiple freq domain opportunities for HARQ ACK in UL CA case and/or wideband CC case
- Larger K2 values
- 2-stage UL grant

RAN1

7.2.2.2.4 Configured grant enhancements

Essential

- DFI design, including content and CG PUSCH to DFI timing
- UCI design, including content and multiplexing

Optimizations

- Ending symbol flexibility
- CBG based transmission with CG resource

RAN1

7.2.2.2.5 Wideband operations

Essential

- Coreset for wideband (multiple or multi-cluster)

Optimizations

- PDCCH restrictions (such as confinement within a LBT subband or not)
- PUSCH Alt 2 support or not

RAN2

11.2.1.1 User plane - RACH

Essential

- **MSG3**
 - Multiple opportunities (RAN2 sent an LS to RAN1 for feasibility) can impact MAC.
- **RAR**
 - Timer window value and modification for RA-RNTI (or another method) to handle extended window.
- **2-step RACH**
 - Some unlicensed aspects need to be discussed; will start in August (was waiting for progress in the 2-step RACH WI).

Optimizations

- **MSG1**
 - Existing agreements are sufficient unless RAN1 agrees on multiple resources in different sub-bands and whether to take into account LBT failures in each sub-band.

RAN2

11.2.1.2 User plane - MAC

Essential

- **UL LBT Failures**
 - RAN2 agreed to have a mechanism for handling consistent LBT failures. In addition, since RACH counters are only updated upon successful transmission, this mechanism is needed for RACH failures.
- **CG finalization**
 - Configuration and retransmission are the main remaining issues. Many agreements have been made.

Optimizations

- **LBT - General**
 - Handling of DL LBT failures is not essential such as reporting missed RS is not essential unless RAN1 requests RAN2
- **DRX**
 - Better management of active time is good for power optimization and latency but can be second priority, considering that there are different opinions among companies including some companies who do not want any optimizations.
- **WB operation**
 - Not essential for RAN2; the discussion should be driven by RAN1.

RAN2

11.2.2.1 Control plane - Inactive and idle mode

Essential

- **Paging**
 - The main remaining issue is for stopping paging monitoring. Even though it is a power optimization, it is considered critical.

Optimization

- **System Information optimizations for NR-U**
 - No enhancements were agreed for single SI message case and it could be sufficient for Rel-16. Whether SIB9 for IIoT needs a second SI message should be discussed.

RAN2

11.2.2.2 Control plane - Connected mode and RRC

Essential

- **RLM RLF**
 - The main remaining issue is how the missing RS samples are handled at PHY layer which should be decided by RAN1.
- **RRM**
 - Current progress in RAN2 should be sufficient. Measurement details for RSSI and CO should be decided by RAN1/RAN4.

RAN2

11.2.3 Others

Essential

- The CAPC determination for CG has an FFS for multiplexing with high priority data and the Table for 5QI to CAPC mapping should be finalized.

RAN4

Frequency band definition

Essential

- Specify new unlicensed band for the 5 GHz frequency range
 - RAN4 agreed to reform band46 (i.e. band n46) but RAN4 is still discussing channel raster, channel bandwidths, sub-bands, etc.

Optimization

- Specify new unlicensed band for the 6 GHz frequency range
 - Regulation is not yet completed for this frequency range. It is proposed to focus the work on 5GHz band and do 6GHz best-effort.

RAN4

System parameters

Essential

- Wideband operation (UE and BS)
 - RAN4 is currently discussing UL and DL wideband operation and related emission requirements for in-channel leakage/selectivity.
- Spectrum utilization
 - Agreement on number of RBs per 20MHz and 60kHz SCS is conditioned to agreement on emission requirements (ACLR, SEM, ...)
- Sync raster
 - RAN4 is discussing synchronization raster for NR-U operation in standalone mode.

RAN4

Essential

- UE RF requirements
 - Limited discussions in RAN4 on this item.
No agreements made so far.
- BS RF Requirements
 - Limited discussions in RAN4 on this item.
Some agreements were made so far.
- RRM Requirements
 - Limited discussions in RAN4 on this item.
Some agreements were made so far.



Thank you

Follow us on: **f** **t** **in** **@**

For more information, visit us at:

www.qualcomm.com & www.qualcomm.com/blog

Nothing in these materials is an offer to sell any of the components or devices referenced herein.

©2018 Qualcomm Technologies, Inc. and/or its affiliated companies. All Rights Reserved.

Qualcomm is a trademark of Qualcomm Incorporated, registered in the United States and other countries. Other products and brand names may be trademarks or registered trademarks of their respective owners.

References in this presentation to “Qualcomm” may mean Qualcomm Incorporated, Qualcomm Technologies, Inc., and/or other subsidiaries or business units within the Qualcomm corporate structure, as applicable. Qualcomm Incorporated includes Qualcomm’s licensing business, QTL, and the vast majority of its patent portfolio. Qualcomm Technologies, Inc., a wholly-owned subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of Qualcomm’s engineering, research and development functions, and substantially all of its product and services businesses, including its semiconductor business, QCT.