3GPP TSG-RAN WG4 Meeting #110-bis
Changsha, China, 15 – 19 April, 2024

R4-2405605

On RRM specification quality improvement

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Background

- RAN#103 approved an WF (RP-240782) for RAN4 spec quality improvement

> - The RAN4 Rel-19 specifications are expected to be available by December 2024.
> - RAN4 will organize the discussions for improving the specifications in Q2 and Q3 2024 in RAN4 meeting(s), and report to RAN#104 and RAN#105
> - Focus on 38.133 and 38.101-1/38.101-2/38.101-3, not covering other specifications in this RAN task
> - Motivation of the work:
> - Try to improve the above specifications for Rel-19 for 5G in the short term
> - Try to conclude on guidance including the structure, drafting rule to ensure the quality of specifications for UE RF and RRM.
> - Set up one dedicated agenda to collect the input from companies for specification improvement
> - Companies are expected to point out the key issues and also provide the concrete solutions.
> - No corresponding CR is expected before September
> - Schedule the specific time slot for the single discussions on the specification improvement in RAN4 main session starting from April
> - Identify the key issues and root reasons behind
> - Summarize the candidate solutions for the next action
> - Further discuss and decide how to capture the outcome of this RAN task in RAN#105

- In this paper, we provide our views on the key issues in the RRM spec quality and solutions for quality improvement.

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Key issues in RRM spec quality (examples in Annex)

- Discrepancy
  - > different approaches for adding requirements for new feature, extending existing clauses or creating new clauses
  - > same or similar issues, some with defined requirements while some not
  - → This will reduce the readability, and sometimes may cause ambiguity related to applicability
- Complexity and Unclarity
  - > too many branches/cases or too many applicability conditions for a requirement
  - > Main point of requirements are not made accurately and clearly
  - → This will cause difficult for people not involved in the discussion, e.g. product people, to understand the requirements
- Duplication
  - > some duplication are based on agreement, but many are unnecessary and avoidable
  - > same or similar requirements defined in different formats or wording in multiple places across the spec
  - → This will make maintenance spec more and more difficult

Most of the issues are due to insufficient time and efforts for CR planning, drafting and checking

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Proposed solutions

- Work plan / procedure improvement to allow more time to plan, draft and check CRs, e.g.
  - earlier start on CR discussion rather than the last 2 meetings,
  - agree on CR structure or sample CR,
  - check interaction among WIs when approving formal CR at the end of release
- Provide drafting rule for better alignment and interpretation
  - avoid complex requirements,
  - generic principle for adding requirements for new features,
  - encourage more use of figure, table or pseudo-code for better interpretation
- Other improvement for better reading and traceability, e.g.
  - allow keeping comments for better explanation, e.g. maintaining a simple TR with references to Tdocs like CRs/WFs
  - allow keeping information for each requirement such as the WI or the CRs introduces the requirements

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Annex: examples of spec quality issues

- Discrepancy:
  - > same feature: RedCap positioning in INACTIVE
  - > different measurements: RSTD and Rx-Tx
  - > one clause includes the full requirements, the other clause includes a reference to non-RedCap requirements with full set of applicability conditions

This discrepancy can be avoided if there was alignment among companies how to add requirements for this new feature

5.6A.4.5 Measurement period requirement without FH

After receiving both *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-TDOA-RequestLocationInformation* message from the LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.6A.4.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period $T_{RSTD,Total}$ defined as:

$$T_{RSTD,Total} = \sum_{i=1}^{L} T_{RSTD,i} + (L-1) \times \max(T_{effect,i})$$

Where:

- i is the index of positioning frequency layer,
- L is total number of positioning frequency layers, and
- $T_{effect,i}$ is the periodicity of the PRS RSTD measurement in positioning frequency layer i

$T_{RSTD,i}$ is the measurement period for PRS RSTD measurement in positioning frequency layer i as specified below:

$$T_{RSTD,i} = \left(K_{carrier_PRS_RedCap} \times N_{Rx,TEG,i} \times N_{RxBeam,i} \times \left\lceil \frac{N_{PRS,i}^{slot}}{N'} \right\rceil \times \left\lceil \frac{L_{available_PRS,i}}{N} \right\rceil \times N_{sample} - 1\right) \times T_{effect,i} + T_{last,i},$$

5.6A.6.5 Measurement Period Requirements without FH

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34], UE shall be able to measure multiple (up to the UE capability specified in clause 5.6.4.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period $T_{UERxTx,Total}$ ms defined in 5.6.4.5.

If the RRC state transion occurs from RRC_INACTIVE to RRC_CONNECTED state during the UE Rx-Tx time difference measurement period then the UE shall restart the UE Rx-Tx time difference measurement after it obtains SRS configuration and Timing Advance command from the serving cell.

If cell reselection occurs during the UE Rx-Tx time difference measurement period then the UE shall restart the UE Rx-Tx time difference measurement after it obtains SRS configuration and Timing Advance command from the new serving cell.

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Annex: examples of spec quality issues

- Complexity and Unclarity :
  - > SCell activation requirements for single SCell in clause 8.3.2 is more than 6 pages long and includes 10 cases, with many parameters and conditions
  - > There are also other clauses for other SCell activation related requirements in clause 8.3
  - > Figure in right is just requirements for unknown SCell in FR1 (without definitions for parameters and conditions)

This complexity can be reduced at least by a better structure and more proper use of indentation (whether we need to cover so many cases is subject to technical discussion).

If the SCell is unknown and belongs to FR1, and if one of the following conditions is met

- 'ssb-PositionInBurst' indicates only one SSB is being actually transmitted, or
- 'ssb-PositionInBurst' indicates multiple SSBs and TCI indication is provided in same MAC PDU with SCell activation,

provided that the side condition Ês/Iot ≥ -2dB is fulfilled, $T_{activation_time}$ is:

- $T_{FirstSSB_MAX} + T_{SMTC_MAX} + T_{rs}$ + 5ms, if the following conditions are met,
  - the SCell is contiguous to an active serving cell in the same band, and
  - its *ssb-PositionInBurst* is same as the one of contiguous FR1 active serving cell, and
  - its SMTC offset is same as the one of contiguous FR1 active serving cell, and
  - its RTD with contiguous FR1 active serving cell is smaller than or equal to 260ns with respect to the to-be-activated SCell's SSB numerology, and its reception power difference with contiguous FR1 active serving cell is smaller than or equal to 6dB;
- $T_{FirstSSB_MAX} + T_{SMTC_MAX} + 2*T_{rs}$ + 5ms, otherwise.

otherwise, provided that the side condition Ês/Iot ≥ -2dB is fulfilled, $T_{activation_time}$ is:

- 6ms + $T_{FirstSSB_MAX} + T_{SMTC_MAX} + T_{rs} + T_{L1\text{-}RSRP,measure} + T_{L1\text{-}RSRP,report} + T_{HARQ} + \max(T_{uncertainty_MAC} + T_{FineTiming}$ + 2ms, $T_{uncertainty_SP})$, if semi-persistent CSI-RS is used for CSI reporting,
- 3ms + $T_{FirstSSB_MAX} + T_{SMTC_MAX} + T_{rs} + T_{L1\text{-}RSRP,measure} + T_{L1\text{-}RSRP,report} + \max(T_{HARQ} + T_{uncertainty_MAC}$ + 5ms + $T_{FineTiming}$, $T_{uncertainty_RRC} + T_{RRC_delay})$, if periodic CSI-RS is used for CSI reporting.
- However, when the following conditions are fulfilled, no activation requirement will be applied for this unknown SCell:
  - the SCell is contiguous to an active serving cell in the same band, and
  - A single SSB is used in the unknown SCell; or multiple SSBs are used in the SCell and TCI state indication for PDCCH is provided by the same MAC PDU used for SCell activation; and
  - its *ssb-PositionInBurst* is same as the one of contiguous FR1 active serving cell, and
  - its SMTC offset is same as the one of contiguous FR1 active serving cell
  - its RTD with contiguous FR1 active serving cell is larger than 260ns with respect to the to-be-activated SCell's SSB numerology, or its reception power difference with contiguous FR1 active serving cell is larger than 6dB;

Annex: examples of spec quality issues

The intra-frequency measurement requirements in clause 9.2.5 applies for the following scenarios:

- SSB based intra-frequency measurements with no measurement gap,
  - for a UE supporting concurrent gaps and when concurrent gaps are configured:
    - When none of the SMTC occasions of this intra-frequency measurement object are overlapped by the union of concurrent measurement gaps.
    - When part of the SMTC occasions of this intra-frequency measurement object are overlapped by the union of concurrent measurement gaps.
  - otherwise, for a UE not supporting concurrent gaps or if concurrent gaps are not configured:
    - When none of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.
    - When part of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.
  - SSB based intra-frequency measurements object with no measurement gap for UE capable of [*NeedForInterruptionNR-r18*],

9.1.5.1 Monitoring of multiple layers outside gaps

For a UE supporting concurrent gaps or [concurrent gaps with Pre-MG] or [concurrent gaps with NCSG], and when concurrent [gaps] are configured the carrier-specific scaling factor $CSSF_{outside_gap,i}$ for measurement object *i* derived in this chapter is applied to following measurement types :

- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when none of the SMTC occasions of this intra-frequency measurement object are overlapped by the union of concurrent [GAPs].
- SSB-based intra-frequency measurement with no measurement gap in clause 9.2.5 and 9.2A.5, when part of the SMTC occasions of this intra-frequency measurement object are overlapped by the union of concurrent [GAPs].
- CSI-RS based intra-frequency measurement in clause 9.10.2, when none of CSI-RS resources for L3 measurement of this intra-frequency measurement object are overlapped by the union of concurrent [GAPs].
- CSI-RS based intra-frequency measurement in clause 9.10.2, when all CSI-RS resources for L3 measurement of this intra-frequency measurement object are partially overlapped by the union of concurrent [GAPs].
- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when none of the SMTC occasions of this inter-frequency measurement object are overlapped by the union of concurrent [GAPs], if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.
- SSB-based inter-frequency measurement with no measurement gap in clause 9.3.9, when part of the SMTC occasions of this inter-frequency measurement object are overlapped by the union of concurrent [GAPs], if UE supports *interFrequencyMeas-NoGap-r16* and the flag *interFrequencyConfig-NoGap-r16* is configured by the Network.

- Duplication:
  - > Defining whether a measurements should be taken within or outside MG requires complex requirements, and same requirements are defined in both delay part (9.2.1/9.3.1) and CSSF part (9.1.5) in different wording (above figures)
  - > There are two formats for the definition of Kp for L3 measurement and P factor for L1 measurement, and they leads to the same technical outcome.

  This duplication can be avoided if more time is allowed to review and discuss the CRs before they have to be agreed to complete WI on time.

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