**3GPP TSG RAN WG1 Meeting #109-e R1-22xxxxx**

**e-Meeting, May 9th –20th, 2022**

**Source: Moderator (vivo)**

**Title: Discussion summary #1 of [109-e-R17-FR2-2-03]**

**Agenda item: 8.2.3**

**Document for: Discussion and decision**

# Introduction

In this contribution, we summarize issues related to timeline and reference signal for new SCSs on supporting NR from 52.6 GHz to 71 GHz for the following email discussion in RAN1 #109-e.

[109-e-R17-FR2-2-03] Email discussion under 8.2.3 for maintenance on RS and timeline, for issues 3-2, 3-3 and 3-4 in R1-2205124 – Huaming (vivo)

* 1st check point: May 13 (any RRC impact by May 12)
* Final check point: May 18

# Remaining issues

## 2.1. Minimum applicable scheduling offset for 480/960 kHz SCS

In [17, LG], it is pointed out that at the last RAN2 e-meeting, it was agreed to adopt the value of 64 for maxK0-SchedulingOffset-r17 and maxK2-SchedulingOffset-r17 for 480 kHz and 960 kHz SCS as below.

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| --- |
| Agreement (RAN2 e-meeting)* To adopt 64 for maxSchedulingK0/2-SchedulingOffset-r17 for SCS 480 and 960 kHz
* Can come back to this in the next meeting if there are issues with RAN1 with these values (no LS sent but companies should check with the RAN1 colleagues). Add editor's note about this to RRC CR.
 |

Accordingly, the following update can be found in TS 38.331 v17.0.0.

maxK0-SchedulingOffset-r16 INTEGER ::= 16 -- Maximum number of slots configured as min. scheduling offset (K0)

maxK2-SchedulingOffset-r16 INTEGER ::= 16 -- Maximum number of slots configured as min. scheduling offset (K2)

maxK0-SchedulingOffset-r17 INTEGER ::= 64 -- Maximum number of slots configured as min. scheduling offset (K0)

maxK2-SchedulingOffset-r17 INTEGER ::= 64 -- Maximum number of slots configured as min. scheduling offset (K2)

In is argued in [17, LG] the maximum value of k0 and k2 were increased from 32 to 128 for 480/960 kHz SCS. Since the minimum scheduling offset restriction introduced in Rel-16 can be applied for these SCSs, it is reasonable to also increase the value ranges of maxK0-SchedulingOffset and maxK2-SchedulingOffset according to the increased k0 and k2. [17, LG] proposed to support to adopt 64 for maxK0-SchedulingOffset-r17 and maxK2-SchedulingOffset-r17.

Moderator’s comment:

Given the above RAN2 agreement has already been captured in TS 38.331 and there seems no corresponding RAN1 specification impact, the following conclusion is suggested to confirm no issue identified in RAN1 with these values.

##### Conclusion 1-1

No issue is identified in RAN1 to adopt 64 as agreed in RAN2 for maxSchedulingK0/2-SchedulingOffset-r17 for SCS 480 and 960 kHz.

Companies are encouraged to provide comments especially if they have any issue/concern on these values.

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| --- | --- |
| Company Name | Comments/Views |
| Intel | Agree with moderator |
| Ericsson | Support Conclusion 1-1 |
| InterDigital | We are fine with the Conclusion 1-1 |

It is observed in [17, LG] that according to the TS 38.214, for aperiodic CSI reporting and aperiodic CSI-RS when the triggering PDCCH and the CSI-RS have the same numerology, a UE is not expected to be triggered by CSI triggering state indicated by the CSI request field in DCI in which CSI-RS triggering offset is smaller than the currently applicable minimum scheduling offset restriction *K*0min when the minimum scheduling offset restriction is applied.

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| --- |
| TS 38.214, clause 5.2.1.5.1…The UE does not expect that aperiodic CSI-RS is transmitted before the OFDM symbol(s) carrying its triggering DCI. When the minimum scheduling offset restriction is applied, UE is not expected to be triggered by CSI triggering state indicated by the CSI request field in DCI in which CSI-RS triggering offset is smaller than the currently applicable minimum scheduling offset restriction *K*0min.… |

[17, LG] argued that if the minimum applicable value of scheduling offset increases to 64 for 480/960 kHz, the value range of CSI-RS triggering offset for 480/960 kHz should also be increased to provide a CSI-RS triggering offset not less than the applicable minimum scheduling offset. [17, LG] proposed the supported values of CSI-RS trigger offset for 480/960kHz are also 4x of the supported values for 120 kHz.

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| TS 38.331, clause 6.3.2***aperiodicTriggeringOffset, aperiodicTriggeringOffset-r16***Offset X between the slot containing the DCI that triggers a set of aperiodic NZP CSI-RS resources and the slot in which the CSI-RS resource set is transmitted. For *aperiodicTriggeringOffset*, the value 0 corresponds to 0 slots, value 1 corresponds to 1 slot, value 2 corresponds to 2 slots, value 3 corresponds to 3 slots, value 4 corresponds to 4 slots, value 5 corresponds to 16 slots, value 6 corresponds to 24 slots. For *aperiodicTriggeringOffset-r16*, the value indicates the number of slots. The network configures only one of the fields. When neither field is included, the UE applies the value 0. |

Moderator’s comment:

The extension of applying the same treatment to CSI-RS trigger offset as applicable minimum scheduling offset seems straightforward. The following proposal is formulated for discussion.

##### Proposal 1-2 (high priority)

Support the following values of *aperiodicTriggeringOffset-r17* for SCS 480 and 960 kHz, where the value indicates the number of slots.

{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31}\*4.

Companies are encouraged to provide comments.

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| --- | --- |
| Company Name | Comments/Views |
| Intel | ok |
| Ericsson | Support Proposal 1-2 |
| InterDigital | We are fine with the proposal.  |

## 2.2. Antenna port field when two mapping types are indicated

It is observed in [10, Samsung] that a TDRA row is allowed to include separate SLIV and mapping type. It is also observed in [10, Samsung] that mapping type A and mapping type B can have separate DMRS configurations, where the fields *dmrs-Type*, *dmrs-AdditionalPosition* and *maxLength* in *DMRS-DownlinkConfig* may be set differently. Furthermore, mapping type A and B have the different DMRS configurations may result different antenna port tables defined in TS 38.212.

It is then pointed out in [10, Samsung] that if antenna port field only indicates one entry of Antenna Port tables when two mapping types are indicated in a TDRA row and the corresponding antenna port tables for two mapping types are different, there is unnecessary restriction on the entries with the same index of both antenna port tables. In consequence, this may cause some values not usable as antenna port tables are of different size and some values in one table are not defined in the other table.

It is then proposed in [10, Samsung] to support that antenna port field indicates each entry of two Antenna Port tables if a TDRA row with both mapping type A and mapping type B is indicated and the corresponding antenna port tables are different. A corresponding TP is provided in [10, Samsung].

Moderator’s comment:

Current specification does have the restriction where only one common index can be indicated if UE are configured with both mapping types. The following proposal and corresponding TP from [10] are copied below for discussion. Companies are encouraged to comment if they see this issue is critical for FR2-2 operation and if so, requires specification change(s) to address.

##### Proposal 2-1

Support that antenna port field indicates separate entry of two Antenna Port tables if a TDRA row indicated both mapping type A and mapping type B and their corresponding antenna port tables are different.

##### TP#2-1 (was TP#1 from [10])

========================= Start of TP #2-1 for TS 38.212, clause 7.3.1.1.2 and 7.3.1.2.2 ===================

7.3.1.1.2 Format 0\_1

=============================== Unchanged Text Omitted ===================================

- Antenna ports – number of bits determined by the following

If the row indicated by the Time domain resource assignment field includes single mapping type or *dmrs- UplinkForPUSCH-MappingTypeA and dmrs-UplinkForPUSCH-MappingTypeB* have same *dmrs-Type* and *maxLength*

- 2 bits as defined by Tables 7.3.1.1.2-6, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=1, except that *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured and π/2 BPSK modulation is used;

- 2 bits as defined by Tables 7.3.1.1.2-6A, if transform precoder is enabled and *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured, π/2 BPSK modulation is used, *dmrs-Type*=1, and *maxLength*=1, where nSCID is the scrambling identity for antenna ports defined in [Clause 6.4.1.1.1.2, TS38.211];

- 4 bits as defined by Tables 7.3.1.1.2-7, if transform precoder is enabled, *dmrs-Type*=1, and *maxLength*=2, except that *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured and π/2 BPSK modulation is used;

- 4 bits as defined by Tables 7.3.1.1.2-7A, if transform precoder is enabled and *dmrs-UplinkTransformPrecoding* and *tp-pi2BPSK* are both configured, π/2 BPSK modulation is used, *dmrs-Type*=1, and *maxLength*=2, where nSCID is the scrambling identity for antenna ports defined in [Clause 6.4.1.1.1.2, TS38.211];

- 3 bits as defined by Tables 7.3.1.1.2-8/9/10/11, if transform precoder is disabled, *dmrs-Type*=1, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-12/13/14/15, if transform precoder is disabled, *dmrs-Type*=1, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 4 bits as defined by Tables 7.3.1.1.2-16/17/18/19, if transform precoder is disabled, *dmrs-Type*=2, and *maxLength*=1, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*;

- 5 bits as defined by Tables 7.3.1.1.2-20/21/22/23, if transform precoder is disabled, *dmrs-Type*=2, and *maxLength*=2, and the value of rank is determined according to the SRS resource indicator field if the higher layer parameter *txConfig = nonCodebook* and according to the Precoding information and number of layers field if the higher layer parameter *txConfig = codebook*.

If the row indicated by the Time domain resource assignment field includes two mapping types and *dmrs- UplinkForPUSCH -MappingTypeA and dmrs- UplinkForPUSCH –MappingTypeB* have different *dmrs-Type or maxLength*

- bits where the MBS bits is the "Antenna ports" bitwidth derived according to *dmrs- UplinkForPUSCH -MappingTypeA* and the LSB bits is the "Antenna ports" bitwidth derived according to *dmrs- UplinkForPUSCH -MappingTypeB*.

where the number of CDM groups without data of values 1, 2, and 3 in Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively.

If a UE is configured with both *dmrs-UplinkForPUSCH-MappingTypeA* and *dmrs-UplinkForPUSCH-MappingTypeB*, the bitwidth of this field equals , where  is the "Antenna ports" bitwidth derived according to *dmrs-UplinkForPUSCH-MappingTypeA* and  is the "Antenna ports" bitwidthderived according to *dmrs-UplinkForPUSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PUSCH corresponds to the smaller value of  and .

=============================== Unchanged Text Omitted ===================================

7.3.1.2.2 Format 1\_1

=============================== Unchanged Text Omitted ===================================

- Antenna port(s) – 4, 5, or 6 bits as defined by Tables 7.3.1.2.2-1/2/3/4 and Tables 7.3.1.2.2-1A/2A/3A/4A if the row indicated by the Time domain resource assignment field includes single mapping type or *dmrs- DownlinkForPDSCH-MappingTypeA and dmrs-DownlinkForPDSCH-MappingTypeB* have same *dmrs-Type* and *maxLength*; bits where the MBS bits is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and the LSB bits is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeB* if the row indicated by the Time domain resource assignment field includes two mapping types and *dmrs- DownlinkForPDSCH-MappingTypeA and dmrs-DownlinkForPDSCH-MappingTypeB* have different *dmrs-Type* or *maxLength*, where the number of CDM groups without data of values 1, 2, and 3 refers to CDM groups {0}, {0,1}, and {0, 1,2} respectively. The antenna ports  shall be determined according to the ordering of DMRS port(s) given by Tables 7.3.1.2.2-1/2/3/4 or Tables 7.3.1.2.2-1A/2A/3A/4A. When a UE receives an activation command that maps at least one codepoint of DCI field '*Transmission Configuration Indication*' to two TCI states, the UE shall use Table 7.3.1.2.2-1A/2A/3A/4A; otherwise, it shall use Tables 7.3.1.2.2-1/2/3/4. The UE can receive an entry with DMRS ports equals to 1000, 1002, 1003 when two TCI states are indicated in a codepoint of DCI field '*Transmission Configuration Indication*'.

If a UE is configured with both *dmrs-DownlinkForPDSCH-MappingTypeA* and *dmrs-DownlinkForPDSCH-MappingTypeB* andif the row indicated by the Time domain resource assignment field have single mapping type or *dmrs- DownlinkForPDSCH-MappingTypeA and dmrs-DownlinkForPDSCH-MappingTypeB* have same *dmrs-Type* and *maxLength*, the bitwidth of this field equals , where  is the "Antenna ports" bitwidth derived according to *dmrs-DownlinkForPDSCH-MappingTypeA* and  is the "Antenna ports" bitwidthderived according to *dmrs-DownlinkForPDSCH-MappingTypeB*. A number of  zeros are padded in the MSB of this field, if the mapping type of the PDSCH corresponds to the smaller value of  and .

============================== End of TP #2-1 for TS 38.212 ==================================

Companies are encouraged to provide comments to the above proposal, and if agree to proposal 2-1, further on the TP#2-1.

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| Company Name | Comments/Views |
| Intel | It seems the TP is not needed. In our view, even for single antenna port indication, gNB may still be able to select appropriate DMRS port for the indicated mapping type. In typical operation, mapping type would be same for the scheduled PDSCHs/PUSCHs. Given this is for maintenance phase, it may not be desirable to further optimize the design for multi-PxSCH scheduling at this late stage  |
| Ericsson | Do not support Proposal 2-1 or the TP.Agree with Intel that we should not undertake such optimizations at this stage in maintenance. The typical use case would be to have the same mapping type for each scheduled PDSCH/PUSCH. |
| InterDigital | We don’t support the proposal. We failed to observe a critical motivation to introduce scheduling multiple PxSCH scheduling types with different antenna port tables in the matinenance phase.  |

## 2.3. PTRS-DMRS Association field when two mapping types are indicated

It is also pointed out in [10, Samsung] that if PTRS-DMRS Association field only indicates one DMRS port when both mapping types are indicated in a TDRA row, there is a restriction which may not lead to best PTRS antenna port for both mapping types.

It is proposed in [10, Samsung] to support PTRS-DMRS association field indicates each DMRS port as PTRS ports for mapping type A and mapping type B. A corresponding TP is provided in [10, Samsung].

Moderator’s comment:

Again, current specification does have the restriction where no separate indication for different mapping types if UE is configured with both mapping types. The following proposal and corresponding TP from [10] are copied below for discussion. Companies are encouraged to comment if they see this issue is critical for FR2-2 operation and if so, requires specification change(s) to address.

##### Proposal 3-1

Support that PTRS-DMRS association field indicates separate DMRS port for mapping type A and mapping type B if a TDRA row indicated both mapping type A and mapping type B and their corresponding antenna port tables are different.

##### TP#3-1 (was TP#2 from [10])

======================== Start of TP #3-1 for TS 38.212, clause 7.3.1.1.2===========================

7.3.1.1.2 Format 0\_1

=============================== Unchanged Text Omitted ===================================

- PTRS-DMRS association – number of bits determined as follows

- 0 bit if *PTRS-UplinkConfi*g is not configured in either *dmrs-UplinkForPUSCH-MappingTypeA* or *dmrs-UplinkForPUSCH-MappingTypeB* and transform precoder is disabled, or if transform precoder is enabled, or if *maxRank=1*;

If the row indicated by the Time domain resource assignment field includes single mapping type or *dmrs- UplinkForPUSCH-MappingTypeA and dmrs-UplinkForPUSCH-MappingTypeB* have same *dmrs-Type* and *maxLength*,

- 2 bits otherwise, where Table 7.3.1.1.2-25/7.3.1.1.2-25A and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) when one PT-RS port and two PT-RS ports are configured by *maxNrofPorts* in *PTRS-UplinkConfig* respectively, and the DMRS ports are indicated by the Antenna ports field. When the SRS resource set indicator field is present and *maxRank>2*, this field indicates the association between PTRS port(s) and DMRS port(s) corresponding to SRS resource indicator field and/or Precoding information and number of layers field according to Table 7.3.1.1.2-25 and 7.3.1.1.2-26. When the SRS resource set indicator field is present and equals "10" and "11" and *maxRank=2*, the MSB of this field indicates the association between PTRS port(s) and DMRS port(s) corresponding to SRS resource indicator and/or Precoding information and number of layers field, and the LSB of this field indicates the association between PTRS port(s) and DMRS port(s) corresponding to Second SRS resource indicator field and/or Second Precoding information field, according to Table 7.3.1.1.2-25A.

If the row indicated by the Time domain resource assignment field includes two mapping types and or *dmrs- UplinkForPUSCH-MappingTypeA and dmrs-UplinkForPUSCH-MappingTypeB* have different *dmrs-Type* or *maxLength*,

- 4 bits, where MSB 2 bits are for *dmrs-UplinkForPUSCH-MappingTypeA* and LSB 2bits are for *dmrs-UplinkForPUSCH-MappingTypeB.* For each 2 bits, Table 7.3.1.1.2-25/7.3.1.1.2-25A and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) when one PT-RS port and two PT-RS ports are configured by *maxNrofPorts* in *PTRS-UplinkConfig* respectively, and the DMRS ports are indicated by the Antenna ports field. When the SRS resource set indicator field is present and *maxRank>2*, this field indicates the association between PTRS port(s) and DMRS port(s) corresponding to SRS resource indicator field and/or Precoding information and number of layers field according to Table 7.3.1.1.2-25 and 7.3.1.1.2-26. When the SRS resource set indicator field is present and equals "10" and "11" and *maxRank=2*, the MSB of this field indicates the association between PTRS port(s) and DMRS port(s) corresponding to SRS resource indicator and/or Precoding information and number of layers field, and the LSB of this field indicates the association between PTRS port(s) and DMRS port(s) corresponding to Second SRS resource indicator field and/or Second Precoding information field, according to Table 7.3.1.1.2-25A.

If "Bandwidth part indicator" field indicates a bandwidth part other than the active bandwidth part and the "PTRS-DMRS association" field is present for the indicated bandwidth part but not present for the active bandwidth part, the UE assumes the "PTRS-DMRS association" field is not present for the indicated bandwidth part.

- Second PTRS-DMRS association – 2 bits if PTRS-DMRS association field and SRS resource set indicator field are present and *maxRank>2* and if the row indicated by the Time domain resource assignment field includes single mapping type or *dmrs- UplinkForPUSCH-MappingTypeA and dmrs-UplinkForPUSCH-MappingTypeB* have same *dmrs-Type* and *maxLength*; 4 bits if PTRS-DMRS association field and SRS resource set indicator field are present and *maxRank>2* and if the row indicated by the Time domain resource assignment field includes two mapping types and *dmrs- UplinkForPUSCH-MappingTypeA and dmrs-UplinkForPUSCH-MappingTypeB* have different *dmrs-Type* or *maxLength*, where the MSB 2 bits are for *dmrs-UplinkForPUSCH-MappingTypeA* and LSB 2bits are for *dmrs-UplinkForPUSCH-MappingTypeB*; 0 bit otherwise. For each 2 bits, Table 7.3.1.1.2-25 and 7.3.1.1.2-26 are used to indicate the association between PTRS port(s) and DMRS port(s) corresponding to Second SRS resource indicator field and/or Second precoding information field when one PT-RS port and two PT-RS ports are configured by *maxNrofPorts* in *PTRS-UplinkConfig* respectively, and the DMRS ports are indicated by the Antenna ports field.

============================== End of TP #3-1 for TS 38.212 ==================================

Companies are encouraged to provide comments to the above proposal, and if agree to proposal 3-1, further on the TP#3-1.

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| Company Name | Comments/Views |
| Intel | Same comment as above. It seems the TP is not needed. In our view, gNB may still be able to select appropriate PTRS-DMRS association field for the indicated mapping type. In typical operation, mapping type would be same for the scheduled PDSCHs/PUSCHs. Given this is for maintenance phase, it may not be desirable to further optimize the design for multi-PxSCH scheduling at this late stage |
| Ericsson | Do not support Proposal 3-1 or the TP.Agree with Intel that we should not undertake such optimizations at this stage in maintenance. The typical use case would be to have the same mapping type for each scheduled PDSCH/PUSCH. |
| InterDigital | We don’t support the proposal. We failed to observe a critical motivation to introduce scheduling multiple PxSCH scheduling types with different antenna port tables in the matinenance phase.  |

# Conclusion

TBD

# Reference

1. [R1-2203081](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203081.zip) Remaining issues of PDSCH/PUSCH enhancement for 52-71GHz spectrum Huawei, HiSilicon
2. [R1-2203292](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203292.zip) Remaining issues on data channel enhancements for 52.6 to 71GHz ZTE, Sanechips
3. [R1-2203371](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203371.zip) Remaining issues for PDSCH/PUSCH enhancements to supporting 52.6-71 GHz band in NR InterDigital, Inc.
4. [R1-2203401](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203401.zip) Discussion on PDSCH/PUSCH enhancements for NR 52.6-71 GHz Panasonic
5. [R1-2203432](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203432.zip) Remaining issues on PDSCH/PUSCH enhancements for up to 71GHz operation CATT
6. [R1-2203510](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203510.zip) Maintenance on PDSCH/PUSCH enhancements for NR operation from 52.6GHz to 71GHz vivo
7. [R1-2203678](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203678.zip) Remaining issues of PDSCH/PUSCH enhancements for 52.6 to 71GHz NEC
8. [R1-2203708](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203708.zip) Remaining issues of multi-PDSCH/PUSCH scheduling via a single DCI Fujitsu Limited
9. [R1-2203784](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203784.zip) Remaining issues on PDSCH and PUSCH enhancements for NR 52.6-71GHz xiaomi
10. [R1-2203860](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203860.zip) Maintenance on PDSCH/PUSCH enhancements for NR from 52.6 GHz to 71 GHz Samsung
11. [R1-2203988](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2203988.zip) Discussion on remaining issue for PDSCH/PUSCH enhancements OPPO
12. [R1-2204112](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204112.zip) PDSCH-PUSCH Enhancements Ericsson
13. [R1-2204190](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204190.zip) Discussion on multi-PXSCH scheduling ASUSTeK
14. [R1-2204203](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204203.zip) On remaining issues for PDSCH PUSCH Enhancements Apple
15. [R1-2204340](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204340.zip) Remaining issues on PDSCH/PUSCH enhancements for NR in FR2-2 NTT DOCOMO, INC.
16. [R1-2204601](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204601.zip) Remaining issues on PDSCH/PUSCH enhancements Nokia, Nokia Shanghai Bell
17. [R1-2204613](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204613.zip) Remaining issues of PDSCH/PUSCH enhancements to support NR above 52.6 GHz LG Electronics
18. [R1-2204707](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204707.zip) Remaining discussion on multi-PDSCH scheduling design for 52.6-71 GHz NR operation MediaTek Inc.
19. [R1-2204768](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204768.zip) Discussion on PDSCH/PUSCH enhancements for extending NR up to 71 GHz Intel Corporation
20. [R1-2204980](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_109-e/Docs/R1-2204980.zip) PDSCH and PUSCH enhancements Qualcomm Incorporated