3GPP TSG RAN meeting #102
Edinburgh, Scotland, December 11-15, 2023

RP-233775

Agenda Item: 9.1.4.5

Qualcomm

Views on Other RAN4 Topics for Release 19

Qualcomm Incorporated

Summary

- General
- RF Spec Issues
- RRM Spec Issues

RAN4 Specification Quality

Specification Issues

- RAN4 UE specification quality is worrisome for both RRM (38.133) and RF (38.101-X)
  - Large number of maintenance CRs in each meeting, some even for Rel-15
  - Large amount of time spent clarifying the specifications
  - RAN4 workload makes it impossible to thoroughly check CRs and propose/discuss improvements
- RRM Specification Issues – 38.133
  - Very large size (already split into multiple files)
  - Extremely difficult to understand what the actual requirements are and how they apply
  - See examples on subsequent slides
- RF Specification Issues – 38.101-X
  - Files very difficult to scroll through (see also RP-233776 on CA framework overhaul)
  - Many ambiguities, many sub-features defined separately instead of a general framework (e.g. PC handling with CA), many dependencies on implementation details
- RAN4 should spend time on fixing the specifications
  - Setting up a dedicated WI for spec improvement is an option to consider
  - These issues should be understood and resolved before the work on next generation starts

RRM Specification Issues (38.133)

- Issues in the specifications
  - Too many corner cases, too many parameters and conditions to define a requirement (see number of “ifs” for a requirement).
  - Applicability conditions for requirements are becoming more complex and hard to capture clearly and concisely in plain English. This is partly due to interactions between multiple features. In many cases the wording used in the specification is cumbersome and unnecessarily lengthy, making it harder to understand the requirements.
  - Excessive duplication of requirements that are common across multiple scenarios or features. This practice increases the burden of maintaining the specifications; corrections are needed in multiple places to fix a single issue. In addition, there is negative impact on usability due to larger file sizes.
  - RAN4 would benefit by developing process improvements and guidelines for drafting CRs
    - Develop guidelines for drafting requirements with complex logic. Discuss whether to adopt a pseudo-code approach at least in some cases.
    - Develop guidelines to avoid/discourage excessive duplication of requirements in the specifications.
    - Develop guidelines for WI planning (work plan) so that enough time is allocated to drafting/reviewing/revising CRs.
    - Consider adopting a running-CR approach to allow more time for draftCRs to be reviewed and revised across multiple RAN4 meetings before submitting them to RAN for approval.

RF Specification Issues (38.101-X)

- Issues in the specifications
  - Specs depend too much on implementation details (e.g. number of antenna connectors, number of PAs, etc)
  - Many sub-features defined separately instead of having a general framework(e.g. PC handling with CA)
  - Many ambiguities which can lead to different interpretations
  - See Annex for some concrete examples

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Thank you

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Annex 1 - RRM Spec issues

Complicated specifications

- Example on the left is just a part of the requirement on cell identification
  - Complete requirement is about twice longer

$T_{identify_intra_without_index} = (T_{PSS/SSS_sync_intra} + T_{SSB_measurement_period_intra})$ ms

$T_{identify_intra_with_index} = (T_{PSS/SSS_sync_intra} + T_{SSB_measurement_period_intra} + T_{SSB_time_index_intra})$ ms

Where:

T_{PSS/SSS_sync_intra}: it is the time period used in PSS/SSS detection given in table 9.2.5.1-1, 9.2.5.1-2, 9.2.5.1-4 (deactivated SCell) or 9.2.5.1-5 (deactivated SCell) or 9.2.5.1-9 (deactivated SCell) or 9.2.5.1-11 or 9.2.5.1-12 (deactivated PSCell) or 9.2.5.1-13 (deactivated PSCell).

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, T_{PSS/SSS_sync_intra} is given in Table 9.2.5.1-11; otherwise, T_{PSS/SSS_sync_intra} is given in Table 9.2.5.1-2.

$T_{SSB_time_index_intra}$: it is the time period used to acquire the index of the SSB being measured given in table 9.2.5.1-3, 9.2.5.1-15 (FR2-2), 9.2.5.1-6 (deactivated SCell), 9.2.5.1-10(deactivated SCell) or 9.2.5.1-14 (deactivated PSCell).

$T_{SSB_measurement_period_intra}$: equal to a measurement period of SSB based measurement given in table 9.2.5.2-1, table 9.2.5.2-2 table 9.2.5.2-3 (deactivated SCell), 9.2.5.2-4(deactivated SCell), 9.2.5.2-5 or 9.2.5.2-6(deactivated SCell), 9.2.5.2-8(deactivated PSCell) or 9.2.5.2-9(deactivated PSCell).

- For UE supporting power class 6 with *highSpeedMeasFlagFR2-r17* configured, if SMTC <= 40ms, $T_{SSB_measurement_period_intra}$ is given in Table 9.2.5.2-7; otherwise, $T_{SSB_measurement_period_intra}$ is given in Table 9.2.5.2-2.

$CSSF_{intra}$: it is a carrier specific scaling factor and is determined

according to $CSSF_{outside_gap,i}$ in clause 9.1.5.1 for measurement conducted outside measurement gaps, i.e. when intra-frequency SMTC is fully non overlapping or partially overlapping with measurement gaps or NCSG, or according to $CSSF_{within_gap,i}$ in clause 9.1.5.2 for measurement conducted within measurement gaps, i.e. when intra-frequency SMTC is fully overlapping with measurement gaps, or according to $CSSF_{within_ncsg,i}$ in clause 9.1.5.3 for measurement conducted within NCSG, i.e. when intra-frequency SMTC is fully overlapping with NCSG.

For a UE that supports Pre-MG, an SMTC occasion is only considered to be overlapped by Pre-MG if the Pre-MG is activated.

if the high layer in TS 38.331 [2] signalling of *smtc2* is configured, the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc2*; Otherwise the assumed periodicity of intra-frequency SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

$M_{pss/sss_sync_w/o_gaps}$: For a UE supporting FR2-1 power class 1 or 5, $M_{pss/sss_sync_w/o_gaps}$ =40. For a UE supporting power class 2, $M_{pss/sss_sync_w/o_gaps}$ =24. For a UE supporting FR2-1 power class 3, $M_{pss/sss_sync_w/o_gaps}$ =24. For a UE supporting FR2-1 power class 4, $M_{pss/sss_sync_w/o_gaps}$ =24. For a UE supporting FR2-2 power class 1, $M_{pss/sss_sync_w/o_gaps}$ = 60. For a UE supporting FR2-2 power class 2, $M_{pss/sss_sync_w/o_gaps}$ = 36. For a UE supporting FR2-2 power class 3, $M_{pss/sss_sync_w/o_gaps}$ = 36.

$M_{meas_period_w/o_gaps}$: For a UE supporting FR2-1 power class 1 or 5, $M_{meas_period_w/o_gaps}$ =40. For a UE supporting FR2-1 power class 2, $M_{meas_period_w/o_gaps}$ =24. For a UE supporting FR2-1 power class 3, $M_{meas_period_w/o_gaps}$ =24.

Source sample text

Annex 2 - RF Spec issues

Ambiguities in the spec

Intra-band CA

- Intra-band UL CA section, single CC maximum power (6.2.1) applies when only one component carrier is configured for UL
  - It implies that when two component carriers are configured for UL, then maximum power applies from 6.2A.1
  - Ambiguity whether requirement applies when only one CC is activation or when the scheduled UL is in a single CC?
- In MPR section, MPR is defined for contiguous allocation but contiguous allocation is also when only one CC is allocated
  - Improvement would be to state which maximum power and MPR applies in which condiotions

6.2A.1.1 UE maximum output power for Intra-band contiguous CA

For uplink intra-band contiguous carrier aggregation, the maximum output power is specified in Table 6.2A.1.1-1. For downlink intra-band contiguous carrier aggregation with a single uplink component carrier configured in the NR band, the maximum output power is specified in Table 6.2.1-1 for power class 3 and other power classes if indicated in clause 5.5A.1.

Table 6.2A.1.1-1: UE Power Class for intra-band contiguous CA

6.2A.2.1 UE maximum output power reduction for Intra-band contiguous CA

For intra-band contiguous carrier aggregation the allowed Maximum Power Reduction (MPR) for the maximum output power in 6.2A.1.1-1 with contiguous RB allocation is specified in Table 6.2A.2.1-1 for UE power class 3 CA bandwidth classes B and C. The MPR with contiguous RB allocation is specified in Table 6.2A.2.1-1a for power class 2 CA bandwidth classes B and C when the signalling is absent for *dualPA-Architecture* IE, and for power class 2 CA bandwidth classe C when the signalling is indicated for *dualPA-Architecture* IE. The MPR with contiguous RB allocation is specified in Table 6.2A.2.1-1b for power class 2 CA bandwidth classes B and C with TxD supported.

For CA bandwidth class B and bandwidth class C with contiguous RB allocation, the following parameters are defined to specify valid RB allocation ranges for Inner and Outer RB allocations:

An RB allocation is contiguous if $L_{CRB1} = 0$ or $L_{CRB2} = 0$ or ($L_{CRB1} \neq 0$ and $L_{CRB2} \neq 0$ and $RB_{Start1} + L_{CRB1} = N_{RB1}$ and $RB_{Start2} = 0$), where RB_{Start1}, L_{CRB1}, and N_{RB1} are for CC1, RB_{Start2}, L_{CRB2}, and N_{RB2} are for CC2, CC1 is the component carrier with lower frequency.

In contiguous CA, a contiguous allocation is an inner allocation if

For CA bandwidth classes B and C with non-contiguous RB allocation, the following parameters are defined to specify valid RB allocation ranges for Inner, Outer1 and Outer2 RB allocations:

Non-Contiguous RB allocation is defined as $RB_{Start1} + L_{CRB1} < N_{RB1}$, or $RB_{Start2} > 0$, when both uplink CCs are activated and allocated with RB(s), where RB_{Start1}, L_{CRB1}, and N_{RB1} are for CC1, RB_{Start2}, L_{CRB2}, and N_{RB2} are for CC2, CC1 is the component carrier with lower frequency.

In contiguous CA, a non-contiguous RB allocation is a non-contiguous Inner RB allocation if the following conditions are met:

Ambiguitites in spec

Inter-band UL CA

- The word assigned is ambiguous, it can be allocated(scheduled RBs) or activated or configured.
  - Just to note that the current ongoing work for defining the applicability of powerClass, ue-PowerClass and ue-PowerClassPerBandPerBC is partly because of this ambiguity. Many TUs used for this work and discussion is scattered in many agendas, reply-LS, both Rel-15 maintenance and rel-17 maintenance

6.2A.1.3 UE maximum output power for Inter-band CA

For inter-band downlink carrier aggregation with one uplink carrier assigned to one NR band, the transmitter power requirements in Table 6.2.1-1 apply for power class 3 and other power classes if indicated in clause 5.5A.3.

For inter-band carrier aggregation with two uplink contiguous carrier assigned to one NR band, the transmitter power requirements specified in subclause 6.2A.1.1 apply.

For inter-band carrier aggregation with two uplink non-contiguous carrier assigned to one NR band, the transmitter power requirements specified in subclause 6.2A.1.2 apply. For inter-band uplink carrier aggregation with uplink assigned to two NR bands, UE maximum output power shall be measured over all component carriers from different bands. If each band has separate antenna connectors, maximum output power is defined as the sum of maximum output power from each UE antenna connector. The period of measurement shall be at least one sub frame (1 ms). The maximum output power is specified in Table 6.2A.1.3-1.

Ambiguities in the spec

UL MIMO

- The specification states that “For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the allowed Maximum Power Reduction (MPR) …“
- Ambiguity on what is the spec when UE is scheduled for PUCCH (only 1-port exists) and PUSCH (2-layer or 2-port 1-layer) in the same slot
  - UE here would be without ULFPTx PC2
  - In 1-port Table 6.2.2-2 would apply
  - In 2-port Table 6.2D.2-1 would apply
  - But between two transmissions, different MPR would apply
- Spec improvement would be to define the conditions when what applies:
  - One option is to define to apply based on maxRank in pusch-Config or maxMIMO-Layers in PUSCH-ServingCellConfig for all transmissions (details TBD)
  - Or then only based on uplink grant, like this part says but it not in MPR section

6.2D.2 UE maximum output power reduction for UL MIMO

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2D.1-1 is specified in Table 6.2.2-1for PC3, Table 6.2D.2-1 for 2Tx PC2 when the UE does not indicate ul-FullPwrMode-r16 or ul-FullPwrMode2-TPMIGroup-r16 for the band and Table 6.2.2-2 for 2Tx PC2 when the UE indicates ul-FullPwrMode-r16 or ul-FullPwrMode2-TPMIGroup-r16 for the band, Table 6.2D.2-2 and Table 6.2D.2-3 for PC1.5 respectively. For UE power class 1.5, the allowed maximum power reduction (MPR) defined in Table 6.2D.2-3 is in accordance with the indicated *modifiedMPR-Behavior* specified in Table L.1-1 for channel bandwidths ≤ 100 MHz. The requirements shall be met with UL MIMO configurations defined in Table 6.2D.1-2. For UE supporting UL MIMO, the maximum output power is defined as the sum of the maximum output power from both UE antenna connectors.

For UE support uplink full power transmission (ULFPTx) for UL MIMO except the feature *ul-FullPwrMode-r16* or *ul-FullPwrMode2-TPMIGroup-r16*, the allowed MPR for the maximum output power in Table 6.2D.1-1 is specified in Table 6.2.2-1 for PC3, Table 6.2D.2-1 when *TxD* is indicated and Table 6.2.2-2 when *TxD* is not indicated for PC2 , Table 6.2D.2-2 and Table 6.2D.2-3 for PC1.5 respectively, and the requirements shall be met with the PUSCH configurations specified in Table 6.2D.1-3, based upon UE’s support of uplink full power transmission mode. A UE indicating the feature *ul-FullPwrMode-r16* or *ul-FullPwrMode2-TPMIGroup-r16* for a band shall meet the maximum output power requirement with MPR according to clause 6.2.2. When a UE that indicates PC1.5 for a given band is limited to PC2 by the rules in clause 6.2.1, the MPR requirements in Table 6.2.2-2 apply. For UE support uplink full power transmission (ULFPTx) for UL MIMO, the maximum output power is defined as the sum of the maximum output power from both UE antenna connectors.

The same MPR requirements shall be applicable to UE with 1-layer UL MIMO transmission (either with or without ULPFTx) as with the UL MIMO configurations of using 2-layer UL MIMO transmission with codebook of $\frac{1}{\sqrt{2}}\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$.

For the UE maximum output power modified by MPR, the power limits specified in clause 6.2D.4 apply.

For the UE maximum output power modified by MPR, the power limits specified in clause 6.2D.4 apply.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0_0 or by DCI format 0_1 for single antenna port codebook based transmission, the corresponding requirements in clause 6.2D.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signaling. A UE indicating the feature *ul-FullPwrMode-r16* or *ul-FullPwrMode2-TPMIGroup-r16* for a band shall meet the requirement in clause 6.2 with MPR according to clause 6.2.2