**3GPP TSG RAN Meeting #100 RP-230xxx**

**Taipei, June 12-14, 2023**

## Status Report to TSG

**Agenda item:** **9.3.1.3**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **WI / SI Name** | Further NR coverage enhancements | | | | |
| included in this status report | Study Item:  No | Core part:  Yes | Performance part:  Yes | | Testing part:  No |
| **Acronym** | NR\_cov\_enh2 | | | | |
| **Unique ID** | 940095 | | | | |
| **TSG Tdoc of latest approved WI/SI description (if any)** | RP-221858 | | | | |
| **Target Completion Date**  **(indicate if changed)** | Study Item:  NA | Core part: 12/2023 | Performance part: 06/2024 | Testing part:  NA | |
| **Overall Completion level** | Study Item:  NA | Core part:  60% | Performance Part:  0% | Testing part:  NA | |

Note: Overall completion level percentage numbers should use one of the colors below:

* xx%: Normal progress, no RAN plenary action needed
* xx%: Progress behind schedule, may need RAN plenary intervention. If so, SR should clearly define requested action
* xx%: Progress critically behind, RAN plenary shall intervene. SR should define requested action

**Source:**

|  |  |  |
| --- | --- | --- |
| **Leading WG** | | RAN WG1 |
| **Rapporteur** | **Name** | Nanxi LI |
| **Company** | China Telecom |
| **Email** | linanxi@chinatelecom.cn |

## 1 Work plan related evaluation

|  |  |
| --- | --- |
| **Do you want to modify the time budget for this WI/SI compared to what was endorsed at the last RAN meeting?** | No |

*If you answered No: Then please remove the Excel file from the zip file of this status report.*

*If you answered Yes: Then please fill out the attached Excel template to request a modification of the time budgets for your WI /SI. The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI. The basis are the endorsed time budgets of the last RAN meeting. Please highlight all changes of the values.  
 One time unit (TU) corresponds to ~ 2 hours in the meeting.  
 If this status report covers a WI with Core and Performance part, then please have one line for each in the attached Excel table.  
 Note: If no Excel table is attached, then this means no time budget change.*

## 2. Detailed progress in RAN WGs since last TSG meeting (for all involved WGs)

## 2.1 RAN1

#### 2.1.1 Agreements

RAN1 #112bis-e

**PRACH enhancements:**

Agreement

Confirm the following working assumptions.

|  |
| --- |
| Working Assumption  For multiple PRACH transmissions with same Tx beam, to differentiate the multiple PRACH transmissions with single PRACH transmission, at least support that multiple PRACH are transmitted on separate ROs.   * Note: Separate RO means that the RO is separated with single PRACH transmission. * FFS: whether Rel-17 framework of feature combination (*FeatureCombination-r17*) and additional RACH configuration (*AdditionalRACH-Config-r17*) can be reused for Rel-18 multiple PRACH transmissions to realize the corresponding PRACH resource partitioning.   Working Assumption  For multiple PRACH transmissions with same Tx beam, to differentiate the multiple PRACH transmissions with single PRACH transmission, support that multiple PRACH are transmitted with separate preamble on shared ROs.   * Note: Shared or separate RO/preamble means that the RO/preamble is shared or separated with single PRACH transmission. * FFS: whether Rel-17 framework of feature combination (*FeatureCombination-r17*) and additional RACH configuration (*AdditionalRACH-Config-r17*) can be reused for Rel-18 multiple PRACH transmissions to realize the corresponding PRACH resource partitioning. |

Agreement

Send LS to inform RAN2 about the 2 confirmed Working Assumptions, and details on how to realize PRACH resource partitioning is up to RAN2.

Conclusion

There is no consensus to support multiple PRACH transmissions within one RACH attempt located at same time instance in Rel-18.

Note: multiple PRACH transmissions within one RACH attempt located at same time instance includes multiple PRACH transmissions in FDMed ROs located at the same time instance and multiple PRACH transmissions with different preambles in the same RO.

Conclusion

There is no consensus to support utilizing different preambles during the multiple PRACH transmissions with the same Tx beam in one attempt.

Agreement

* Multiple PRACH transmissions within one RACH attempt are only performed within one RO group.
  + The number of valid ROs in the RO group is equal to one of the configured number(s) of multiple PRACH transmissions.
    - Note1: If only one value is configured for multiple PRACH transmissions, then the number of valid ROs in the RO group is equal to this value.
    - Note2: If multiple values are configured for multiple PRACH transmissions, for each value, the number of valid ROs in the RO group is equal to the corresponding number of multiple PRACH transmissions.
    - Note 3: Valid RO(s) refers to what is defined in existing specification.

Agreement

Final LS [R1-2304141](file:///C:\MyMeetings\TSGR1_112b-e\Docs\R1-2304141.zip) is approved.

Agreement

The starting point of RAR window is after the last symbol of the last valid RO in the RO group corresponding to the multiple PRACH transmissions.

Note: Valid RO(s) refers to what is defined in existing specification, i.e., Section 8.1 in TS 38.213.

Note: The last valid RO is irrespective of whether the PRACH transmission on the last valid RO in the RO group is dropped or not.

**Power domain enhancements:**

Agreement

* If FDSS-SE is supported in Rel-18, DMRS are mapped on PRBs of both inband and extension and gNB can assume that they are filtered using the same Tx shaping filter as data.
* FFS: whether and which optimizations to Rel-15 and/or Rel-16 DMRS, including sequence extension and/or mapping, to be used with FDSS-SE, are needed.
* Note: whether this will have RAN1 specification impact (if any) is a separate discussion and subject to RAN4’s conclusion to support FDSS-SE as one MPR/PAR reduction solution for Rel-18 (if any).

**Observation**

RAN1 discussed advantages and disadvantages of solutions included in [R1-2302270](file:///C:\MyMeetings\TSGR1_112b-e\Docs\R1-2302270.zip) (R4-2303701) on enhancements to realize increasing UE power high limit for CA and DC. Pros and cons of the inclusion in the PHR report of at least one of the following quantities have been analyzed for different reporting mechanisms, triggers, and reporting periodicities:

* ∆PPowerClass
* Power class
* P-MPR
* Start and length of evaluation period for power class fallback
* Estimated duration of power class fallback
* Estimated duration over which UE can sustain Pcmax before additional P-MPR is required
* Sustainable duty cycle to prevent a fallback
* Energy/power availability

Note: Discussion is still ongoing, and its full current content can be found in Section 2.1.2 of [R1-2303924](file:///C:\MyMeetings\TSGR1_112b-e\Docs\R1-2303924.zip).

**Dynamic switching between DFT-S-OFDM and CP-OFDM:**

Agreement

For DCI format 0\_1/0\_2 containing dynamic waveform indication, bit width of each field is set to the maximum between the bit width of the field if transform precoding is disabled and the bit width of the field if transform precoding is enabled, if different.

* If, for the waveform indicated in the DCI, the bit width N of a field would be smaller than the bit width of the field set as per the above, UE decodes the field using N least significant bits. If N=0, the UE ignores the field for the indicated waveform.

Agreement

For potential enhancements to assist the scheduler in determining waveform switching, RAN1 to select 1 from the following options:

* Option 1: Reporting of power headroom information for a reference PUSCH using target waveform different from waveform of actual PUSCH.
  + Details FFS.
  + Note: reporting PH information for both waveforms is not precluded.
  + Note: additional trigger for PH for reference PUSCH is not precluded.
* Option 2: New trigger of power headroom report based on waveform switching event.
  + Details FFS.
* Option 3: Both Option 1 and Option 2.
  + Details FFS.
* Option 4: No enhancement.

Conclusion

For PUSCH transmission scheduled by C-RNTI with DCI format 0\_0, UE considers transform precoding enabled or disabled according to *msg3-transformPrecoder* as in legacy.

Agreement

Dynamic waveform switching is configured separately for each BWP, within *PUSCH-Config*.

Agreement

For UE configured with multi-PUSCH scheduling in time domain in a carrier *(*i.e. *pusch-TimeDomainAllocationListForMultiPUSCH*), DCI format 0\_1 supports 1-bit field for dynamic waveform switching indication.

* When configured, 1-bit field indicates waveform for all scheduled PUSCH transmissions.

Agreement

For PUSCH scheduled by DCI format 0\_1/0\_2 with dynamic waveform switching indication field configured, and *useInterlacePUCCH-PUSCH* is not configured, downselect between following options:

* Option 1 (configuration restriction with error case handling):
  + UE does not expect *resourceAllocation* set to *resourceAllocationType0*.
  + If DFT-S-OFDM is indicated and *resourceAllocation* set to *dynamicSwitch*, UE does not expect MSB of FDRA field set to 0.
* Option 2 (UE only uses *resourceAllocation* if CP-OFDM is indicated):
  + If DFT-S-OFDM is indicated, UE applies type 1 resource allocation.
  + If CP-OFDM is indicated, UE applies resource allocation according to *resourceAllocation* IE.
  + Size of FDRA field is aligned between size for type 1 resource allocation and size according to *resourceAllocation* IE.

Agreement

For PUSCH scheduled by DCI format 0\_1/0\_2 with dynamic waveform switching indication field configured, downselect between following options:

* Option 1 (configuration restriction with error case handling):
  + UE does not expect *dmrs-Type* to be set to *type2*.
* Option 2 (UE only uses *dmrs-Type* if CP-OFDM is indicated):
  + If DFT-S-OFDM is indicated, UE applies DMRS type 1.
  + If CP-OFDM is indicated, UE applies DMRS type according to *dmrs-Type*.

Agreement

For configuration of 1-bit dynamic waveform switching indication in DCI format 0\_1/0\_2 per a carrier, downselect between following options:

* Option 1: Separate configuration of presence of dynamic waveform switching field for DCI format 0\_1 and DCI format 0\_2.
* Option 2: Common configuration of presence of dynamic waveform switching field for DCI format 0\_1 and DCI format 0\_2.

RAN1 #113

**PRACH enhancements:**

Agreement

A set of RO group(s) for a configured number of multiple PRACH transmissions is determined/configured within a time period X, starting from frame 0. The determined/configured set of RO groups repeats every time period X.

* + The time period X is *K* SSB-to-RO association pattern periods.
  + Note: Whether/how to introduce SSB-to-RO group mapping
  + FFS: *K* is configured by the network or determined based on some rule.

Conclusion

If multiple values for the number of multiple PRACH transmissions are configured, support both options to differentiate between multiple PRACH transmissions with different numbers.

* Option 1: Multiple PRACH transmissions with different numbers are transmitted on separate ROs.
* Option 2: Multiple PRACH transmissions with different numbers are transmitted with separate preamble on shared ROs.

Note: Shared or separate RO/preamble means that the RO/preamble is shared or separated between multiple PRACH transmissions with different numbers.

Agreement

If one or more PRACH transmission(s) of the multiple PRACH transmissions in one PRACH attempt are dropped based on the rules causing to drop PRACH transmission(s) in existing spec., the dropped PRACH transmission(s) is not postponed.

* + FFS: whether to introduce new rules causing to drop PRACH transmission.
  + FFS: whether there is standard impact if the dropped PRACH transmission affect the remaining PRACH transmission within the same RO group.

Agreement

RA-RNTI is calculated based on the last valid RO in the RO group corresponding to the multiple PRACH transmissions.

Note 1: Valid RO(s) refers to what is defined in existing specification, i.e., Section 8.1 in TS 38.213.

Note 2: The last valid RO is irrespective of whether the PRACH transmission on the last valid RO in the RO group is dropped or not.

Conclusion

There is no consensus to support Multiple PRACH transmission with different Tx beams in Rel-18.

Agreement

For RO group determination for multiple PRACH transmissions, following parameters are considered.

* The candidate number of multiple PRACH transmissions, e.g. {2,4,8}, is/are explicitly configured.
  + The number of ROs within one RO group can be implicitly determined accordingly.
  + Default value(s) is/are not precluded
* The number of SSB-to-RO association pattern periods *K* within the time period X, down select from the following options.
  + **Option 1:** *K* is explicitly configured.
  + **Option 2:** *K* is implicitly determined
  + **Option 3:** *K* is a fixed value for all number of multiple PRACH transmissions.
* Determination of starting RO for each RO group for each value of the number of multiple PRACH transmissions, down select from the following options.
  + **Option 1:** Index/indices of the starting RO(s) of the RO group(s) is/are explicitly indicated.
    - FFS: whether other parameters configured by gNB to allow density control and/or RO group(s) position alignment for multiple configured numbers
    - FFS: whether only the starting RO of the first RO group is explicitly indicated, and the starting ROs of the other RO groups are implicitly determined.
    - FFS: other ROs for each RO group
  + **Option 2:** The time start position and the frequency start position of the first valid RO for each RO group are implicitly determined.
    - FFS: other ROs for each RO group
    - FFS: whether other parameters configured by gNB to allow density control and/or RO group(s) position alignment for multiple configured numbers
* FFS: The frequency hopping offset, if frequency hopping is supported.
* FFS: RO group specific preamble if multiple PRACH transmissions with different numbers are transmitted with separate preamble on shared ROs
* FFS: Time span of the RO group
* All other legacy parameters for single PRACH transmission can be reused, if applicable.

Agreement

* For multiple PRACH transmissions with separate preamble on shared ROs, reuse legacy SSB to RO mapping rule, and only the ROs mapped to SSBs for single PRACH transmission can be used for multiple PRACH transmissions.

Agreement

* For multiple PRACH transmissions on separate ROs, down-select one of the following options:
  + Option 1: SSB-to-RO group mapping is introduced.
  + Option 2: Reuse legacy SSB to RO mapping rule

**Power domain enhancements:**

**Agreement**

If FDSS-SE is supported in Rel-18, for the case of DMRS sequence length before extension of the sequence, if any, larger than or equal to 30, legacy DMRS sequences are used with FDSS-SE.

RAN1 to down-select in RAN1 #114 only one of the following alternatives:

* Alternative A:
  + Sequence length determination is based on the number of PRBs in the total allocation
  + Legacy mapping procedure is used over the total allocation
* Alternative B:
  + Sequence length determination is based on the number of PRBs in the inband.
  + The sequence is cyclically extended to span the number of PRBs in the total allocation.
  + FFS: whether the mapping of the DMRS sequence to the REs start from the first PRB of the total allocation or from the first PRB of the inband.
* Alternative C
  + Sequence length determination is based on the number of PRBs in the inband.
  + Mapping and extension of the DMRS sequence is performed like for data.

FFS: the case of DMRS sequence length before extension of the sequence, if any, smaller than 30.

FFS: whether this applies to Low-PAPR Type 2 DMRS

Note: down-selection should be based at least on OBO evaluations, as well as delta(SNR). Other metrics, e.g., PAPR and CM, can also be considered.

Working Assumption

* If FDSS-SE is supported in Rel-18:
* transport block size is calculated using the number of PRBs in the inband.
* The number of PRBs used to determine the DFT size for transform precoding is the number of PRBs in the inband.
* FFS: how the number of PRBs/subcarriers in the inband is determined by the UE, i.e., details about FDRA indication

Agreement

* If FDSS-SE is supported in Rel-18, RAN1 to down-select in RAN1 #114 only one of the following options for spectrum extension configuration:
  + Option 1: Spectrum extension is [configured/indicated/determined] using an extension factor. One or more extension factors are supported
  + Option 2: Spectrum extension is [configured/indicated/determined] using an even number of PRBs. One or more candidate number of PRBs is supported
* FFS: details.
* Note: whether this has impact on DCI or not or has further specification impact or not is a separate discussion and is also subject to RAN4’s conclusion to support FDSS-SE in Rel-18.

Agreement

* If FDSS-SE is supported in Rel-18:
* The number of resource blocks used to determine the PUSCH transmission power is the number of PRBs in the total allocation
* FFS: how the number of PRBs/sub-carriers in the inband and total allocation is determined by the UE, i.e., details about FDRA indication

**Conclusion**

If enhancements to the PHR report are to be specified in Rel-18, at least the following enhancements to the PHR report framework might be potentially useful for realizing high power uplink transmissions in CA and DC:

* Reporting of ∆PPowerClass and/or current power class
* Reporting of P-MPR.

Discussion continues in RAN1 on whether enhancements to the PHR report are needed in Rel-18.

**Working Assumption**

If FDSS-SE is supported in Rel-18:

* For PT-RS symbol mapping, the index *m* of PT-RS samples in OFDM symbol *l* prior to transform precoding is a function of the number of sub-carriers in the inband.

FFS: how the number of PRBs/sub-carriers in the inband and total allocation is determined by the UE, i.e., details about FDRA indication

**Dynamic switching between DFT-S-OFDM and CP-OFDM:**

**Agreement**

Configuration of dynamic waveform switching indicator field, for a BWP, is separately configurable between DCI format 0\_1 and DCI format 0\_2.

Agreement

For potential enhancements to assist the scheduler in determining waveform switching, RAN1 to select 1 from the following options:

* Option 1: Reporting of power headroom information for a reference PUSCH using target waveform different from waveform of actual PUSCH.
* Details FFS.
* Note: Any MAC CE related decision is up to RAN2
* Option 4: No enhancement.

#### 2.1.2 Remaining Open issues

* PRACH coverage enhancements
  + Detailed mechanism(s) to support multiple PRACH transmissions with same beams for 4-step RACH procedure.
* Power domain enhancements
  + Study and if necessary specify enhancements to realize increasing UE power high limit for CA and DC based on Rel-17 RAN4 work on “Increasing UE power high limit for CA and DC”, in compliance with relevant regulations.
  + Study and if necessary specify enhancements to reduce MPR/PAR, including frequency domain spectrum shaping with and without spectrum extension for DFT-S-OFDM and tone reservation.
* Detailed mechanism(s) to support dynamic switching between DFT-S-OFDM and CP-OFDM.

## 2.2 RAN2

#### 2.2.1 Agreements

RAN2 #121bis-e

Agreements

* RAN2 assumes that MSG1 repetition can be applicable to all 4-step CBRA procedures (FFS for SI request)
* CFRA support is FFS

Agreements

* RAN2 assumes that MSG1 repetition can be applicable to NUL
* RAN2 assumes that MSG1 repetition can be applicable to SUL

Agreements

* Msg1 repetition with different repetition number {2, 4, 8} are treated a separate feature, and a RACH partition is associated with a specific repetition number (Stage 3 details are FFS, e.g. we should not use all the spare values in the current IE)

Agreements

* RAN2 waits for further inputs from RAN1 for how to associate RA-RNTI to the PRACH occasion for multiple PRACH transmissions and also for ra-ResponseWindow start point

Agreements

* General assumption is that various feature combinations can be configured (which is up to network implementation), unless explicitly specified otherwise
* RAN2 will not support the fallback from legacy RA to Msg1 repetition and vice versa; Other fall back scenarios are FFS

Agreements

* BWP selection mechanism is not impacted by PRACH coverage enhancements. Legacy BWP selection mechanism is re-used
* RA type selection mechanism is not impacted by PRACH coverage enhancements. Legacy RA type selection mechanism is re-used

RAN2 #122

Agreements

* MSG1 repetition can be applicable to the 4-step CBRA procedure initiated by Msg3-based SI request
* FFS for MSG1 repetition can be applicable to the 4-step CBRA procedure initiated by Msg1-based SI request.

Agreements

* RAN2 intends to support CFRA for msg1 repetition for ReconfigurationWithSync case, FFS for other cases.

Agreements

* RAN2 to agree to configure multiple RSRP thresholds for different repetition numbers.
* The RSRP threshold(s) for triggering Msg1 repetition are configured per-BWP.

#### 2.2.2 Remaining Open issues

* Specify following PRACH coverage enhancements (RAN1, RAN2)
  + Multiple PRACH transmissions with same beams for 4-step RACH procedure
  + Note 1: The enhancements of PRACH are targeting for FR2, and can also apply to FR1 when applicable.
  + Note 2: The enhancements of PRACH are targeting short PRACH formats, and can also apply to other formats when applicable.

## 2.3 RAN3

#### 2.3.1 Agreements

#### 2.3.2 Remaining Open issues

## 2.4 RAN4

#### 2.4.1 Agreements

RAN4 #106bis-e

The progress in RAN4 #106bis-e meeting is summarized below:

* The draft CR to TS38.101-1\_General way to enable increase higher power limit feature for new CA band combinations was endorsed in R4-2305138.
* The draft CR to TS38.101-3\_General way to enable increase higher power limit feature for new ENDC band combinations was endorsed in R4-2305139.
* The topic summary for [106-bis-e][141] NR\_cov\_enh2\_part1 was provided in R4-2306303.
* The topic summary for [106-bis-e][142] NR\_cov\_enh2\_part2 was provided in R4-2306304.
* The WF on NR further coverage enhancement part1 was approved in R4-2306625.
* The WF on remaining open issues for MPR/PAR reduction for coverage enhancement was approved in R4-2306627.

RAN4 #107

The progress in RAN4 #107 meeting is summarized below:

* The topic summary for [107][144] NR\_cov\_enh2\_part1 was provided in R4-2310027.
* The topic summary for [107][145] NR\_cov\_enh2\_part2 was provided in R4-2310028.
* The Ad hoc minutes for coverage enhancement part1 was provided in R4-2310264.
* The Ad hoc minutes for coverage enhancement part1 was provided in R4-2310265.
* The WF on coverage enhancement part1 was approved in R4-2310484.
* The draft Reply LS on enhancements to realize increasing UE power high limit for CA and DC was approved in R4-2310500.

#### 2.4.2 Remaining Open issues

* Continue the discussion on enhancements to realize increasing UE power high limit for CA and DC based on Rel-17 RAN4 work on “Increasing UE power high limit for CA and DC”, in compliance with relevant regulations.
* Continue the discussion on enhancement to reduce MPR/PAR.

## 2.5 RAN5

#### 2.5.1 Agreements

#### 2.5.2 Remaining Open issues

#### 2.5.3 Remaining Open issues with cross-WG dependencies

## 2.6 RAN6

#### 2.6.1 Agreements

#### 2.6.2 Remaining Open issues

## 3. Detailed progress in SA/CT WGs since last TSG meeting (for all involved WGs)

## 3.1 SAx/CTs

#### 3.1.1 Agreements with cross-TSG impacts

#### 3.1.2 Remaining Open issues with cross-TSG impacts

## 4. References

NOTE: This can be e.g. a list of all related Tdocs in the affected WGs since last TSG, references to LSs, produced TRs/TSs, the work/study item description or status reports of previous TSGs.

RAN1 #112bis-e:

1. R1-2302350 Discussion on PRACH coverage enhancements Huawei, HiSilicon
2. R1-2302509 Discussions on remaining issues of PRACH coverage enhancements vivo
3. R1-2302573 PRACH coverage enhancements OPPO
4. R1-2302623 Discussion on PRACH coverage enhancements Spreadtrum Communications
5. R1-2302690 PRACH coverage enhancements CATT
6. R1-2302759 Discussion on PRACH coverage enhancements ZTE
7. R1-2302818 Discussions on PRACH coverage enhancement Intel Corporation
8. R1-2302835 PRACH coverage enhancements TCL Communication Ltd.
9. R1-2302863 PRACH Coverage Enhancement using Multiple PRACH Transmissions Sony
10. R1-2302880 PRACH coverage enhancements Nokia, Nokia Shanghai Bell
11. R1-2302885 Discussion on PRACH coverage enhancements Panasonic
12. R1-2302915 Discussion on PRACH coverage enhancements Fujitsu
13. R1-2302970 Discussion on PRACH coverage enhancements xiaomi
14. R1-2303034 Discussion on PRACH coverage enhancement China Telecom
15. R1-2303086 Discussion on solutions for NR PRACH coverage enhancement Mavenir
16. R1-2303090 PRACH coverage enhancements Lenovo
17. R1-2303153 PRACH coverage enhancements Samsung
18. R1-2303206 PRACH coverage enhancements ETRI
19. R1-2303209 Discussion on PRACH coverage enhancements Quectel
20. R1-2303256 Discussion on PRACH coverage enhancements CMCC
21. R1-2303353 On PRACH coverage enhancements MediaTek Inc.
22. R1-2303411 Discussion on CFRA for Multiple PRACH Transmission FGI
23. R1-2303453 Discussion on PRACH coverage enhancements InterDigital, Inc.
24. R1-2303508 Discussion on PRACH coverage enhancement Apple
25. R1-2303615 PRACH Coverage Enhancements Qualcomm Incorporated
26. R1-2303640 Views on multiple PRACH transmission for coverage enhancement Sharp
27. R1-2303661 Discussion on PRACH coverage enhancement Ericsson
28. R1-2303681 Discussion on PRACH coverage enhancement NEC
29. R1-2303731 Discussion on PRACH coverage enhancements NTT DOCOMO, INC.
30. R1-2303750 Discussion on PRACH repeated transmission for NR coverage enhancement LG Electronics
31. R1-2303959 FL Summary#1 on PRACH coverage enhancements Moderator (China Telecom)
32. R1-2303960 FL Summary#2 on PRACH coverage enhancements Moderator (China Telecom)
33. R1-2303961 FL Summary#3 on PRACH coverage enhancements Moderator (China Telecom)
34. R1-2303962 FL Summary#4 on PRACH coverage enhancements Moderator (China Telecom)
35. R1-2304141 LS on PRACH coverage enhancement RAN1, China Telecom
36. R1-2304234 Final summary on PRACH coverage enhancements Moderator (China Telecom)
37. R1-2302351 Discussion on coverage enhancement in power domain Huawei, HiSilicon
38. R1-2302510 Discussions on remaining issues of power domain enhancements vivo
39. R1-2302574 The study of power domain enhancements OPPO
40. R1-2302624 Discussion on power domain enhancements Spreadtrum Communications
41. R1-2302691 Discussion on MPR/PAR reduction enhancements CATT
42. R1-2302760 Discussion on power domain enhancements ZTE
43. R1-2302787 Discussions on power domain enhancement Intel Corporation
44. R1-2302864 Considerations on tone reservation for PAPR reduction Sony
45. R1-2302881 RAN1 impacts for power domain enhancements Nokia, Nokia Shanghai Bell
46. R1-2302886 Discussion on power domain enhancements Panasonic
47. R1-2302916 Discussion on Power domain enhancements Fujitsu
48. R1-2302971 Discussion on power domain enhancements Xiaomi
49. R1-2303035 Discussion on power domain enhancements China Telecom
50. R1-2303091 Power domain enhancements Lenovo
51. R1-2303154 Power domain enhancements Samsung
52. R1-2303257 Discussion on power domain enhancements CMCC
53. R1-2303354 Views on power domain enhancements MediaTek Inc.
54. R1-2303454 Discussion on power domain enhancements InterDigital, Inc.
55. R1-2303509 Discussion on power domain coverage enhancement Apple
56. R1-2303616 Power-domain enhancements Qualcomm Incorporated
57. R1-2303658 Discussion on power domain enhancements Google Inc.
58. R1-2303662 Power Domain Enhancement Schemes and Performance Ericsson
59. R1-2303732 Discussion on power domain enhancements NTT DOCOMO, INC.
60. R1-2303751 Discussion on Power Domain Enhancements LG Electronics
61. R1-2303767 Power domain enhancements for Rel-18 CovEnh Sharp
62. R1-2303777 DMRS design for power domain enhancements Indian Institute of Tech (H)
63. R1-2303921 FL summary of power domain enhancements (AI 9.12.2) Moderator (Nokia)
64. R1-2303922 FL summary #2 of power domain enhancements (AI 9.12.2) Moderator (Nokia)
65. R1-2303923 FL summary #3 of power domain enhancements (AI 9.12.2) Moderator (Nokia)
66. R1-2303924 FL summary #4 of power domain enhancements (AI 9.12.2) Moderator (Nokia)
67. R1-2303925 Final FL summary of power domain enhancements (AI 9.12.2) Moderator (Nokia)  
    R1-2302352 Discussion on dynamic waveform switching for coverage enhancement Huawei, HiSilicon
68. R1-2302511 Discussions on remaining issues of dynamic waveform switching vivo
69. R1-2302575 Considerations on dynamic switching between DFT-S-OFDM and CP-OFDM OPPO
70. R1-2302625 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM Spreadtrum Communications
71. R1-2302692 Dynamic switching between DFT-S-OFDM and CP-OFDM CATT
72. R1-2302761 Discussion on dynamic waveform switching ZTE
73. R1-2302788 Dynamic switching between DFT-S-OFDM and CP-OFDM waveform Intel Corporation
74. R1-2302865 Considerations on dynamic waveform switching for various PUSCH types Sony
75. R1-2302882 Dynamic switching between DFT-s-OFDM and CP-OFDM Nokia, Nokia Shanghai Bell
76. R1-2302972 Discussion on dynamic switching between DFT-s-OFDM and CP-OFDM Xiaomi
77. R1-2303018 Dynamic switching between DFT-S-OFDM and CP-OFDM InterDigital, Inc.
78. R1-2303036 Discussion on dynamic waveform switching between DFT-s-OFDM and CP-OFDM China Telecom
79. R1-2303039 Discussion on dynamic waveform switching Panasonic
80. R1-2303085 Discussion on solutions for NR dynamic switching between DFT-S-OFDM and CP-OFDM Mavenir
81. R1-2303092 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM Lenovo
82. R1-2303155 Dynamic switching between DFT-S-OFDM and CP-OFDM Samsung
83. R1-2303207 Dynamic switching between DFT-S-OFDM and CP-OFDM ETRI
84. R1-2303258 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM CMCC
85. R1-2303355 Dynamic switching between waveforms MediaTek Inc.
86. R1-2303382 Discussion of dynamic switching between DFT-S-OFDM and CP-OFDM Transsion Holdings
87. R1-2303510 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM Apple
88. R1-2303617 Dynamic switching between DFT-S-OFDM and CP-OFDM Qualcomm Incorporated
89. R1-2303641 Dynamic switching between DFT-S-OFDM and CP-OFDM for Rel-18 CovEnh Sharp
90. R1-2303644 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM Google Inc.
91. R1-2303663 Discussion on Dynamic UL Waveform Switching Ericsson
92. R1-2303682 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM NEC
93. R1-2303733 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM NTT DOCOMO, INC.
94. R1-2303752 Discussion on dynamic waveform switching for NR coverage enhancement LG Electronics
95. R1-2303788 Summary #1 on dynamic switching between DFT-S-OFDM and CP-OFDM Moderator (InterDigital, Inc.)
96. R1-2303789 Summary #2 on dynamic switching between DFT-S-OFDM and CP-OFDM Moderator (InterDigital, Inc.)
97. R1-2303790 Summary #3 on dynamic switching between DFT-S-OFDM and CP-OFDM Moderator (InterDigital, Inc.)
98. R1-2304222 Summary #5 on dynamic switching between DFT-S-OFDM and CP-OFDM Moderator (InterDigital, Inc.)

RAN1 #113:

1. R1-2304383 Discussions on PRACH coverage enhancements New H3C Technologies Co., Ltd.
2. R1-2304503 Discussions on remaining issues of PRACH coverage enhancements vivo
3. R1-2304580 Discussion on PRACH coverage enhancements Spreadtrum Communications
4. R1-2304598 Discussion on PRACH coverage enhancements ZTE
5. R1-2304649 Discussion on PRACH coverage enhancements Huawei, HiSilicon
6. R1-2304717 PRACH coverage enhancements CATT
7. R1-2304775 Discussion on PRACH coverage enhancements Fujitsu
8. R1-2304807 Discussions on PRACH coverage enhancement Intel Corporation
9. R1-2304865 Discussion on PRACH coverage enhancement China Telecom
10. R1-2304884 Discussion on PRACH coverage enhancements xiaomi
11. R1-2304975 PRACH coverage enhancements Lenovo
12. R1-2304999 Discussion on PRACH coverage enhancement NEC
13. R1-2305053 PRACH Coverage Enhancement using Multiple PRACH Transmissions Sony
14. R1-2305115 Discussion on PRACH coverage enhancements CMCC
15. R1-2305136 PRACH coverage enhancements Nokia, Nokia Shanghai Bell
16. R1-2305139 PRACH coverage enhancements TCL Communication Ltd.
17. R1-2305151 Discussion on PRACH coverage enhancements Quectel
18. R1-2305190 PRACH coverage enhancements Charter Communications, Inc
19. R1-2305271 Discussion on PRACH coverage enhancement Apple
20. R1-2305306 Discussion on PRACH coverage enhancements Panasonic
21. R1-2305361 PRACH Coverage Enhancements Qualcomm Incorporated
22. R1-2305392 Discussion on PRACH repeated transmission for NR coverage enhancement LG Electronics
23. R1-2305453 PRACH coverage enhancements OPPO
24. R1-2305538 PRACH coverage enhancements Samsung
25. R1-2305569 Views on multiple PRACH transmission for coverage enhancement Sharp
26. R1-2305616 Discussion on PRACH coverage enhancements NTT DOCOMO, INC.
27. R1-2305664 On PRACH coverage enhancements MediaTek Inc.
28. R1-2305687 Discussion on PRACH coverage enhancement Mavenir
29. R1-2305802 PRACH coverage enhancements ETRI
30. R1-2305858 Discussion on PRACH coverage enhancements InterDigital, Inc.
31. R1-2306008 Discussion on PRACH coverage enhancement Ericsson
32. R1-2306036 FL Summary#1 on PRACH coverage enhancements Moderator (China Telecom)
33. R1-2306037 FL Summary#2 on PRACH coverage enhancements Moderator (China Telecom)
34. R1-2306038 FL Summary#3 on PRACH coverage enhancements Moderator (China Telecom)
35. R1-2306039 FL Summary#4 on PRACH coverage enhancements Moderator (China Telecom)
36. R1-2304504 Discussions on remaining issues of power domain enhancements vivo
37. R1-2304581 Discussion on power domain enhancements Spreadtrum Communications
38. R1-2304599 Discussion on power domain enhancements ZTE
39. R1-2304650 Discussion on coverage enhancement in power domain Huawei, HiSilicon
40. R1-2304718 Discussion on MPR/PAR reduction enhancements CATT
41. R1-2304776 Discussion on Power domain enhancements Fujitsu
42. R1-2304808 Discussions on power domain enhancement Intel Corporation
43. R1-2304866 Discussion on power domain enhancements China Telecom
44. R1-2304885 Discussion on power domain enhancements xiaomi
45. R1-2304976 Power domain enhancements Lenovo
46. R1-2305116 Discussion on power domain enhancements CMCC
47. R1-2305137 RAN1 impacts for power domain enhancements Nokia, Nokia Shanghai Bell
48. R1-2305272 Discussion on power domain coverage enhancement Apple
49. R1-2305307 Discussion on power domain enhancements Panasonic
50. R1-2305362 Power-domain enhancements Qualcomm Incorporated
51. R1-2305393 Discussion on Power Domain Enhancements LG Electronics
52. R1-2305454 The study of power domain enhancements OPPO
53. R1-2305484 Power Domain Enhancement Schemes and Performance Ericsson
54. R1-2305539 Power domain enhancements Samsung
55. R1-2305617 Discussion on power domain enhancements NTT DOCOMO, INC.
56. R1-2305665 Discussion on power domain enhancements MediaTek Inc.
57. R1-2305808 DMRS design for power domain enhancements Indian Institute of Tech (H)
58. R1-2305850 Power domain enhancements for Rel-18 CovEnh Sharp
59. R1-2305859 Discussion on power domain enhancements InterDigital, Inc.
60. R1-2305913 Discussion on power domain enhancements Google Inc.
61. R1-2305978 FL summary #2 of power domain enhancements (AI 9.12.2) Moderator (Nokia)
62. R1-2305979 FL summary #3 of power domain enhancements (AI 9.12.2) Moderator (Nokia)
63. R1-2305980 Final FL summary of power domain enhancements (AI 9.12.2) Moderator (Nokia)
64. R1-2306127 FL summary #4 of power domain enhancements (AI 9.12.2) Moderator (Nokia)
65. R1-2304505 Discussions on remaining issues of dynamic waveform switching vivo
66. R1-2304582 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM Spreadtrum Communications
67. R1-2304600 Discussion on dynamic waveform switching ZTE
68. R1-2304651 Discussion on dynamic waveform switching for coverage enhancement Huawei, HiSilicon
69. R1-2304719 Dynamic switching between DFT-S-OFDM and CP-OFDM CATT
70. R1-2304799 Dynamic switching between DFT-S-OFDM and CP-OFDM InterDigital, Inc.
71. R1-2304809 Dynamic switching between DFT-S-OFDM and CP-OFDM waveform Intel Corporation
72. R1-2304867 Discussion on dynamic waveform switching between DFT-s-OFDM and CP-OFDM China Telecom
73. R1-2304870 Discussion on dynamic waveform switching Panasonic
74. R1-2304886 Discussion on dynamic switching between DFT-s-OFDM and CP-OFDM xiaomi
75. R1-2304977 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM Lenovo
76. R1-2305000 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM NEC
77. R1-2305054 Considerations on dynamic waveform switching for various PUSCH types Sony
78. R1-2305117 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM CMCC
79. R1-2305138 Dynamic switching between DFT-s-OFDM and CP-OFDM Nokia, Nokia Shanghai Bell
80. R1-2305273 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM Apple
81. R1-2305363 Dynamic switching between DFT-S-OFDM and CP-OFDM Qualcomm Incorporated
82. R1-2305394 Discussion on dynamic waveform switching for NR coverage enhancement LG Electronics
83. R1-2305455 Considerations on dynamic switching between DFT-S-OFDM and CP-OFDM OPPO
84. R1-2305479 Summary #3 on dynamic switching between DFT-S-OFDM and CP-OFDM Moderator (InterDigital, Inc.)
85. R1-2305485 Discussion on Dynamic UL Waveform Switching Ericsson
86. R1-2305540 Dynamic switching between DFT-S-OFDM and CP-OFDM Samsung
87. R1-2305570 Dynamic switching between DFT-S-OFDM and CP-OFDM for Rel-18 CovEnh Sharp
88. R1-2305618 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM NTT DOCOMO, INC.
89. R1-2305666 Dynamic switching between waveforms MediaTek Inc.
90. R1-2305682 Discussion on solutions for NR dynamic switching between DFT-S-OFDM and CP-OFDM Mavenir
91. R1-2305714 Discussion of dynamic switching between DFT-S-OFDM and CP-OFDM Transsion Holdings
92. R1-2305803 Dynamic switching between DFT-S-OFDM and CP-OFDM ETRI
93. R1-2305914 Discussion on dynamic switching between DFT-S-OFDM and CP-OFDM Google Inc.
94. R1-2306239 Summary #4 on dynamic switching between DFT-S-OFDM and CP-OFDM Moderator (InterDigital, Inc.)
95. R1-2306255 Summary #5 on dynamic switching between DFT-S-OFDM and CP-OFDM Moderator (InterDigital, Inc.)

RAN2 #121bis-e:

1. R2-2302567 Discussion on PRACH coverage enhancements CATT
2. R2-2302598 RAN2 Impacts of Further NR Coverage Enhancements vivo
3. R2-2302600 RAN2 Impacts for further NR Coverage Enhancements Samsung Electronics Co., Ltd
4. R2-2302888 Discussion on Multiple PRACH transmissions Ericsson
5. R2-2302926 Uplink Coverage Enhancement Qualcomm Incorporated
6. R2-2303074 Work plan for Further NR coverage enhancements China Telecom
7. R2-2303075 RAN2 impacts of Coverage Enhancement China Telecom
8. R2-2303292 RAN2 impacts on R18 PRACH coverage enhancements ZTE Corporation, Sanechips
9. R2-2303605 Multiple PRACH transmissions InterDigital
10. R2-2303692 RAN2 impacts of PRACH CE Nokia, Nokia Shanghai Bell
11. R2-2303815 Discussion on RAN2 impacts for PRACH coverage enhancement Huawei, HiSilicon
12. R2-2304011 RAN2 aspects on support of multiple PRACH transmission LG Electronics Inc.
13. R2-2304034 Discussion on RAN2 impact of PRACH enhancement Xiaomi

RAN2 #122:

1. R2-2304613 LS on PRACH coverage enhancement (R1-2304141; contact: China Telecom) RAN1
2. R2-2304702 RAN2 Impacts of Multiple PRACH Transmissions from CP vivo Mobile Com. (Chongqing)
3. R2-2304703 RAN2 Impacts of Multiple PRACH Transmissions from UP vivo Mobile Com. (Chongqing)
4. R2-2304723 Control plane aspects of further NR Coverage Enhancements Samsung Electronics Co., Ltd
5. R2-2304724 User plane aspects of further NR Coverage Enhancements Samsung Electronics Co., Ltd
6. R2-2304903 Discussion on CP issues for MSG1 repetition CATT
7. R2-2304904 Discussion on UP issues for MSG1 repetition CATT
8. R2-2305127 UL Coverage Enhancements Control Plane Qualcomm Incorporated
9. R2-2305128 UL Coverage Enhancements User Plane Qualcomm Incorporated
10. R2-2305237 RACH partition framework of Coverage Enhancement China Telecom
11. R2-2305269 UP Impacts for Further NR Coverage Enhancements NEC Corporation
12. R2-2305354 Discussion on Multiple PRACH Transmission Procedures Ericsson
13. R2-2305355 Discussion on Multiple PRACH Transmission Configuration Ericsson
14. R2-2305403 CP issues for PRACH coverage enhancement ZTE Corporation, Sanechips
15. R2-2305404 UP issues for PRACH coverage enhancement ZTE Corporation, Sanechips
16. R2-2305732 Discussion on RAN2 impact of PRACH enhancement Xiaomi
17. R2-2305753 UP impacts of PRACH CE Nokia, Nokia Shanghai Bell
18. R2-2305754 Fallback cases for PRACH repetition Nokia, Nokia Shanghai Bell
19. R2-2305929 Multiple PRACH transmissions – CP aspects InterDigital
20. R2-2305930 Multiple PRACH transmissions – UP aspects InterDigital
21. R2-2306231 RRC aspects for Msg1 repetition Huawei, HiSilicon
22. R2-2306232 Discussion on MAC aspect with MSG1 repetition Huawei, HiSilicon
23. R2-2306349 Signalling aspects on support of PRACH repetition LG Electronics Inc.
24. R2-2306350 RA procedure to support PRACH repetition LG Electronics Inc.

RAN4 #106bis-e:

1. R4-2304087 PC and associated information reporting Nokia, Nokia Shanghai Bell
2. R4-2304146 Power-class fallback reporting in the PHR, the P-MPR method and the high-power limit Ericsson
3. R4-2304189 Discussion on the potential solutions for the enhancement for SAR issue Fujitsu Limited
4. R4-2304318 Simulation results for non-transparent MPR reduction schemes Apple
5. R4-2304604 On link-level benefits of transparent and non-transparent PAPR reduction techniques Qualcomm Incorporated
6. R4-2304605 Draft LS on UE signaling to enhance UL reliability Qualcomm Incorporated
7. R4-2304933 Scope of the work for MPR/PAR -objective Nokia, Nokia Shanghai Bell
8. R4-2304934 RF simulation parameters for MPR/PAR evaluations Nokia, Nokia Shanghai Bell
9. R4-2304935 RF simulation results for transparent schemes Nokia, Nokia Shanghai Bell
10. R4-2304936 RF simulation results for non-transparent schemes Nokia, Nokia Shanghai Bell
11. R4-2304937 RF specification impacts Nokia, Nokia Shanghai Bell
12. R4-2305092 Discussion of enhancement of increasing UE power high limit for CA and DC vivo
13. R4-2305116 RF simulation results for transparent schemes for enhancement to reduce MPR vivo
14. R4-2305117 RF simulation results for non-transparent schemes for enhancement to reduce MPR vivo
15. R4-2305137 General way to enable increase higher power limit feature for new CA and ENDC band combinations ZTE Corporation
16. R4-2305138 Draft CR to TS38.101-1\_General way to enable increase higher power limit feature for new CA band combinations ZTE Corporation, CHTTL, samsung
17. R4-2305139 draft CR to TS38.101-3\_General way to enable increase higher power limit feature for new ENDC band combinations ZTE Corporation, CHTTL, samsung
18. R4-2305172 Draft LS on Enhancement of increasing UE power high limit for CA and DC NTT DOCOMO INC.
19. R4-2305350 Discussion on enhancement of increasing UE maximum power high limit Xiaomi
20. R4-2305601 On enhancements of increasing UE power high limit for CA and DC Huawei, HiSilicon
21. R4-2305602 On further enhancements to reduce MPR/PAR Huawei, HiSilicon
22. R4-2305634 RF spec impact for MPR reduction scheme Ericsson
23. R4-2305635 Background and way forward to use RAN1 LS with results on MPR/PAR reduction Ericsson
24. R4-2305636 simulation parameter discussion for transparent and non-transparent schemes Ericsson
25. R4-2305637 Simulation results for the non-transparent scheme Ericsson
26. R4-2305638 Simulation results for the transparent scheme Ericsson
27. R4-2306220 Topic summary for [106-bis-e][141] NR\_cov\_enh2\_part1 Moderator (Huawei)
28. R4-2306221 Topic summary for [106-bis-e][142] NR\_cov\_enh2\_part2 Moderator (Nokia)
29. R4-2306303 Topic summary for [106-bis-e][141] NR\_cov\_enh2\_part1 Moderator (Huawei)
30. R4-2306304 Topic summary for [106-bis-e][142] NR\_cov\_enh2\_part2 Moderator (Nokia)
31. R4-2306625 WF on NR further coverage enhancement part1 Huawei, HiSilicon
32. R4-2306626 LS on enhancements to realize increasing UE power high limit for CA and DC NTT DOCOMO, INC.
33. R4-2306627 WF on remaining open issues for MPR/PAR reduction for coverage enhancement Nokia
34. R4-2306628 WF on simulation results and observations for MPR/PAR reduction for coverage enhancement Huawei, HiSilicon

RAN4 #107:

1. R4-2307067 Discussion on the enhancement for SAR issue mitigation Fujitsu Limited
2. R4-2307124 UL duty cycle scheme improvement Nokia, Nokia Shanghai Bell
3. R4-2307125 draftCR for configured transmitted power for two bands uplink inter band CA including Intra band contiguous CA Nokia, Nokia Shanghai Bell
4. R4-2307303 Draft LS on enhancements to realize increasing UE power high limit for CA and DC NTT DOCOMO, INC.
5. R4-2307745 Draft Reply LS on enhancements to realize increasing UE power high limit for CA and DC Ericsson
6. R4-2308105 Net gain analysis and next steps for MPR/PAR - objective Nokia, Nokia Shanghai Bell
7. R4-2308106 RF simulation parameters for MPR/PAR evaluations Nokia, Nokia Shanghai Bell
8. R4-2308107 RF simulation results for transparent schemes Nokia, Nokia Shanghai Bell
9. R4-2308108 RF simulation results for non-transparent schemes Nokia, Nokia Shanghai Bell
10. R4-2308109 RF specification impacts Nokia, Nokia Shanghai Bell
11. R4-2308110 Collected Simulation Results for MPR/PAR evaluations Nokia, Nokia Shanghai Bell
12. R4-2308275 RF simulation results for transparent schemes vivo
13. R4-2308276 RF simulation results for non-transparent schemes vivo
14. R4-2308949 On enhancements of increasing UE power high limit for CA and DC Huawei, HiSilicon
15. R4-2308950 On further enhancements to reduce MPR/PAR Huawei, HiSilicon
16. R4-2308972 R18 Coverage enhancement related to SAR mitigation OPPO
17. R4-2309075 On Rel-18 coverage enhancement Apple
18. R4-2309199 RF spec impact for MPR reduction scheme Ericsson
19. R4-2309200 simulation parameter discussion for transparent and non-transparent schemes Ericsson
20. R4-2309201 Simulation results for the non-transparent scheme Ericsson
21. R4-2309202 Simulation results for the transparent scheme Ericsson
22. R4-2309212 Observations of RAN4 MPR Results Ericsson
23. R4-2309285 Evaluation of MPR reduction schemes Qualcomm Incorporated
24. R4-2309286 On UE signaling to enhance UL reliability Qualcomm Incorporated
25. R4-2310027 Topic summary for [107][144] NR\_cov\_enh2\_part1 Moderator (Huawei)
26. R4-2310028 Topic summary for [107][145] NR\_cov\_enh2\_part2 Moderator (Nokia)