**3GPP TSG-RAN4 Meeting #96-eR4-20xxxxx**

**, 24th Aug -**

**Agenda item:** **xx**

**Source: Apple**

**Title: Email discussion of R17 RRM enhancement**

**Document for:** **Approval**

# Introduction

In this contribution, the possible technical points for R17 RRM enhancement are listed, and RAN4 is targeting to determine the working scope of R17 RAN4 led WI(s) based on the agreed proposals from this contribution.

# New proposals for R17 RRM further enhancement

The following new proposals for R17 RRM enhancement are collected from the following WID proposals in RAN #88e.

|  |  |  |
| --- | --- | --- |
| TDoc | Title | Source |
| RP-200641 | New WID on NR RRM requirement for UE different RX beam sets in FR2 | LG Electronics Inc. |
| RP-200813 | New WID on NR RRM requirement enhancements in Rel-17 | ZTE Corporation |
| RP-200926 | New WID on NR RRM further enhancement in Rel-17 | CATT |
| RP-200939 | Motivation to introduce new R17 WI on further RRM enhancement | MediaTek Inc. |
| RP-201030 | New WID proposal: further RRM enhancement | Huawei, HiSilicon |
| RP-201101 | WID of REL-17 NR RRM further enhancement | Apple, Intel |

## NR RRM requirement for UE different RX beam sets in FR2 [RP-200641]

In Rel-15 and Rel-16, FR2 NR RRM requirements have been specified without considering how to select a set of RX beams to perform RRM measurement on a carrier. According to RAN1 agreement in [R1-1805760], different sets of RX beams can be used in measurements based on different measurement objects.

For a UE using different sets of RX beams, the measured and reported RSRP can be bias by RX beamforming gain, i.e., up to difference between fine beam and rough beam. It is problematic for Network to decide cell change based on the reported RSRP. In other word, RLF can occur abnormally. Therefore, RAN4 should investigate some solutions for it and specify the related requirements.

1. Study mobility due to UE different RX beam sets between different MOs in FR2 [RAN4]
   * Example, fine beam for MO1(serving cell) and rough beam for MO2(neighboring cell)
2. Introduce RRM requirements and signalling for UE different RX beam sets based on the outcome of study phase[RAN4, RAN2]

**Summary of companies’ views on NR RRM requirement for UE different RX beam sets in FR2**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We are fine to do some study on the solutions to address the issue. However, we should be careful if beamforming gain difference among different RX beam sets are to be standardized. It may result in restriction of UE implementation. |

## CSI-RS based L3 mobility [RP-200813, RP-200926]

New proposals for CSI-RS based L3 mobility [RAN4]

* Specify intra frequency measurement requirements for the case that the BW of the target CSI-RS resources is not within the active BWP of the UE (ZTE, CATT)
* Specify inter frequency measurement requirements for the case that the BW of the target CSI-RS resources is within the active BWP of the UE (ZTE, CATT)
* Specify inter frequency measurement requirements for the case that CSI-RS resource of serving cell is not available in all configured MOs (ZTE, CATT)
* Specify RRM requirements for the case when no associatedSSB is configured or not detected (ZTE, CATT)
* Specify RRM requirements for the case that CSI-RS resources in the same MO have different BWs (ZTE, CATT)
* CSI-RS are not QCLed with the associated SSB (CATT)

**Summary of companies’ views on new proposals for CSI-RS based L3 mobility**

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| --- | --- |
| Company | Views and comments |
| Intel | Most of the objectives have been widely discussed in R16. However, they were not finalized due to consideration of UE complexity and performance. We believe the concern may still be there even in R17. It is better to have further justification on how typical these scenarios are. Some input from operators and infra venders can be helpful. |

## RRC release with redirection enhancement [RP-200813]

RRC release with redirection enhancement [RAN4]

* Discuss and decide the value of reduced RRC processing delay for RRC release with redirection
* Specify RRM core requirements if necessary

**Summary of companies’ views on RRC release with redirection enhancement**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We don’t think there will be any impact on RRM core requirements. The potential impact is on corresponding test requirements. Our question is whether the intension is to update the RRC processing delay from R15 or R17? |
|  |  |

## RLM enhancement requirement [RP-200926]

RLM enhancement requirement

* Specify the second IS/OOS BLER pair for VoNR service;

**Summary of companies’ views on RLM enhancement requirement**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We support the objective. The second IS/OOS BLER has already been supported in RAN1 since R15. However, it cannot be correctly implemented since no corresponding RAN4 requirements. |
|  |  |

## SRS antenna port switching [RP-200926, RP-200939, RP-201101]

NR SRS antenna port switching [RAN4] (CATT, MTK, Apple)

* Specify RRM interruption requirement of NR SRS antenna port switching for NR SA, NR-DC, EN-DC and NE-DC.
  + NR SRS antenna port switching impacting LTE CC
  + NR SRS antenna port switching impacting NR CC

**Summary of companies’ views on SRS antenna port switching**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We support the objective. |
|  |  |

## Active TCI-state switch for CSI reporting via CSI-RS reconfiguration [RP-200939]

Active TCI-state switch for CSI reporting via CSI-RS reconfiguration [RAN4]

* Introduce the delay requirements for active TCI-state switch for CSI reporting via CSI-RS, including
  + New TCI state is configured for the same CSI-RS for CQI
  + New CSI-RS configuration with new TCI state is configured to replace the previous CSI-RS configuration
* Specify UE behavior when the TCI-state for PDSCH is different to the TCI-state for CSI-RS for CSI reporting

**Summary of companies’ views on active TCI-state switch for CSI reporting via CSI-RS reconfiguration**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We are open to do some study. However, this enhancement is considered as less critical compared with others, since the scenario can be avoided by network. |
|  |  |

## Gapless measurement [RP-200939, RP-201030]

Enhanced gapless measurement [RAN4]

* Study the principles in determining whether the carrier, which can be measured both within and outside measurement gaps and when gaps are configured, should be measured within gaps or outside gaps (Huawei)
* Specify RRM requirements, based on the agreed principles, for carriers that can be measured both within and outside measurement gaps
  + Impacts at least the CSSF outside gaps and CSSF within gaps (MTK, Huawei)
  + Measurement delay (MTK)
  + Interruption due to RF re-tuning. (MTK)
* Note: Assumption is that the measurement requirements for *gapIndication-r16*=*’no-gap*’ has been introduced in Rel-16 following same principle as inter-frequency measurement without gap in Rel-16 RRM Enhancement WI.

**Summary of companies’ views on gapless measurement**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Technically fine. However, we don’t consider this as critical enhancement and consider low priority for this objective. On one hand, mathematically, it might take a lot of time to develop a generic principle in determining whether the carrier, which can be measured both within and outside measurement gaps and when gaps are configured, should be measured within gaps or outside gaps. On the other hand, considerable gain may only be achieved when measurement situation is quite complicated. But in our understanding, this may not be the typical scenario. |
|  |  |

## [Study phase] Enhanced DCI-based BWP switch in FR2 [RP-200939]

DCI-based BWP switch in FR2 [RAN4, RAN2]

* Study the feasibility to introduce shortened delay for the DCI-based BWP switch in FR2
  + The study should consider the conclusions of Rel-16 BWP-related feature, e.g., SCell dormancy, MIMO layer adaptation, and BWP switch in multiple CCs.
  + According to the conclusions, corresponding RRC signaling or UE capability support may be needed.

**Summary of companies’ views on [Study phase] Enhanced DCI-based BWP switch in FR2**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We already have two different UE capabilities on this. Is the intention to study something even shorter than Type-1 requirement? If so, we don’t think there is too much room for further enhancement. Even so, the gain is quite limited. If the target is something between Type-1 and Type-2 requirements, we are open to study. |
|  |  |

## Inter-RAT NR measurement without gaps when configured with EN-DC [RP-201030]

Inter-RAT NR measurement without gaps when configured with EN-DC [RAN4]

* Define the conditions under which UE can perform inter-RAT measurement without gaps when configured with EN-DC
* Specify RRM requirements for inter-RAT measurement without gaps when configured with EN-DC
  + The RRM requirements for inter-frequency measurement without gaps defined in Rel-16 are used as starting point
* Define related UE capability, if necessary

**Summary of companies’ views on Inter-RAT NR measurement without gaps when configured with EN-DC**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | In our understanding the motivation is to enable gapless inter-RAT NR measurement configured by E-UTRAN when the target SSB is fully confined within UE NR active BWP. If our understanding is correct, it is better to clarify this in the objective. |
|  |  |

## BFR based on CBRA [RP-201030]

BFR based on CBRA [RAN4]

* Study the UE behavior in BFR when none of the resources in set q1 is valid for CFRA, e.g.
  + Time point when UE triggers measurement for CBRA based BFR
  + DL and UL QCL assumption after CBRA based BFR
* Specify RRM requirements for BFR based on CBRA

**Summary of companies’ views on BFR based on CBRA**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We are open to this. |
|  |  |

## HO with PSCell [RP-201030]

HO with PSCell [RAN4]

* Determine the scenarios for HO with PSCell for which RRM requirements are to be specified
  + from NR SA to EN-DC
  + from EN-DC to EN-DC
  + from NE-DC to NE-DC
  + from NR-DC to NR-DC
* Study the UE behavior for HO with PSCell
  + Existing requirements for HO and PSCell addition as baseline
  + Timeline and interaction between HO and PSCell addition
* Specify RRM requirements for HO with PSCell based on agreed UE behavior

**Summary of companies’ views on HO with PSCell**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We are open to this. Existing requirement can be used as starting point. |
|  |  |

## RRM Enhancement for larger CC number [RP-201101]

RRM Enhancement for larger CC number [RAN4]

* Study and, if necessary, introduce UE capability with searcher number greater than 2 and specify the corresponding new RRM requirements
* Study and specify enhanced RRM measurement mechanism and requirements for FR2 intra-band and inter-band CA with large CC number.

**Summary of companies’ views on RRM Enhancement for larger CC number**

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| --- | --- |
| Company | Views and comments |
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|  |  |

## PUCCH SCell activation/deactivation [RP-201101]

PUCCH SCell activation/deactivation [RAN4]

* Specify SCell Activation Delay Requirement for Deactivated PUCCH SCell (including valid TA and invalid TA)
* Specify SCell Activation Delay Requirement for Deactivated PUCCH SCell with Multiple SCells (including valid TA and invalid TA)
* Specify SCell Deactivation Delay Requirement for Activated PUCCH SCell
* Specify SCell Deactivation Delay Requirement for Activated PUCCH SCell with Multiple SCells.

**Summary of companies’ views on PUCCH SCell activation/deactivation**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Support. The procedure has already been supported in other working groups in earlier release. |
|  |  |

## IDLE mode requirement for SMTC2-LP [RP-201101]

IDLE mode requirement for SMTC2-LP [RAN4]

* Specify corresponding RRM requirement for SMTC2-LP in IDLE mode

**Summary of companies’ views on IDLE mode requirement for SMTC2-LP**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Support. |
|  |  |

## TCI switching enhancement in REL-17 [RP-201101]

TCI switching enhancement in REL-17 [RAN4, RAN1]

* Work on the feasibility of enhancement to maintain the UE reception and transmission during the period (or part of period) of MAC CE based TCI switching
* Work on the feasibility of enhancement to maintain the UE reception and transmission during the period (or part of period) of RRC based TCI switching

**Summary of companies’ views on TCI switching enhancement in REL-17**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Support. |
|  |  |

## Non-simultaneous UL carrier operation in FR2 [RP-201101]

Non-simultaneous UL carrier operation in FR2

* RRM requirements for non-simultaneous transmission on aggregated intra-band non-contiguous FR2 UL carriers (up to the conclusion and progress in RF session)

**Summary of companies’ views on non-simultaneous UL carrier operation in FR2**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | It was not introduced in R16. We need to check if this is in the scope of R17 RF. If so, then RRM objectives can be added after RF session has conclusions. |
|  |  |

## [NR-U related] CGI reading enhancements [RP-201101]

CGI reading enhancements [RAN4, RAN2]

* Specify requirements for reporting the CGI of a cell using CCA in the downlink
* Investigate enhancements to minimize interruptions in SIB1 decoding based on providing UE with assistance information on potential occasions when SIB1 will and will not be scheduled using the SI-RNTI
  + The investigation should assume that all cells on a frequency layer will use the same occasions for potential SIB1 transmission
  + According to implementation, the assistance information may also be used by the UE for other procedures involving SIB1 decoding such as reducing power consumption during reselection, however this does not impact specification requirements.

**Summary of companies’ views on [NR-U related] CGI reading enhancements**

|  |  |
| --- | --- |
| Company | Views and comments |
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|  |  |

## Others

Note: Other new proposals would be captured here if have.

# New proposals for R17 measurement gap enhancement

The following new proposals for R17 MG are collected from the following WID proposals in RAN #88e.

|  |  |  |
| --- | --- | --- |
| TDoc | Title | Source |
| RP-201000 | Motivation for new WI on Measurement Gap Enhancements | Qualcomm Incorporated |
| RP-201101 | WID of REL-17 NR RRM further enhancement | Apple, Intel |
| RP-201115 | New WID Proposal: NR measurement gap enhancements | Intel Corporation, Apple |

## Network Controlled Small Gap (NCSG) specification [RP-201000]

Network Controlled Small Gap (NCSG) specification [RAN4, RAN2]

* RRM requirements for NCSG [RAN4]
  + Requirements for Visible Interruption Length (VIL) for different numerologies in FR1 and FR2
  + Specification of NCSG patterns, Measurement Length (ML), and Visible Interruption Repetition Period (VIRP)
  + Requirements for DL reception and UL transmission during ML, before start VIL and after end VIL
  + Measurement requirements with NCSG
* Specification of applicability of NCSG patterns [RAN4]
* Signaling design for NCSG patterns [RAN2]

**Summary of companies’ views on network Controlled Small Gap (NCSG) specification**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We are open to this. |
|  |  |

## Burst gap patterns specification [RP-201000]

Burst gap patterns specification [RAN4, RAN2]

* RRM requirements for burst gap patterns [RAN4]
  + Specification of gap burst length (N), applicable MGRPs, and burst periodicity
  + Measurement requirements with burst gap pattern
* Specification of applicability of burst gap patterns [RAN4]
* Signaling design for burst gap patterns [RAN2]

**Summary of companies’ views on burst gap patterns specification**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Technically fine. However, this enhancement is considered with less critical as others. |
|  |  |

## Multiple concurrent and independent MG patterns [RP-201000, RP-201115]

Multiple concurrent and independent MG patterns [RAN4, RAN2]

* RRM requirements for concurrent and independent MG/SMTC patterns [RAN4]
  + Define maximum number of concurrent and independent MG/SMTC patterns active at any time
  + Specification of multiple concurrent MG patterns (MGL, MGRP)/ SMTC patterns and constraints on total NW overhead
  + Specification of rules and UE behavior for proximity of MG instances in time, priority, and partial or full overlap of MG instances
* Specification of applicability of multiple concurrent and independent gap patterns [RAN4]
* Signaling design for simultaneous RRC (re-)configuration of one or more gap patterns [RAN2]

**Summary of companies’ views on multiple concurrent and independent MG patterns**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Support. Multiple concurrent SMTC patterns can bring significant flexibility to network deployment and increase mobility performance. Multiple MG patterns can be used to cover this scenario. On the other hand, enabling parallel MG pattern for measurement with different purpose can also increase efficiency and network performance. |
|  |  |

## [Positioning related] New measurement gap patterns for PRS measurement [RP-201000, RP-201115]

New measurement gap patterns for PRS measurement [RAN4, RAN2] (Intel, Qualcomm)

* Study the feasibility of new measurement gap patterns for PRS measurement [RAN4]
* Study the feasibility of using new measurement gap patterns (including the ones introduced in R16 NR Positioning) for legacy RRM requirement [RAN4]
* Introduce RRM requirement and signaling design based on the outcome of study phase [RAN4]
  + Introduce new measurement gap patterns if needed [RAN4]
  + Update measurement gap applicability if needed [RAN4]
  + RRC signaling support of new measurement gap patterns if needed [RAN2]

**Summary of companies’ views on [Positioning related] New measurement gap patterns for PRS measurement**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Support. To increase MG based PRS measurement performance and MG efficiency, it’s desirable to discuss the feasibility of more new MG patterns for PRS measurement and the impact on legacy RRM requirement. |
|  |  |

## On-demand UE-initiated MG request [RP-201000]

On-demand UE-initiated MG request [RAN4, RAN2]

* Specification of rules for UE-initiated MG request, conflict resolution with existing MG configured by NW, UE behavior when requested MG is not granted [RAN4]
* Signaling design for on-demand UE-initiated MG request for NCSG, burst gap patterns, multiple concurrent independent gap patterns, and new and existing MG patterns [RAN2]

**Summary of companies’ views on on-demand UE-initiated MG request**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We are open to study. However, we prefer to let network control the actual MG configuration |
|  |  |

## Pre-configured MG pattern(s) per configured BWP (fast MG configuration) [RP-201000, RP-201115]

Pre-configured MG pattern(s) per configured BWP (fast MG configuration) [RAN4, RAN2] (Qualcomm, Intel)

* RRM requirements for pre-configured MG pattern(s) per configured BWP [RAN4]
  + Define maximum number of MG pattern(s) per configured BWP and maximum number of total MG patterns per UE
  + Specification of rules and UE behavior for activation/deactivation of a MG following a DCI or MAC-CE based BWP switch
  + Define measurement period requirements with pre-configured MG pattern(s) per configured BWP in the presence of one or more BWP switch per measurement period
* Specification of applicability of pre-configured MG pattern(s) per configured BWP [RAN4]
* Signaling design for pre-configured MG pattern(s) per configured BWP [RAN2]

**Summary of companies’ views on pre-configured MG pattern(s) per configured BWP (fast MG configuration)**

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| --- | --- |
| Company | Views and comments |
| Intel | Support. BWP switching is more dynamic than MG configuration. Since it’s rather difficult for network to configure and de-configure MG according to BWP switching, network may always configure MG e.g. for intra-frequency measurement, and consequentially it will cause throughput loss to both network and UE side in case some of the MGs are unnecessary for intra-frequency measurement |
|  |  |

## Per-CC MG configuration [RP-201000]

Per-CC MG configuration [RAN4, RAN2]

* RRM requirements for per-CC MG configuration [RAN4]
  + Interruption requirements on CCs configured with MG and CCs not configured with MG
  + Measurement requirements for CCs configured with MG
* Specification of applicability of per-CC MG configuration [RAN4]
* Signaling design of per-CC MG configuration and design of capability signaling [RAN2]

**Summary of companies’ views on Per-CC MG configuration**

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| --- | --- |
| Company | Views and comments |
| Intel | We are open to this. We expect that this can be rather straightforward and does not take much efforts in RAN4. |
|  |  |

## MG sharing enhancement [RP-201115]

MG sharing enhancement [RAN4, RAN2]

* Study mobility benefit and data throughput impact as well as UE complexity to enhance the MG sharing mechanism to offer network operators more flexibility on prioritize certain measurement (e.g., measurement on certain RAT) [RAN4]
* Introduce RRM requirements and signaling design according to the outcome of study phase of MG sharing enhancement [RAN4, RAN2]
  + MG sharing enhanced mechanism [RAN4]
  + RRM measurement with enhanced MG sharing mechanism [RAN4]
  + RRC signaling support for MG sharing enhancement if needed [RAN2]

**Summary of companies’ views on MG sharing enhancement**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Support. The singling bit string for MG sharing is quite limited in R15/R16. For instance, LTE plays a key role in EN-DC operation from mobility perspective. So depending on different demands from different network operators, it would be much beneficial if the MG sharing mechanism can allow network to prioritize any RAT measurement. Thus, it’s desirable to enhance the MG sharing mechanism and signalling to offer network operators more flexibility on prioritize any RAT measurement. |
|  |  |

## [Study phase] Enhanced utilization of UL slots before and after measurement gap [RP-200939]

Enhanced utilization of UL slots before and after measurement gap [RAN4, RAN2]

* Study the mechanism to allow UE to report the timing difference between gap boundary and UL slots boundary to network for the purpose of enhancing the utilization of (partial) UL slots before and after measurement gap
  + The study should consider at least different measurement gap configurations, e.g., per-UE gap or per-FR gap, with or without measurement gap timing advance, and different timing advance groups.
  + The study should consider the frequency, accuracy and granularity for UE to reporting this timing difference.
  + According to the conclusions, corresponding RRC signaling, MAC mechanism or UE capability support may be needed

**Summary of companies’ views on [Study phase] Enhanced utilization of UL slots before and after measurement gap**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We are open to study. However, we may not consider this as critical enhancement. |
|  |  |

## [NR-U related] Measurement gap enhancements for NR-U [RP-201101]

Measurement gap enhancements for NR-U [RAN4, RAN2]

* Specify requirements for UEs capable of independent RF operation (i.e. without interruptions) between licenced and unlicensed bands. This capability between licenced fr1 bands and nr-u bands above 5ghz would be analogous to the per FR measurement gap capability between FR1 and FR2.

**Summary of companies’ views on [NR-U related] Measurement gap enhancements for NR-U**

|  |  |
| --- | --- |
| Company | Views and comments |
|  |  |
|  |  |

## Others

Note: Other new proposals would be captured here if have.

# Leftover topics from R16 RRM enhancement

The following leftover topics for R17 RRM enhancement are collected from the “Summary of email discussion [R16\_NR\_RRM] remaining work on Rel-16 NR RRM” (RP-201344), exception sheet (RP-201341) and corresponding WID proposals in RAN #88e.

|  |  |  |
| --- | --- | --- |
| TDoc | Title | Source |
| RP-201344 | Summary of email discussion [R16\_NR\_RRM] remaining work on Rel-16 NR RRM, including CSI-RS measurement and NR positioning | Intel |
| RP-201101 | WID of REL-17 NR RRM further enhancement | Apple, Intel |
| RP-200813 | New WID on NR RRM requirement enhancements in Rel-17 | ZTE Corporation |
| RP-201341 | Rel-16 WI exception for Core part: NR RRM enhancement | Intel, ZTE, Apple |

## UL spatial relation change requirement for BC bit-0 UE [issue 1 in section 1 of RP-201344]

Remaining issue for UL spatial relation change [RAN4]

* UL spatial relation change requirement for BC bit-0 UE

**Summary of companies’ views on UL spatial relation change requirement for BC bit-0 UE**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Depends on the progress of ongoing discussion. May need to be revisited after RAN4#96e. |
|  |  |

## SRS carrier switching requirement for inter-band FR2 CA [issue 2 in section 1 of RP-201344]

RRM requirement for SRS carrier switching requirement for inter-band FR2 CA [RAN4]

**Summary of companies’ views on SRS carrier switching requirement for inter-band FR2 CA**

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| --- | --- |
| Company | Views and comments |
| Intel | We are open to this. |
|  |  |

## Multiple SCell activation/deactivation requirement in FR2 inter-band CA [issue 3 in section 1 of RP-201344]

RRM requirement for multiple SCell activation/deactivation requirement in FR2 inter-band CA [RAN4]

**Summary of companies’ views on multiple SCell activation/deactivation requirement in FR2 inter-band CA**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Technically fine. We may not consider this as high priority. Network can also trigger SCell activation in sequence. |
|  |  |

## UE transmit timing adjustment enhancement [RP-200813, issue 5 in section 1 of RP-201344]

UE transmit timing adjustment enhancement [RAN4]

* Discussion and Decision on UE transmit timing adjustment mechanism when there is large downlink timing jump
* Specify RRM core requirements for new UE transmit timing adjustment mechanism
* Discussion and Decision whether to introduce the requirements in release independent manner.

**Summary of companies’ views on UE transmit timing adjustment enhancement**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | It is fine for us to continue studying one shot timing adjustment. However, it seems unrelated to issue 5 in section 1 of RP-201344, which is about UL spatial relation switch. |
|  |  |

## [eMIMO related] Applicable timing for pathloss RS activated/updated by MAC-CE [RP-200813]

Applicable timing for pathloss RS activated/updated by MAC-CE [RAN4]

* Specify Applicable timing for pathloss RS activated/updated by MAC-CE when the RS is unknown
* Specify RRM requirements for MAC-CE based pathloss RS activation when the RS is unknown to the UE

Note: Whether this topic is needed depending on discussion in the RAN4#96-e meeting.

**Summary of companies’ views on applicable timing for pathloss RS activated/updated by MAC-CE**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | Depends on progress in RAN4#96e. on the other hand, targeting unknown RS is with low priority. |
|  |  |

## Others [RP-201341]

More leftover topics might be included in the Rel-17 scope based on the discussion of topics in RP-201341, and the on-going topics are duplicated as below.

|  |
| --- |
| **RAN4 part**  RRM requirement:  1. BWP switching on multiple CCs   * Definition of N in simultaneous DCI- and timer-based BWP switching on multiple CCs * Definition of D in simultaneous RRC based BWP switching on multiple CCs * RRM requirement for partial overlapped timer-based BWP switching on multiple CCs   2. UL spatial relation change   * Whether to consider timing tracking when associated DL-RS for sub1. and sub2. * Whether and how to define requirement for UL signal which has spatial relation to an unknown DL RS   3.SRS carrier-based switching requirements   * FFS interruption requirements for case 1, case 2 and case 3.   + Case 1: CA is co-location deployed   + Case 2: Single TAG CA, or carriers in the same TAG for multiple TAG CA   + Case 3: uplink time difference does not exceed a threshold X     - X = [5] us   + Note: SRS carrier switching requirement for inter-band FR2 CA is out of scope   4. CGI reading requirements with autonomous gap   * MIB decoding delay for FR2 * SNR conditions for SIB1 decoding delay requirements * Value of timer T321 for FR2   5. FR2 inter-band CA RRM   * The interruption requirements for CBM UE. * The scheduling restrictions and measurement restrictions due to incorrect network configuration * The unknown SCell activation requirement for CBM UE in case2.   + Case 2: SCell being activated belongs to FR2 and if there is no active serving cell on that FR2 band provided that PCell or PSCell is FR2. * Note: In case the requirements for CBM are not finalized in RAN4 #96e, no Rel-16 requirements will be introduced. |

# Leftover topics from R16 CSI-RS L3 measurement

The following leftover topics from R16 CSI-RS L3 measurement are collected from the “Summary of email discussion [R16\_NR\_RRM] remaining work on Rel-16 NR RRM” (RP-201344) and exception sheet (RP-201340) in RAN #88e.

|  |  |  |
| --- | --- | --- |
| TDoc | Title | Source |
| RP-201344 | Summary of email discussion [R16\_NR\_RRM] remaining work on Rel-16 NR RRM, including CSI-RS measurement and NR positioning | Intel |
| RP-201345 | Rel-16 WI Exception for Core part: RRM requirement for CSI-RS based L3 measurement in NR | CATT |

## CMTC for CSI-RS L3 measurement [issue 5 in section 2 of RP-201344]

CMTC for CSI-RS L3 measurement [RAN4, RAN2]

* RRM requirement based on CMTC for CSI-RS L3 measurement
* Signaling design for CMTC of CSI-RS L3 measurement

**Summary of companies’ views on CMTC for CSI-RS L3 measurement**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | We are open to this. |
|  |  |

## Others [RP-201340]

More leftover topics might be included in the Rel-17 scope based on the discussion of topics in RP-201340, and the on-going topics are duplicated as below.

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| --- |
| * CSI-RS configuration applicability   + FFS on whether to define additional configuration {D=1 with PRBs ≥ 96}     - Note: In case the requirements are not finalized in RAN4 #96e, no Rel-16 requirements will be introduced for {D=1 with PRBs ≥ 96}.Topic will be handled with low priority. * Scope of requirement   + whether UE is required to perform Rx beam sweeping for CSI-RS based L3 measurement * UE capability   + New UE capability on the simultaneous reception of CSI-RS of neighbour cell and SSB of serving cell   + New UE capability for minimum separation between two slots     - Note: can be handled with low priority * UE measurement capability requirement   + Relation between CSI-RS layer and SSB layer   + Whether multiple MOs can be counted as one frequency layer   + How to count SSB frequency layers   + Number of CSI-RS layers/cells/beams * Cell identification requirement   + whether to introduce 2 different requirements for with index and without index   + the tuning time of inter-frequency GAP   + time-domain restriction on CSI-RS resources configuration   + note: CMTC for CSI-RS L3 measurement is out of scope * Scheduling restriction on the following cases   + when UE is not able to support mixed numerology of data and CSI-RS L3 mobility   + when UE performs CSI-RS intra-frequency measurements in a TDD band   + when UE performs RX beam sweeping * The collision case between L1 measurement of serving cell and CSI-RS L3 measurement of neighbour cell * CSSF for CSI-RS based measurement within measurement gap and outside of measurement gap. * Synchronization assumption for CSI-RS measurement |

# Leftover topics from R16 NR positioning

The following leftover topics for R17 positioning enhancement are collected from the “Summary of email discussion [R16\_NR\_RRM] remaining work on Rel-16 NR RRM” (RP-201344) and exception sheet (RP-201343) in RAN #88e.

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| --- | --- | --- |
| TDoc | Title | Source |
| RP-201344 | Summary of email discussion [R16\_NR\_RRM] remaining work on Rel-16 NR RRM, including CSI-RS measurement and NR positioning | Intel |
| RP-201343 | Rel-16 WI Exception for Core part: NR positioning support | Intel |

## UE behavior for the case of active BWP switching during PRS measurement [issue 2 in section 3 of RP-201344]

RRM requirement for UE behavior for the case of active BWP switching during PRS measurement [RAN4]

**Summary of companies’ views on UE behavior for the case of active BWP switching during PRS measurement**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | As long as the PRS measurement is done in MG, no need to define this. |
|  |  |

## Concurrent PRS processing and RRM measurements [issue 3 in section 3 of RP-201344]

RRM requirement for concurrent PRS processing and RRM measurements [RAN4]

**Summary of companies’ views on concurrent PRS processing and RRM measurements**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | As long as the PRS measurement is done in MG, no need to define this. |
|  |  |

## Scheduling restrictions for PRS measurements in FR1 [issue 5 in section 3 of RP-201344]

RRM requirement for scheduling restrictions for PRS measurements in FR1 [RAN4]

**Summary of companies’ views on scheduling restrictions for PRS measurements in FR1**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | As long as the PRS measurement is done in MG, no need to define this. |
|  |  |

## Others [RP-201343]

More leftover topics might be included in the Rel-17 scope based on the discussion of topics in RP-201343, and the on-going topics are duplicated as below.

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| --- |
| RAN4 remaining issues:  TS 38.133 requirements   1. PRS RSTD measurement requirements:  * Measurement period requirement * Measurement capability  1. UE Rx-Tx time difference measurement requirements:  * Measurement period requirement * Measurement capability  1. PRS RSRP measurement requirements  * Measurement delay requirement * Measurement capability  1. Other RRM impacts  * New measurement gap patterns for positioning measurements and impacts on existing RRM measurements   + Note: In case RRM requirements for new MG are not finalized in RAN4#96-e then no new MG will be introduced in Rel-16. |

# Leftover topics from R16 NR-U RRM

The following leftover topics for R17 NR-U RRM are collected from the “Summary of email discussion on NR-U Exception sheet” (RP-201323) and exception sheet (RP-201387) in RAN #88e.

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| --- | --- | --- |
| TDoc | Title | Source |
| RP-201323 | Summary of email discussion on NR-U Exception sheet | Qualcomm |
| RP-201387 | Rel-16 WI Exception for Core part: NR-based access to unlicensed spectrum | Qualcomm |

## CSI-RS based RRM for NR-U [proposal 1 of RP-201323]

CSI-RS based RRM requirements for NR-U (L3 measurement, L1 measurement, RLM, BM, etc.) [RAN4]

**Summary of companies’ views on CSI-RS based RRM for NR-U**

|  |  |
| --- | --- |
| Company | Views and comments |
| Intel | CSI-RS based RRM requirements are quite complicated. Even for licensed band there are quite a lot of leftover in R16 CSI-RS WI. We don’t think current CSI-RS related RRM requirements are stable enough to be extended to unlicensed band. On the other hand, NR-U can still work based on SSB based RRM. |
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## Others [RP-201387]

More leftover topics might be included in the Rel-17 scope based on the discussion of topics in RP-201387, and the on-going topics are duplicated as below.

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| --- |
| Core part: RRM Open issues in RAN4 are   * Remaining issues in cell reselection regarding definition of unavailable SMTC, definition of Ms, and max number of unavailable SMTC before UE starts cell detection again * Remaining issues in SCell activation interruption window specification; activation/deactivation requirements when *ScellDeactivationTimer* is not configured * Remaining issues in Active TCI state switching: UE behavior in RRC-based TCI state switching upon exceeding the maximum number of DL LBT failures * Ending point of UL BWP switching delay upon detection of consistent UL LBT failure. * Remaining issues in RLM and LR:   + OOS requirements for SSB-based RLM   + the set of SSB’s UE is required to monitor   + BFD requirements * Remaining issues in Measurements:   + UE behaviour in case of successively exceeding the maximum number of DL LBT failure during measurements   + UE behaviour in RRC\_CONNECTED mode when the serving cell is unavailable for consecutive SSB bursts   + Applicability of the signaling of SMTC2 to NR-U   + Scheduling restriction during RSSI/CO measurements (stretch goal)   + UE behavior when receiving the MAC CE deactivation command for semi-persistent CSI reporting, in case of UL LBT failure for sending the ACK   + L1-RSRP reporting delay for semi-persistent CSI reporting with PUCCH   + RSSI measurement period (stretch goal)   + Different requirements for LBE (dynamic channel access) and FBE (semi static channel access)   + Number of candidate SSBs the UE is required to monitor during intra and inter-frequency measurements and cell detection   + RSSI measurement bandwidth (stretch goal) |

# Conclusion

In this contribution, we discuss the possible technical points for R17 RRM enhancement, and RAN4 is targeting to determine the working scope of R17 RAN4 led WI(s) based on the agreed proposals from this contribution.

# References