**3GPP TSG RAN WG1 #110 R1-2nnnnn**

**Toulouse, France, August 22nd – 26th, 2022**

**Agenda Item: 8.16.5**

**Source: Moderator (AT&T)**

**Title: Summary of UE features for** **NR\_FeMIMO, NR\_ext\_to\_71GHz, NR\_NTN\_solutions, IoT over NTN, NR\_IAB\_enh, NR\_DSS, LTE\_NR\_DC\_enh2, NR\_pos\_enh, and NR\_DL1024QAM\_FR1**

**Document for: Discussion/Decision**

# Introduction

This document presents the summary of email discussion [110-R17-UE\_features\_2] during RAN1 #110.

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| [110-R17-UE\_features\_2] To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the FL summary for online session, etc – Ralf (AT&T)* NR-MIMO, NR from 52.6GHz to 71 GHz, NR-NTN, positioning, eIAB, DSS, IoT over NTN, 1024QAM
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According to the RAN1 Chair:

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| * For each Rel-17 WI and Rel-18 WI/SI, an email thread will be created
	+ The email threads will be used by chair/vice-chairs/rapporteurs/FLs to share updates on online/offline schedule, details on what is to be discussed, to share the Tdoc number of the FL summary to be treated in online session, etc
	+ The email threads are not intended for any technical discussions and there will not be any endorsements via email
* Additional email threads may be created for handling of LSs and other maintenance issues
	+ To be decided after initial review of tdocs submitted to RAN1#110
* As usual, individual draft folders will be created for all sub-agenda items in the inbox
	+ The draft folders will be used for providing the initial FL summaries and further updates, and may be used to collect company views
	+ IMPORTANT: Use draft folders on the 3GPP portal (used for e-meetings) and not the one on 10.10.10.10 3GPP portal draft folder 🡪 https://www.3gpp.org/ftp/TSG\_RAN/WG1\_RL1/TSGR1\_110/Inbox/drafts
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The following was discussed during RAN1 #110 within the scope of [110-R17-UE\_features\_2]. All proposals are based on the latest RAN1 UE features lists for Rel-17 in [1] and [2] for NR and LTE, respectively.

# Summary of Contributions Submitted to RAN1 #110

The following is the moderator’s summary of contributions submitted to RAN1 #110 in this agenda item.

## NR\_FeMIMO

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|  23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI2. Support of up to K SSBRI-RSRP pairs in one report where a pair is associated with a PCI different from serving cell PCI can be reported3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC |  | Yes |  | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) is not supported | per band | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}Component 4 candidate values: {1, 2, 4, 8}Note: K is equal to maxNumberNonGroupBeamReportingNote: component 4 is also counted in FG16-1g/16-1g-1 | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | Similar to components 2 and 3 of FG 23-4 for inter-cell mTRP, we believe that the following two components should be supported for inter-cell beam measurement in FG 23-1-2:* **Component 5:** The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI;
* **Component 6:** The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI;

There are two distinct reasons that justify the need for the above components in 23-1-2:* Some companies argued that instead of supporting above two components in 23-1-2, it is sufficient that a UE reports component 4 in 23-1-2 “The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement”. Note that component 4 essentially lumps all additional PCIs into one report regardless of their SSB periodicities and positions relative to those of the SSBs of the serving cell and, therefore, we do not think it would be a technically viable substitute for the independent reports of the suggested component 5 and component 6. To see this, let us have a clarifying example: assume that the UE is configured to measure 3 Cells (including the PCIs the same as or different from serving cell PCI) where SSBs from different cells are configured on the same positions as in figure 1. According to RAN4 requirements, a UE supports at least 8 Rx beams to measure one L1-RSRP/L1-SINR value. If a UE can only use one beam at a time, the UE cannot sweep all Rx beams for cells other than the serving cell without affecting the measurement for serving cell. On the other hand, as shown in Figure 2, the same UE may sweep all Rx beams for all cells in the TDM manner if the SSBs of different cells have non-overlapping positions. If UE only reports component 4 in 23-1-2, there is no way for the UE to report two different values for the scenarios shown in Figure 1 and Figure 2. Instead, UE has to only report a most conservative number for the PCIs that it can handle for L1-RSRP measurement regardless of the relative positions of their corresponding SSBs. This would have a seriously restricting effect on the configured inter-cell beam measurements for the UE.

Figure 1: a UE cannot sweeping all beams for other than serving cellFigure 2: a UE can sweep all beams for all cells but with large latency* Some companies also argued that components 2 and 3 of FG 23-4 for inter-cell mTRP can be reused for the inter-cell beam measurement and reporting. However, if UE supports inter-cell beam management but does not support inter-cell MTRP operation, UE will not report FG 23-4 and, hence, gNB would not know the maximum number of configured additional PCIs for beam measurement X1 or X2. It is however feasible that, for the number of configured additional PCIs for inter-cell beam management (component 5 and 6 in FG 23-1-2) and the number of configured additional PCIs for inter-cell MTRP operation (component 2 and 3 in FG 23-4), UE reports one of them or both of them. If only one of component pairs in 23-4 or 23-1-2 is reported, it can be used for both inter-cell beam management and inter-cell MTRP operation.

***Proposal 6-1: Introduce two components (component 5 and component 6 as follows) in FG 23-1-2 for the reporting of X1/X2 for inter-cell beam management.**** ***Component 5: The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI;***
* ***Component 6: The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI;***

***Note: For the number of configured additional PCIs for inter-cell beam management (component 5 and 6 in FG 23-1-2) and the number of configured additional PCIs for inter-cell MTRP operation (component 2 and 3 in FG 23-4), UE can report one of them or both of them. If only one of the above pairs is reported, it can be used for both inter-cell beam management and inter-cell MTRP operation.*** |

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| 23. NR\_FeMIMO | 23-3-1c | Two PHR reporting | Support of PHR reporting related to M-TRP PUSCH repetition (calculate two PHRs (at least corresponding to the CC that applies m-TRP PUSCH repetitions), each associated with a first PUSCH occasion corresponding to each SRS resource set, and report two PHRs.) | 23-3-1 or 23-3-1-2 | Yes |  | Two PHR reporting is not supported | Per Band | n/a | n/a | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | A Rel-17 UE can be configured with STRP PHR and/or MTRP PHR measurement and report whether MTRP PHR is supported. In practice, a gNB may configure STRP PHR or MTRP PHR in different CCs at the same time and there are rare scenarios to configure STRP PHR and MTRP PHR in one CC at the same time. However, a UE has to reserve maximum computation capability in order to support all possible configurations from gNB, which increases the UE implementation complexity and results in unnecessary resources waste. So we propose to introduce a UE reporting on the max number of PHR reports across all CCs in CA.***Proposal 6-5: Support to add the component 2 in FG 23-3-1c,**** ***Component 2. The maximum number of supported PHR reports across all CCs (including those related to M-TRP PUSCH repetition and the legacy Rel-15/16 PUSCH transmission) , with candidate value { {1, 2, 4, 8,12,16,20,32,48,64}***
* ***Note: MTRP PHR report is counted as 2 and STRP PHR report is counted as 1.***
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| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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| Company | Summary |
| Samsung [7] | Regarding the agreement on the QCL prioritization rule considering CORESETs activated two TCI states, it has been agreed that a new UE is introduced as follows.

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| AgreementWhen a CORESET is activated with two TCI states which overlaps with another CORESET, support extension of Rel-15 prioritization rule for PDCCH monitoring of PDCCH candidates in overlapping monitoring occasions with different QCL-TypeD* FFS: Prioritization rule considers CORESETs indicated with 1 and/or 2 TCI states
* Supports identifying two QCL-TypeD properties for multiple overlapping CORESETs
	+ UE capability is introduced
* FFS other details
* FFS: Strive to have same / similar solution as discussed under AI 8.1.2.1
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Also, the corresponding UE capability has been captured in Clause 10.1 of TS38.213.

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| If a UE - is configured for single cell operation or for operation with carrier aggregation in a same frequency band, - monitors PDCCH candidates in overlapping PDCCH monitoring occasions in multiple CORESETs that have been configured with same or different *qcl-Type* set to 'typeD' properties on active DL BWP(s) of one or more cells, - one or more CORESETs have two activated TCI states, and- reports *twoTypeDcapabilityname*the UE monitors PDCCHs only in a CORESET with a first *qcl-Type* set to first 'typeD' properties and, if any, a second *qcl-Type* set to second 'typeD' properties that are different than the first 'typeD' properties, and in any other CORESET from the multiple CORESETs with corresponding *qcl-Type* set to the first 'typeD' properties or to the second 'typeD' properties - the CORESET corresponds to the CSS set with the lowest index in the cell with the lowest index containing CSS, if any; otherwise, to the USS set with the lowest index in the cell with lowest index- the lowest USS set index is determined over all USS sets with at least one PDCCH candidate in overlapping PDCCH monitoring occasions |

However, it is not clear whether the UE capability has been defined or not. Our view is that a clarification is required whether defining a new UE capability is needed or reusing the following UE capability FG 23-2-2 in [2] is enough for SFN PDCCH as well.

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| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition | 23-2-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

Since PDCCH repetition and SFN PDCCH are different method and cannot be configured simultaneously in the same band, we think that reusing FG 23-2-2 seems simple way to solve a problem. Hence, in order to reuse for the purpose identifying two QCL-TypeD properties to receive SFN PDCCH, we would like to revise FG 23-2-2 as follows.**Proposal 2:** Revise name, description, and pre-requisite of FG 23-2-2 as follows.

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| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition or SFN PDCCH | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition or SFN PDCCH | 23-2-1 or 23-6-1 or 23-6-2 or 23-6-1-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition or SFN PDCCH is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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| 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based  | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)- sequential mapping for repetitions larger than 2- cyclic mapping for 2 repetitions3. Support of two SRS resource sets with usage set to 'codebook'4. Supported number of SRS resources in one SRS resource set | 2-14 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 4 candidate values: {1,2 ,4}Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling |

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| Company | Summary |
| NTT Docomo [14] | In [1], for FG23-3-1, there is a typo in the component number, and it is not consistent with the component number in the Note. The component 3 and 4 should be component 2 and 3 respectively.**Proposal 1-2: Adopt the following update for FG23-3-1.**

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| 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based  | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)- sequential mapping for repetitions larger than 2- cyclic mapping for 2 repetitions2. Support of two SRS resource sets with usage set to 'codebook'3. Supported number of SRS resources in one SRS resource set | 2-14 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 3 candidate values: {1,2 ,4}Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling |

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| 23. NR\_FeMIMO | 23-3-1-1 -codebook based  | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based - sequential mapping for repetitions larger than 2- cyclic mapping for 2 repetitions2. Support of two SRS resource sets with usage set to ‘codebook’3. Supported number of SRS resources in one SRS resource set | 2-14, 11-5 | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,4} | Optional with capability signalling |

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| Company | Summary |
| NTT Docomo [14] | For FG23-3-1-1, similar Note as FG23-3-1 should be included, i.e., If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c.**Proposal 1-3: Add a note “If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c” for FG23-3-1-1.**

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| 23. NR\_FeMIMO | 23-3-1-1 -codebook based  | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based - sequential mapping for repetitions larger than 2- cyclic mapping for 2 repetitions2. Support of two SRS resource sets with usage set to ‘codebook’3. Supported number of SRS resources in one SRS resource set | 2-14, 11-5 | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,4}Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling |

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| 23. NR\_FeMIMO | 23-5-2 | MTRP BFR based on two BFD-RS sets | 1. Maximum number of supported measured BFD-RS resources per set per BWP2. The maximum number of CCs per band configured with BFR (including spCell/SCell/MTRP BFR in Rel-15/16/17)3. Supported maximum number of measured BFD-RS resources across two BFD-RS sets per BWP  |  | Yes |  | MTRP BFR based on two BFD-RS sets is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2}Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8, 9}Component 3 candidate values: {2,3,4} | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | In Rel-16, FG 16-1g and FG-16-1g-1 are used to report the total number of resources that can be used for DL measurement including beam management, beam failure detection, new beam identification, pathloss measurement and radio link monitoring. In R17, it was agreed that the number of resources used for MTRP beam management is also counted in these two FGs, since MTRP beam management is a kind of beam management. In particular, the following note is adopted in the description of FG 23-5-1 where component 2 and 3 are the maximum number of configured resources that can be measured in MTRP beam management.* Note: component 2 and 3 are also counted in FG 16-1g and 16-1g-1

Similarly, the number of resources used for beam failure detection (i.e., BFD-RS) in MTRP BFR should also be counted in FG 16-1g and FG-16-1g-1. In particular, the following note need to be introduced in the description of FG 23-5-2, where component 3 is the maximum number of BFD-RS across two BFD-RS sets in MTRP BFR. * Note: component 3 is also counted in FG 16-1g and 16-1g-1

Without such note, it is possible that gNB will not count the number of BFD-RS for MTRP BFR in FG 16-1g and FG-16-1g-1, leading that the total number of resources configured for DL measurement is larger than the one reported by FG 16-1g and FG 16-1g-1. So, we have the following proposal.***Proposal 6-2: Introduce the following note in FG 23-5-2**** ***Note: component 3 is also counted in FG 16-1g and 16-1g-1.***

For FG 23-5-2, another issue is that there is no component on the maximum number of resources for new beam identification (i.e. NBI-RS). Without such component, UE cannot report the maximum number of NBI-RS it can support and gNB can configure as many NBI-RS as it wants. This is risky for UE. Hence, we propose to introduce a component on the maximum number of NBI-RS.***Proposal 6-3: Introducing the following component in FG 23-5-2 with candidate value {2, 4, 8, 16, 32, 64}**** ***Component 4: Supported maximum number of NBI-RS resources across two NBI-RS sets per BWP.***

Similar as BFD-RS, the number of NBI-RS should also be counted in FG 16-1g and FG-16-1g-1. So, we proposal to introduce a similar note for component 4.***Proposal 6-4: Introduce the following note in FG 23-5-2**** ***Note: component 4 is also counted in FG 16-1g and 16-1g-1.***
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| 23. NR\_FeMIMO | 23-5-2a | PUCCH-SR resources for MTRP BFRQ | 1. Max number of PUCCH-SR resources for MTRP BFRQ per cell group |  | Yes |  | PUCCH-SR resources for MTRP BFRQ is not supported | Per UE | No | Yes | No | Component candidate values: {1, 2}Note: A UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1 | Optional with capability signalling |

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| Company | Summary |
| Samsung [7] | For FG 23-5-2a, we do not see the need to add the note: a UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1.**Proposal 1:** Delete the note “a UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1” in FG 23-5-2a, which is unnecessary. |

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| 23. NR\_FeMIMO | 23-7-1c | Basic Features of CSI Enhancement for Multi-TRP – number of CPUs |  Number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses | 23-7-1 | Yes |  |  | Per band | n/a | n/a | n/a | Component candidate values: {2,3 [,4,5]}Note: Maximum number of CPUs is reported in FG 2-35 | Optional with capability signalling |

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| Company | Summary |
| ZTE [4] | In RAN1#109-e, the following agreement was achieved for occupied CPU for multi-TRP operation, but the candidate value(s) were still pending.

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| 23-7-1c | Basic Features of CSI Enhancement for Multi-TRP – number of CPUs |  Number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses | 23-7-1 | Yes |  |  | Per band | n/a | n/a | n/a | Component candidate values: {2,3 [,4,5]}Note: Maximum number of CPUs is reported in FG 2-35 |

In our views, the above is a compromise for loosing the restriction for UE implement (i.e., fixed to be 2 in the legacy spec). Then, we think that there is another candidate of ‘3’ which is sufficient for UE side on considering the additional efforts on calculating inter-TRP channel cross-correlation. In such case, we think that the other pending candidates of [4,5] should be removed.***Proposal 3:*** *Regarding FG 23-7-1c, further introducing additional candidate(s) (i.e., [4, 5]) for ‘number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses’ is NOT supported.*  |
| Apple [13] | * For FG23-7-1c regarding the number of CPU reporting, as compromise, we propose to remove 5 as candidate value, but keep 4 as candidate value

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| 23. NR\_FeMIMO | 23-7-1c | Basic Features of CSI Enhancement for Multi-TRP – number of CPUs | Number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses | 23-7-1 | Yes |  |  | Per band | n/a | n/a | n/a | Component candidate values: {2,3,4}Note: Maximum number of CPUs is reported in FG 2-35 | Optional with capability signalling |

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| NTT Docomo [14] | If large value is supported, even a pair of CMRs for NCJT CSI will occupy large number of CPUs, which increases the cost to configure NCJT. Hence, larger values are not desirable.**Proposal 1-1: Delete the candidate values of 4, 5 for FG 23-7-1c.** |
| Ericsson [15] | One remaining issue on UE features on further enhancements to NR-MIMO is on the number of CPUs occupied by a pair of CMRs for NC-JT CSI hypothesis. In RAN1#104bis-e, the following agreement was made:According to the above agreement, a pair of CMRs for NCJT CSI hypothesis was agreed to be 2. However, during the UE feature discussion in RAN1#109-e, a new UE capability 23-7-1c was agreed for the number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses and candidate values of 2 and 3 were agreed. Whether candidate values of 4 and 5 need to be additionally supported is still an open issue. Given the previous agreement, our preference is not to further increase the number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses beyond 3. Hence, we make the following proposal:**Agreement** For CSI measurement associated to a reporting setting CSI-ReportConfig for NCJT, an NCJT CSI hypothesis based on a pair of CMRs assumes to occupy two CPUs, two active NZP CSI-RS resources, and a number of active ports corresponding to both CMRs.* If a NZP CSI-RS resource is referred X times by CMR pairs for NCJT measurement hypothesis and CMR for Single-TRP measurement hypothesis, the CSI-RS resource and the CSI-RS ports within the CSI-RS resource are counted X times for active resources and active ports.
* Note: For aboveCSI computation, UE assumesPDSCH transmission is single-DCI based multi-TRP scheme**(s)**. FFS: Multi-DCI based multi-TRP scheme
1. For Rel-17 on NR-MIMO, for FG 23-7-1c candidate values of 4 and 5 are not supported.

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| 23. NR\_FeMIMO | 23-7-1c | Basic Features of CSI Enhancement for Multi-TRP – number of CPUs |  Number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses | 23-7-1 | Yes |  |  | Per band | n/a | n/a | n/a | Component candidate values: {2,3 ~~[,4,5]~~}Note: Maximum number of CPUs is reported in FG 2-35 | Optional with capability signalling |

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| Nokia/Nokia Shanghai Bell [16] | * **23-7-1c - Basic Features of CSI Enhancement for Multi-TRP – number of CPUs**
	+ We understand that component values {2,3} are sufficient to address the concerns on UE implementation regarding the counting of CPUs, i.e. do not confirm values 4, 5 in yellow highlight.
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**Others**

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| Company | Summary |
| Apple [13] | In Rel-17 FeMIMO, we introduced two inter-cell operation enhancement especially regarding SSB measurement, one for inter-cell beam management (BM), and the other one is for inter-cell multi-TRP operation. * Inter-cell beam management (BM) is covered by FG23-1-2
* Inter-cell multi-TRP operation is covered by FG23-4

It is important to note that inter-cell BM and inter-cell multi-TRP should be two indepdent UE features since these two features are very likely to be deployed independently. For example, inter-cell BM can be deployed without deploying inter-cell multi-TRP. As results, component 2 and 3 in FG23-4 regarding X1 and X2 should be replicated for inter-cell BM. We proposal to add the following new FG,

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| 23. NR\_FeMIMO | 23-1-2a | Inter-cell beam measurement and reporting  | 1. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI2. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1 | FG23-1-2 | Yes |  |  | per band | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4,5,6,7}Component 2 candidate values: {0,1,2,3,4,5,6,7}Note: case1 and case2 cannot be enabled simultaneously as any configuration that is not based on Case 1 is defined as Case 2 | Optional with capability signalling |

We also proposed to have the following two new FGs* FG 23-6-5: Support of implicit configuration of RS(s) with two TCI states for beam failure detection
* FG 23-6-6: QCL-TypeD collision handling with CORESET with 2 TCI states. This is to implement the following agreement

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| **Agreement**When a CORESET is activated with two TCI states which overlaps with another CORESET, support extension of Rel-15 prioritization rule for PDCCH monitoring of PDCCH candidates in overlapping monitoring occasions with different QCL-TypeD* FFS: Prioritization rule considers CORESETs indicated with 1 and/or 2 TCI states
* Supports identifying two QCL-TypeD properties for multiple overlapping CORESETs
	+ UE capability is introduced
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| 23. NR\_FeMIMO | 23-6-5 | Support implicit configuration of RS(s) with two TCI states for beam failure detection | Support RS(s) with two TCI states configured implicitly for beam failure detection enhancement for HST |  | Yes | N/A |  | Per band | n/a | N |  |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-6 | QCL-TypeD collision handling with CORESET with 2 TCI states | Support of identifying two QCL-TypeD properties for multiple overlapping CORESETs when a CORESET is activated with two TCI states which overlaps with another CORESET. |  | Yes | N/A |  | Per band | n/a | N |  |  | Optional with capability signalling |

* We propose to introduce FG23-7-6 for the support of CSI-IMR

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| 23. NR\_FeMIMO | 23-7-6 | Support of CSI-IM for CSI enhancement for multi-TRP | Support CSI-IM for CSI enhancement for Multi-TRP | 23-7-1 | Yes |  |  | Per UE | n/a | Yes | n/a |  | Optional with capability signalling |

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## NR\_ext\_to\_71GHz

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| 24. NR\_ext\_to\_71GHz | 24-11a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | 24-4 or 24-5 | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Per BC | N/A | N/A | N/A | Candidate values: {[4,] 5, …, , 16}This FG is a working assumption  | Optional with capability signaling  |
| 24. NR\_ext\_to\_71GHz | 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[4,] 5, …, 16}This FG is a working assumption | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3,] 4, 5, …, 16}This FG is a working assumption | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {[4,] 5, …, 16}This FG is a working assumption | Optional with capability |

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| Company | Summary |
| Huawei/HiSilicon [3] | In RAN1#109-e, the capabilities on the number of CCs in carrier aggregation scenarios when serving cells with Rel-17 monitoring capability are involved are agreed as working assumption. In the discussion[5], companies have different views on whether minimum capability of Rel-15 or Rel-16 are the baseline for the CC with r17 PDCCH monitoring capability. In Rel-15, UE is expected to report *pdcch-BlindDetectionCA* withthe value range of {***4***, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16}. In Rel-16, UE can report *maxNumberOfMonitoringCC-r16* in *pdcch-MonitoringCA-r16* with the value range of {***2***, 3, …, 16}if r16 monitoring capability is configured for all serving cells. In case of mixed configuration, the minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability and the capability on the number of CCs with Rel-16 PDCCH monitoring capability is 3. In 480kHz and 960kHz SCS in FR2-2, the multi slot monitoring capability with are defined as basic component of the feature group. The BD/CCE budget per slot group are same as r15 per slot monitoring capability with 120kHz SCS. The restriction on the monitoring occasion in slot only indicates the location of PDCCH and does not imply UE should finish decoding the PDCCH within slot. Considering similar processing capability requirement as in r15 per slot monitoring capability, the minimum number of CCs with Rel-15 PDCCH monitoring capability can be inherited when there are only CCs with r17 monitoring capability configured (case4) or both r15 and r17 monitoring capability configured (case 5). Similarly, the minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability and the capability on the number of CCs with Rel-16 PDCCH monitoring capability can be reused for mixed configuration scenario with both r16 and r17 monitoring capability (case 6). In case of mixed configuration of r15, r16 and r17 monitoring capability, we propose to adopt 3 as minimum number of CC in order to maintain similar processing capability as Rel-15 and Rel-16. ***Proposal 5-1: Confirm the working assumption of FG 24-11a/c/d/e with the following minimum capability of on the number of CC when r17 monitoring capability is involved**** ***Case 4: minimum number of CC with only r17 PDCCH monitoring capability is 4***
* ***Case 5: minimum of the summation of CCs with r15 and r17 PDCCH monitoring capability is 4***
* ***Case 6: minimum of the summation of CCs with r16 and r17 PDCCH monitoring capability is 3***
* ***Case 7: minimum of the summation of CCs with r15, r16 and r17 PDCCH monitoring capability is 3***

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|  | 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {4, 5, …, 16} | Optional with capability |
|  | 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {3, 4, 5, …, 16} | Optional with capability |
|  | 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {3, 5, …, 16} | Optional with capability |

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| Intel [5] | For NR extension to 71GHz, the remaining open issues for UE capability is how to resolve the working assumption on the smallest supported candidate values regarding maximum number of carriers for PDCCH monitoring. The following table shows the current agreement status in RAN1.

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| --- | --- | --- | --- |
| **FG#** | **Feature group** | **Components** | **Note** |
| 24-11a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Candidate values: {[4,] 5, …, , 16}This FG is a working assumption  |
| 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17) | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[4,] 5, …, 16}This FG is a working assumption |
| 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3,] 4, 5, …, 16}This FG is a working assumption |
| 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {[4,] 5, …, 16}This FG is a working assumption |

We think it is acceptable to confirm the working assumption for FG24-11a, 24-11c, 24-11d, and 24-11e. Rel-17 PDCCH monitoring capabilities for FR2-2 in our opinion is quite essential feature for improved throughput and performances. Since FR2-2 main usage is extreme large bandwidths and extreme throughput scenarios, we think the current working assumption value of 4 for smallest indicated value for FG24-11a, 24-11c, and 24-11e seem appropriate.For FG24-11d, we think the current working assumption value of [3] is acceptable. While we anticipate Rel-17 UEs that support FR2-2 to support even more number of CC compared to Rel-16 UEs and expect Rel-17 UEs to have better capability, given that the minimum of the number of carriers for CCE/BD scaling with CA that have mix of Rel-15 and Rel-16 monitoring capabilities on different carriers was 3, the current WA might be something that is ok. **Proposal 1:*** Confirm the working assumption for FG24-11a, 24-11c, 24-11d, and 24-11e.
 |
| vivo [6] | In RAN1#109 meeting [1], the following agreement is made for multi-slot PDCCH monitoring in carrier aggregation scenario:**Agreement*** For the UE capability parameters for carrier aggregation according to Cases 4,5,6,7 agreed in RAN1#108e, support the following value ranges:
	+ Case 4: Capability on the number of CCs with Rel-17 monitoring capability only
		- Range of pdcch-BlindDetectionCA-R17: {[2 or 4], …, 16}
	+ Case 5: Capability on the number of CCs with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[3 or 4], …, 16}
	+ Case 6: Capability on the number of CCs with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[2 or 3], …, 16}
	+ Case 7: Capability on the number of CCs with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3 or 4], …, 16}

Meanwhile, the following working assumption is made in UE feature session [5]:**Workin assumption: Introduce the following new FGs**

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| 24. NR\_ext\_to\_71GHz | 24-11a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | 24-4 or 24-5 | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Per BC | N/A | N/A | N/A | Candidate values: {[4,] 5, …, , 16}This FG is a working assumption  | Optional with capability signaling  |
| 24. NR\_ext\_to\_71GHz | 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[4,] 5, …, 16}This FG is a working assumption | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3,] 4, 5, …, 16}This FG is a working assumption | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {[4,] 5, …, 16}This FG is a working assumption | Optional with capability |

**Proposal 5: Confirm the working assumption on FG 24-11a, 24-11c, 24-11d, 24-11e for CA scenario involving multi-slot PDCCH monitoring.** |
| MediaTek [10] | There are two remaining discussion points. First is whether there is a need to introduce FGs to report UE capability on support of mix of Rel. 17 PDCCH monitoring capability and Rel.15 and/or Rel.16 PDCCH monitoring capability on different carriers in addition to FG 24-11c/d/e. It was argued that support of FG 24-11c/d/e implies support of mix of Rel. 17 PDCCH monitoring capability and Rel.15 and/or Rel.16 PDCCH monitoring capability on different carriers. However, based on current spec, not supporting FG 24-11c/d/e means UE will not perform any BD/CCE limit scaling in the configured DL CCs, which is different from not supporting mix of Rel. 17 PDCCH monitoring capability and Rel.15 and/or Rel.16 PDCCH monitoring capability on different carriers. Therefore, introducing the UE capabilities on support of mix of Rel. 17 PDCCH monitoring capability and Rel.15 and/or Rel.16 PDCCH monitoring capability on different carriers is necessary for the UE which can only support Rel-17 PDCCH monitoring across all the CCs. The other discussion point is the UE capability signaling on the minimum supported number of CCs for the purpose of determining CA BD/CCE limit. In RAN1 #108-e meeting, there was a proposal to specify the candidate reported values on the supported number of Rel-17 CCs based on the candidate reported values of Rel-15 CCs. In our view, due to the similarity between the Rel-16 span-based PDCCH monitoring and Rel-17 multi-slot PDCCH monitoring, it is more suitable to reuse the signaling of Rel-16 PDCCH monitoring capability for the signaling of Rel-17 multi-slot PDCCH monitoring capability. In addition, one of the motivations on introducing Rel-17 multi-slot PDCCH is allowing UE to monitoring only few consecutive slots within a slot group in order to achieve power saving at UE side. Therefore, from the UE implementation point of view, supporting Rel-17 multi-slot PDCCH monitoring is more challenging to supporting Rel-15 slot based PDCCH monitoring even though the BD/CCE within a slot group is defined based on the BD/CCE within a 120kHz.slot. Furthermore, the minimum supported number of Rel-15 CC is 4, which is not a practical CC numbers in 480 and 960 kHz for operation in 60GHz when considering the max channel bandwidth, e.g., there is only 5GHz bandwidth in China which is around 2 CCs for 960kHz with the maximum channel bandwidth.To summarize our preference, we have the following proposalProposal 1: Adopt the following changes in the working assumption FG24-11 a/c/d/e:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | 24-4 or 24-5 | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Candidate values: {2, 3, [4,] 5, …, , 16}~~This FG is a working assumption~~  |
| 24. NR\_ext\_to\_71GHz | 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {3,[4,] 5, …, 16}~~This FG is a working assumption~~ |
| 24. NR\_ext\_to\_71GHz | 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {2,[3,] 4, 5, …, 16}~~This FG is a working assumption~~ |
| 24. NR\_ext\_to\_71GHz | 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {3,[4,] 5, …, 16}~~This FG is a working assumption~~ |
| 24. NR\_ext\_to\_71GHz | 24-11b | Mix of Rel. 17 PDCCH monitoring capability and Rel.15 and Rel.16 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells |  | Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells is not supported |  |
| 24. NR\_ext\_to\_71GHz | 24-11j | Mix of Rel. 17 PDCCH monitoring capability and Rel.15 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability, and Rel-17 monitoring capability on different serving cells |  | Rel-15 monitoring capability, and Rel-17 monitoring capability on different serving cells is not supported |  |
| 24. NR\_ext\_to\_71GHz | 24-11k | Mix of Rel. 17 PDCCH monitoring capability and Rel.16 PDCCH monitoring capability on different carriers | Support Rel-16 monitoring capability, and Rel-17 monitoring capability on different serving cells |  | Rel-16 monitoring capability, and Rel-17 monitoring capability on different serving cells is not supported |  |

 |
| Ericsson [15] | We further observe that the naming of the UE capabilities *pdcch-BlindDetectionCA-R15*, *pdcch-BlindDetectionCA-R16*, and *pdcch-BlindDetectionCA-R17* in the definition of FG 24-11a/c/d/e in the above table has been changed in the latest version of 38.213 to *pdcch-BlindDetectionCA1*, *pdcch-BlindDetectionCA2*, and *pdcch-BlindDetectionCA3*, respectively. Hence, we propose to align the capability naming between the UE capability spreadsheet and 38.213.1. For Rel-17 NR up to 71 GHz, in the description of FG 24-11a/c/d/e update the UE capability naming from *pdcch-BlindDetectionCA-R15*, *pdcch-BlindDetectionCA-R16*, and *pdcch-BlindDetectionCA-R17* to *pdcch-BlindDetectionCA1*, *pdcch-BlindDetectionCA2*, and *pdcch-BlindDetectionCA3*, respectively, to align with 38.213.

One remaining open issue is the lower end of the range of candidate values for the capability on the number of CCs with various combinations of Rel-15/16/17 PDCCH monitoring. This is reflected by the highlighted values the following agreement from RAN1#109-e:**Agreement*** For the UE capability parameters for carrier aggregation according to Cases 4,5,6,7 agreed in RAN1#108e, support the following value ranges:
	+ Case 4: Capability on the number of CCs with Rel-17 monitoring capability only
		- Range of pdcch-BlindDetectionCA-R17: {[2 or 4], …, 16}
	+ Case 5: Capability on the number of CCs with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[3 or 4], …, 16}
	+ Case 6: Capability on the number of CCs with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[2 or 3], …, 16}
	+ Case 7: Capability on the number of CCs with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3 or 4], …, 16}

In our view, Rel-17 multi-slot PDCCH monitoring for 480/960 kHz SCS was designed intentionally to provide the UE with the same about of absolute time for decoding PDCCH per group of X slots (X = 4/8 for 480/960 kHz SCS) as one slot at 120 kHz SCS. Furthermore, the BD/CCE budget for multi-slot PDCCH monitoring was intentionally chosen to be the same per X slots as for 1 slot at 120 kHz SCS. For this reason, the capability on the number of CCs should not be reduced when there is a mix of cells with Rel-15 and Rel-17 monitoring compared to if Rel-15 monitoring is used on all cells. Hence, for Case 4 and Case 5 in the above agreement (corresponds to FG 24-11a and 24-11c, respectively), we prefer to leave the minimum value as 4. For Case 6 and 7 (corresponds to FG 24-11d and 24-11d, respective), the values are reduced to account for more complex Rel-16 monitoring, hence we can support a value of 3, as long as that value applies to both Case 6 and 7. We do not support a value of 2 since it is lower than the case of a mix of Rel-15 and Rel-16 monitoring. In summary we support the following:* Range of pdcch-BlindDetectionCA-R17: {~~4~~…, 16}
* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {4…, 16}
* Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {3…, 16}
* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {3, …, 16}

Based on the above values, propose the following:1. For Rel-17 NR up to 71 GHz, support the following changes to FG 24-11a/c/d/e.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 24-11a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | 24-4 or 24-5 | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Per BC | Candidate values: {~~[~~4,~~]~~ 5, …, , 16}~~This FG is a working assumption~~  | Optional with capability signaling  |
| 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {~~[~~4,~~]~~ 5, …, 16}~~This FG is a working assumption~~ | Optional with capability |
| 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC | Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {~~[~~3,~~]~~ 4, 5, …, 16}~~This FG is a working assumption~~ | Optional with capability |
| 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {~~[~~3~~4~~,~~]~~ 4, 5, …, 16}~~This FG is a working assumption~~ | Optional with capability |

 |
| Nokia/Nokia Shanghai Bell [16] | * **24-11a - Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells**
	+ Confirm the working assumption
	+ Confirm candidate value 4
* **24-11c - Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers**
	+ Confirm the working assumption
	+ Confirm candidate value 4
* **24-11d - Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers**
	+ Confirm the working assumption
	+ Confirm candidate value 3
* **24-11e - Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers**
	+ Confirm the working assumption
 |

**Others**

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [3] | In RAN1#109e, a final agreement concerning FG 26-5 is made with the FFS. “whether FG26-5 is also supported in bands not in Table 5.2.2-1 in TS 38.101-5”. **Agreement:** * In the FGs below, the note “[Note: This UE feature group is applicable only for NR NTN cell and ATG cell, for terrestrial cell except for ATG cell this feature is not supported]” is replaced with a new note “Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5”
	+ FFS whether FG 26-5 is also supported in bands not in Table 5.2.2-1 in TS 38.101-5

Meanwhile, there is an ongoing discussion on whether the feature groups of 32 HARQ processes (FG24-8/8b, FG24-9/9b) can be extended to FR2-1 for 60kHz and 120kHz SCS (FG24-8a and FG24-9a). As discussed in [1], the support of 32 HARQ processes can be beneficial for other scenarios for a UE supporting this feature, e.g. used for FR1 licensed terrestrial bands and FR2-1. For example, for the support of FR1 + FR2 CA, if the PUCCH is transmitted on FR1 with small SCS, then it can be expected that a small number of slots on FR1 would correspond to large number of slots on FR2, which will result in the need of larger number of HARQ processes on FR2, otherwise it will degrade the system performance for FR2. Another example scenario that would be beneficial from the support of 32 HARQ processes is multi-TRP case, in which case the need of number of HARQ processes would be increased. In FR2-2, the reason to introduce 32 HARQ processes for FR2-1 is to avoid HARQ processes starvation when multiple PDSCH is scheduled by a single DCI. It is also beneficial when gNB configuring small number of DL/UL switching point in a long periodicity, as discussed in NR-U. The multiple PDSCH scheduling by single DCI has been extended to FR2-1 for 120kHz SCS and it may be further extended to FR1, it would be straightforward to extend 32 HARQ processes to FR2-1 and FR1 as well. In order to avoid ambiguity on the number of HARQ processes during potential BWP switching between different numerologies, the 32 HARQ processes should be applicable for all numerologies in FR1 and FR2 once UE report its capability. Extending the 32 HARQ processes in NTN has been summarized in [3]. Consensus cannot be reached due to different flavors of HARQ process ID indication. However, in NTN, the explicit HARQ process indication has already been agreed. Therefore, there seems no obstacles to extend this FG in other scenarios. The major concern on the complexity at UE side can also be alleviated because the FGs are optionally supported and UE had freedom to report not supporting such FG. As for how to capture the feature 32 HARQ processes in FR1 and FR2-1 for TN operation, it would be simpler to add separate FGs 32 HARQ process for FR1 and FR2-1. The corresponding TPs are provided in Appendix 2***Proposal 2-1: Support to extend FGs for 32 HARQ processes in FR1 and FR2-1 for all numerologies.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **24-8a** | **32 DL HARQ processes for FR2-1** | Support 32 HARQ processes in DL for 60/120 kHz |  | **Yes** | **N/A** | 32 DL HARQ processes for FR 2-1 is not supported | Per band | **N/A** | **N/A** | **N/A** | A UE supporting 32 maximum number of HARQ processes for 120 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 60 kHz SCS for DL in FR2-1 | Optional with capability signalling |
|  | **24-8b** | **32 DL HARQ processes for FR1** | Support 32 HARQ processes in DL for 15/30/60 kHz |  | **Yes** | **N/A** | 32 DL HARQ processes for FR1 is not supported | Per band | **N/A** | **N/A** | **N/A** |  | Optional with capability signalling |
|  | **24-9a** | **32 UL HARQ processes for FR2-1** | Support 32 HARQ processes in UL for 60/120 kHz |  | **Yes** | **N/A** | 32 DL HARQ processes for FR 2-1 is not supported | Per band | **N/A** | **N/A** | **N/A** | A UE supporting 32 maximum number of HARQ processes for 120 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 60 kHz SCS for DL in FR2-1 | Optional with capability signaling |
|  | **24-9b** | **32 UL HARQ processes for FR1** | Support 32 HARQ processes in UL for 15/30/60 kHz |  | **Yes** | **N/A** | 32 DL HARQ processes for FR1 is not supported | Per band | **N/A** | **N/A** | **N/A** |  | Optional with capability signaling |

In RAN1#109-e, it is agreed in high level to introduce FGs for multi slot PDCCH monitoring for NR-DC following similar framework as agreed for CA in RAN1#108-e.However, RAN2 did not add the corresponding FGs because the agreement is not reflected in the LS sent by RAN1[1]. Thus, we propose to add the following 4 FGs in the LS to RAN2, according to the recommendation by the agreement. **Agreement*** The UE capability framework agreed in RAN1#108-e for CA is extended to the case of NR-DC considering different combinations of Rel-17 (per-slot group) monitoring, Rel-15 (per-slot) monitoring, and Rel-16 (per-span) monitoring within different cell groups.
* Suggest the contents under the bullets for NR-DC cases 4/5/6/7 in Proposal 2-12.2 in R1-2205280 as possible implementation of this agreement to the spec editors.
* FG24-11f: Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells
* FG24-11g: Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers
* FG24-11h: Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers
* FG24-11i: Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers

The detail definitions are provided in appendix ***Proposal 5-2: Include in the LS to RAN2 the FGs corresponding to the additional 4 cases on the capability on the number of CCs with different monitoring capability combinations when a UE is configured with NR-DC.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-11f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells | * Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells
* Supported combination of (*pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*)
 | 24-4 or 24-5 | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Per BC | N/A | N/A | N/A | If the UE reports *pdcch-BlindDetectionCA-r17*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17* >= *pdcch-BlindDetectionCA-r17*

Otherwise, if is a maximum total number of downlink cells that have SCS configuration and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* or of *pdcch-BlindDetectionSCG-UE-r17* is {1,2,3}, and

*pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= .* | Optional with capability |
|  | 24-11g | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA1, pdcch-BlindDetectionCA3*)If the UE reports *pdcch-BlindDetectionCA-r15*: * the value range of *pdcch-BlindDetectionMCG-UE-r15* is {0, 1, …, *pdcch-BlindDetectionCA-r15* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r15* is {0, 1, …, *pdcch-BlindDetectionCA-r15* - 1}
* *pdcch-BlindDetectionMCG-UE-r15* + *pdcch-BlindDetectionSCG-UE-r15 >= pdcch-BlindDetectionCA-r15.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r15monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r15* is {0,1,2},
* the value range of *pdcch-BlindDetectionSCG-UE-r15* is {0,1,2},
* *pdcch-BlindDetectionMCG-UE-r15* + *pdcch-BlindDetectionSCG-UE-r15 >= .*

If the UE reports *pdcch-BlindDetectionCA-r17*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= pdcch-BlindDetectionCA-r17.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* or of *pdcch-BlindDetectionSCG-UE-r17* is {0,1,2}, and
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= .*
 | Optional with capability |
|  | 24-11h | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA2, pdcch-BlindDetectionCA3*)If the UE reports *pdcch-BlindDetectionCA-r16*: * the value range of *pdcch-BlindDetectionMCG-UE-r16* is {0, 1, …, *pdcch-BlindDetectionCA-r16* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r16* is {0, 1, …, *pdcch-BlindDetectionCA-r16* - 1},
* *pdcch-BlindDetectionMCG-UE-r16* + *pdcch-BlindDetectionSCG-UE-r16 >= pdcch-BlindDetectionCA-r16.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r16* is {0,1},
* the value range of *pdcch-BlindDetectionSCG-UE-r16* is {0,1},
* *pdcch-BlindDetectionMCG-UE-r16*+ *pdcch-BlindDetectionSCG-UE-r16 >= .*

If the UE reports *pdcch-BlindDetectionCA-r17*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= pdcch-BlindDetectionCA-r17.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0,1,2},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0,1,2},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= .*
 | Optional with capability |
|  | 24-11i | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA1, pdcch-BlindDetectionCA2, pdcch-BlindDetectionCA3*)If the UE reports *pdcch-BlindDetectionCA-r15*: * the value range of *pdcch-BlindDetectionMCG-UE-r15* is {0, 1, …, *pdcch-BlindDetectionCA-r15* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r15* is {0, 1, …, *pdcch-BlindDetectionCA-r15* - 1},
* *pdcch-BlindDetectionMCG-UE-r15* + *pdcch-BlindDetectionSCG-UE-r15 >= pdcch-BlindDetectionCA-r15.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r15monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r15* is {0,1,2},
* the value range of *pdcch-BlindDetectionSCG-UE-r15* is {0,1,2},
* *pdcch-BlindDetectionMCG-UE-r15* + *pdcch-BlindDetectionSCG-UE-r15 >= .*

If the UE reports *pdcch-BlindDetectionCA-r16*: * the value range of *pdcch-BlindDetectionMCG-UE-r16* is {0, 1, …, *pdcch-BlindDetectionCA-r16* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r16* is {0, 1, …, *pdcch-BlindDetectionCA-r16* - 1},
* *pdcch-BlindDetectionMCG-UE-r16* + *pdcch-BlindDetectionSCG-UE-r16 >= pdcch-BlindDetectionCA-r16.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r16* is {0,1},
* the value range of *pdcch-BlindDetectionSCG-UE-r16* is {0,1},
* *pdcch-BlindDetectionMCG-UE-r16*+ *pdcch-BlindDetectionSCG-UE-r16 >= .*

If the UE reports *pdcch-BlindDetectionCA-r17*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= pdcch-BlindDetectionCA-r17.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0,1,2},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0,1,2}, and
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= .*
 | Optional with capability |

In RAN#108-e, the multiple PDSCH/PUSCH scheduling by single DCI has been extended to FR2-1 for 120kHz SCS due to its scheduling efficiency to achieve high throughput. During the discussion and also noted in the Chair’s note, whether such FGs can be further extended to other SCS and FR can be further discussed. For UL, it is already supported for all SCSs in FR1 and FR2-1 when multiple PUSCHs scheduled by single DCI are consecutive. Extending the support of non-contiguous allocation to the 15/30/60kHz SCSs in FR1 and 60kHz SCS in FR2-1 same as those agreed for FR2-1 and FR2-2 for 120kHz/480kHz/960kHz could reduce scheduling overhead and PDCCH monitoring complexity without introducing additional standardization effort. Due to the same reason, we also support to extend multiple PDSCH scheduling by single DCI to 15/30/60kHz SCS in FR1 and 60kHz SCS in FR2-1.***Proposal 5-3: Define new feature groups to support multiple PDSCH scheduling by single DCI and multiple PUSCH scheduling by single DCI for all SCSs in FR1 and FR2-1 as shown in FG24-1f/g/h/i in appendix 2.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-1f | Multiple PDSCH scheduling by single DCIin FR2-1 | 1. Multi-PDSCH scheduling by single DCI 2. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI |  | Yes | N/A | Multiple PDSCH scheduling by single DCI is not supported in FR2-1 | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
|  | 24-1g | Multiple PUSCH scheduling by single DCI in FR2-1 | 1. Multi-PUSCH scheduling by single DCI with non-contiguous allocation  |  | Yes | N/A | Multiple PUSCH scheduling by single DCI is not supported in FR2-1 with non-contiguous allocation | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
|  | 24-1h | Multiple PDSCH scheduling by single DCI in FR1 | 1. Multi-PDSCH scheduling by single DCI 2. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI |  | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported in FR1 | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
|  | 24-1i | Multiple PUSCH scheduling by single DCI in FR1 | 1. Multi-PUSCH scheduling by single DCI with non-contiguous allocation  |  | Yes | N/A | Multiple PUSCH scheduling by single DCI is not supported in FR1 with non-contiguous allocation | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| ZTE [4] | In RAN1 #108-e meeting, the extending multiple PDSCH/PUSCH scheduled by single DCI to other SCSs has been captured in the note of the following agreement [6]. Currently, the multiple PDSCH/PUSCH scheduled by single DCI are only applicable for 120/480/960 kHz in FR2-2 and 120 kHz in FR2-1.**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz in FR2-2 | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements [for both type 1 and type 2 HARQ codebook] for supporting multi-PDSCH scheduling with singe DCI | 24-1 | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported in FR2-2 | Per band | N/A | N/A | N/A | ~~FFS: to extend this FG to other frequency ranges~~  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-1f | Multiple PDSCH scheduling by single DCI for 120kHz in FR2-1 | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements [for both type 1 and type 2 HARQ codebook] for supporting multi-PDSCH scheduling with singe DCI |  | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported in FR2-1 | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

* Continue discussion on extending 24-1f to other SCSs

**Agreement: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz in FR2-2 | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a | Yes | N/A | Multiple PUSCH scheduling by single DCI for 120kHz is not supported in FR2-2 | Per band | N/A | N/A | N/A | ~~FFS: to extend this FG to other frequency ranges~~ | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-1g | Multiple PUSCH scheduling by single DCI for 120kHz in FR2-1 | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS with non-contiguous allocation  |  | Yes | N/A | Multiple PUSCH scheduling by single DCI for 120kHz is not supported in FR2-1 with non-contiguous allocation | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

* Continue discussion on extending 24-1g to other SCSs

In RAN1 #109-e meeting, extending multiple PDSCH/PUSCH scheduling by single DCI to 60 kHz in FR2-2 and 15/30/60 kHz in FR1 was discussed and the possible proposal is as follows. However, it was unfortunate that no consensus was reached on this feature within the last limited time. In this meeting, it is necessary to further discuss applicability of this feature and agree extending it to other SCSs (e.g., 60 kHz in FR2-2 and 15/30/60 kHz in FR1) considering that it is band-agnostic and beneficial to degrade the overhead of DCI signalling. Given that, we recommend extending the applicability of this feature to 60 kHz in FR2-2 and 15/30/60 kHz in FR1 and no differentiation licensed and unlicensed spectrum. ***Proposal 8:*** *It is recommended to extend the applicability of multiple PDSCH/PUSCH scheduling by single DCI to 60 kHz in FR2-2 and 15/30/60 kHz in FR1.****Proposal 9:*** *Adopt the following new FGs on multiple PDSCH/PUSCH scheduling by single DCI:*

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-1h | Multiple PDSCH scheduling by single DCI for 60kHz in FR2-1  | 1. Multi-PDSCH scheduling by single DCI for the operation with 60 kHz SCSs in FR2-12. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | Yes | N/A | Multiple PDSCH scheduling by single DCI for 15/30/60kHz is not supported in FR2-1 | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1i | Multiple PDSCH scheduling by single DCI for for 15/30/60kHz in FR1 | 1. Multi-PDSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs in FR12. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | Yes | N/A | Multiple PDSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1j | Multiple PUSCH scheduling by single DCI for 60kHz in FR2-1  | 1. Multi-PUSCH scheduling by single DCI for the operation with 60 kHz SCSs with non-contiguous allocation in FR2-1 | Yes | N/A | Multiple PUSCH scheduling by single DCI for 15/30/60kHz is not supported in FR2-1 with non-contiguous allocation | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1k | Multiple PUSCH scheduling by single DCI for 15/30/60kHz in FR1 | 1. Multi-PUSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs with non-contiguous allocation in FR1 | Yes | N/A | Multiple PUSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 with non-contiguous allocation | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

The UE capability parameters for carrier aggregation were discussed in RAN1#109-e meeting and the following agreement was achieved.

|  |
| --- |
| **Agreement** * For the UE capability parameters for carrier aggregation according to Cases 4,5,6,7 agreed in RAN1#108e, support the following value ranges:
	+ Case 4: Capability on the number of CCs with Rel-17 monitoring capability only
		- Range of pdcch-BlindDetectionCA-R17: {[2 or 4], …, 16}
	+ Case 5: Capability on the number of CCs with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[3 or 4], …, 16}
	+ Case 6: Capability on the number of CCs with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[2 or 3], …, 16}
	+ Case 7: Capability on the number of CCs with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: {1, 2, …, 15}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3 or 4], …, 16}
 |

As we can see, the value range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17 are still enclosed in square brackets. From a network perspective, we still prefer to set the same minimum number of CCs as Rel-15 for scheduling flexibility.***Proposal 10:*** *Prefer the following value ranges of UE capability parameters for carrier aggregation according to Cases 4,5,6,7 and update the number of CCs for FG 24-11a, FG 24-11c, FG 24-11d and FG 24-11e accordingly.** + *Case 4: Capability on the number of CCs with Rel-17 monitoring capability only*
		- *Range of pdcch-BlindDetectionCA-R17: {4, …, 16}*
	+ *Case 5: Capability on the number of CCs with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells*
		- *pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability*
		- *pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability*
		- *Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: {1, 2, …, 15}*
			* *Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {4, …, 16}*
	+ *Case 6: Capability on the number of CCs with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells*
		- *pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability*
		- *pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability*
		- *Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: {1, 2, …, 15}*
			* *Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {3, …, 16}*
	+ *Case 7: Capability on the number of CCs with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells*
		- *pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability*
		- *pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability*
		- *pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability*
		- *Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: {1, 2, …, 15}*
			* *Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {4, …, 16}*

The case of NR-DC operation considering different combinations of Rel-17 (per-slot group) monitoring, Rel-15 (per-slot) monitoring, and Rel-16 (per-span) monitoring within different cell groups has been agreed and captured in TS 38.213. Therefore, we suggest to add FG 24-22f, FG 24-22g, FG 24-22h and FG 24-22i into the UE feature list. Moreover, similar as Rel-16, those FGs should be defined based on the granularity of per BC.***Proposal 11:*** *Add FG 24-11f, FG 24-11g, FG 24-11h and FG 24-11i into the UE feature list as follows:*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells | Supported combination of (*pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Per BC |
| 24. NR\_ext\_to\_71GHz | 24-11g | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC |
| 24. NR\_ext\_to\_71GHz | 24-11h | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC |
| 24. NR\_ext\_to\_71GHz | 24-11i | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC |

 |
| vivo [6] | Besides, the following agreement is made to support NR-DC scenario with mixed case involving multi-slot PDCCH monitoring capability type:**Agreement*** The UE capability framework agreed in RAN1#108-e for CA is extended to the case of NR-DC considering different combinations of Rel-17 (per-slot group) monitoring, Rel-15 (per-slot) monitoring, and Rel-16 (per-span) monitoring within different cell groups.
* Suggest the contents under the bullets for NR-DC cases 4/5/6/7 in Proposal 2-12.2 in R1-2205280 as possible implementation of this agreement to the spec editors.

However, the UE capabilities are not defined for this NR-DC scenario. Thus new FGs should be introduced with the following table:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells | Supported combination of (*pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells is not supported |  |  |  |  |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11g | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported |  |  |  |  |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11h | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported |  |  |  |  |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11i | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported |  |  |  |  |  | Optional with capability |

**Proposal 6: Introduce new FGs for NR-DC scenario involving multi-slot PDCCH monitoring.** |
| LG Electronics [11] | In [2], the extension of multi-PDSCH or multi-PUSCH scheduling to other SCSs than 120/480/960 kHz was discussed but not agreed. In our view, multi-PXSCH scheduling DCI introduced for FR2-2 can also be applicable to other frequency ranges since this feature is band-agnostic and beneficial in terms of DCI overhead reduction. Therefore, we suggest to extend the applicability of multi-PXSCH scheduling DCI to FR2-1 60 kHz SCS as well as FR1 15/30/60 kHz SCSs.**Proposal: Extend the applicability of multi-PDSCH scheduling DCI and multi-PUSCH scheduling DCI introduced for FR2-2 to FR1 and to FR2-1 60 kHz SCS, and adopt the following new UE features accordingly.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1h | Multiple PDSCH scheduling by single DCI for 60kHz in FR2-1 | 1. Multi-PDSCH scheduling by single DCI for the operation with 60 kHz SCS in FR2-12. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | Multiple PDSCH scheduling by single DCI for 60kHz is not supported in FR2-1 | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-1i | Multiple PDSCH scheduling by single DCI for 15/30/60kHz in FR1 | 1. Multi-PDSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs in FR12. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | Multiple PDSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1j | Multiple PUSCH scheduling by single DCI for 60kHz in FR2-1 | 1. Multi-PUSCH scheduling by single DCI for the operation with 60 kHz SCS with non-contiguous allocation in FR2-1 | Multiple PUSCH scheduling by single DCI for 60kHz is not supported in FR2-1 with non-contiguous allocation | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1k | Multiple PUSCH scheduling by single DCI for 15/30/60kHz in FR1 | 1. Multi-PUSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs with non-contiguous allocation in FR1 | Multiple PUSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 with non-contiguous allocation | Optional with capability signalling |

 |
| NTT Docomo [14] | All the yellow-highlighted parts are related to the minimum number of CCs with Rel-17 multi-slot PDCCH monitoring capability, which was discussed at the end of the last RAN1 e-meeting. The key point, in our understanding, is whether to reduce these numbers further considering UE implementation complexity caused by the support of larger SCS.For the discussion process, we are ok with either to discuss it in UE feature session or in main session under 8.2, while we think it may be straightforward to discuss it under 8.2, as we did in the last e-meeting. In this case, the discussion in UE feature session can be deferred a bit more to see 8.2 progress. Technically, we prefer to keep the current minimum numbers as they are, especially for FG24-11a and FG24-11c. We believe these values should follow the existing UE capability for Rel-15 PDCCH monitoring since, during Rel-17 52.6-71 GHz WI, we tried to reduce UE complexity caused by PDCCH monitoring well so that we can keep it as in Rel-15 NR as much as possible, and such target is well achieved with the latest Rel-17 specifications. Thus, we do not see any justification to define smaller than 4 CCs for them. Moreover, as per the following agreement in RAN4 [2], mandatory channel bandwidth is up to 400 MHz even if larger SCS(s) is supported. Given that, if the mandatory capability on the number of CCs for CA becomes smaller as well, the performance of the whole Rel-17 NR in FR2-2 will be much degraded comparing with IEEE 802.11ad/ay design. To keep NR design reasonable and competitive against another RAT, we strongly believe the values highlighted in yellow above should be kept.

|  |
| --- |
| *Mandatory channel bandwidth** **Agreement:**
	+ 120 kHz: mandatory (100 MHz, 400 MHz)
	+ 480 kHz: mandatory (400 MHz), optional (800 MHz, 1600 MHz)
	+ 960 kHz: mandatory (400 MHz), optional (800MHz, 1600 MHz, 2000 MHz)
 |

We also believe similar capabilities are needed for DC scenario as per the following WI agreement.

|  |
| --- |
| **Agreement*** The UE capability framework agreed in RAN1#108-e for CA is extended to the case of NR-DC considering different combinations of Rel-17 (per-slot group) monitoring, Rel-15 (per-slot) monitoring, and Rel-16 (per-span) monitoring within different cell groups.
* Suggest the contents under the bullets for NR-DC cases 4/5/6/7 in Proposal 2-12.2 in R1-2205280 as possible implementation of this agreement to the spec editors.
 |

We propose to add the four capabilities for DC scenario based on the latest status in UE feature discussion with some modifications to cover the intention of the agreement above: **Proposal 2: For remaining issues regarding NR\_ext\_to\_71GHz, the following two issues should be resolved.** * **For CA related capabilities (i.e., FG24-11a/c/d/e), the minimum number of CCs should be kept as they are, especially for FG24-11a/c (the ones involved with Rel-17 and/or Rel-15 PDCCH monitoring capability only)**
* **For DC related capabilities, support to add the following capabilities**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells | Supported combination of (*pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Per BC | N/A | N/A | N/A | If the UE reports pdcch-BlindDetectionCA-r17,- Candidate values for pdcch-BlindDetectionMCG-UE-r17 is 1 to pdcch-BlindDetectionCA-r17-1- Candidate values for pdcch-BlindDetectionSCG-UE-r17 is 1 to pdcch-BlindDetectionCA-r17-1- - pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17 >= pdcch-BlindDetectionCA-r17Otherwise, if N\_(NR-DC,max,r17)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r17 = r17monitoringcapability and the UE is configured on both the MCG and the SCG for NR-DC as indicated in UE-NR-Capability- the value of pdcch-BlindDetectionMCG-UE-r17 or of pdcch-BlindDetectionSCG-UE-r17 is 1,- pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17 >= N\_(NR-DC,max,r17)^(DL,cells) | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11g | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA-r15, pdcch-BlindDetectionCA-r17*)If the UE reports pdcch-BlindDetectionCA-r15,- Candidate values for pdcch-BlindDetectionMCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15- Candidate values for pdcch-BlindDetectionSCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15- pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15>= pdcch-BlindDetectionCA-r15Otherwise, if N\_(NR-DC,max,r15)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r15 = r15monitoringcapability- Candidate values for pdcch-BlindDetectionMCG-UE-r15 is [0, 1, 2]- Candidate values for pdcch-BlindDetectionSCG-UE-r15 is [0, 1, 2]- pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15 >= N\_(NR-DC,max,r15)^(DL,cells)If the UE reports pdcch-BlindDetectionCA-r17,- Candidate values for pdcch-BlindDetectionMCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17- Candidate values for pdcch-BlindDetectionSCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17- pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17>= pdcch-BlindDetectionCA-r17Otherwise, if N\_(NR-DC,max,r17)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r17 = r17monitoringcapability- Candidate values for pdcch-BlindDetectionMCG-UE-r17 is [0, 1]- Candidate values for pdcch-BlindDetectionSCG-UE-r17 is [0, 1]- pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17 >= N\_(NR-DC,max,r17)^(DL,cells) | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11h | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA-r16, pdcch-BlindDetectionCA-r17*)If the UE reports pdcch-BlindDetectionCA-r16,- Candidate values for pdcch-BlindDetectionMCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16- Candidate values for pdcch-BlindDetectionSCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16- pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r16>= pdcch-BlindDetectionCA-r16Otherwise, if N\_(NR-DC,max,r16)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r16 = r16monitoringcapability- Candidate values for pdcch-BlindDetectionMCG-UE-r16 is [0, 1, 2]- Candidate values for pdcch-BlindDetectionSCG-UE-r16 is [0, 1, 2]- pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16 >= N\_(NR-DC,max,r16)^(DL,cells)If the UE reports pdcch-BlindDetectionCA-r17,- Candidate values for pdcch-BlindDetectionMCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17- Candidate values for pdcch-BlindDetectionSCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17- pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17>= pdcch-BlindDetectionCA-r17Otherwise, if N\_(NR-DC,max,r17)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r17 = r17monitoringcapability- Candidate values for pdcch-BlindDetectionMCG-UE-r17 is [0, 1]- Candidate values for pdcch-BlindDetectionSCG-UE-r17 is [0, 1]- pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17 >= N\_(NR-DC,max,r17)^(DL,cells) | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11i | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15,pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA-r15, pdcch-BlindDetectionCA-r16, pdcch-BlindDetectionCA-r17*)If the UE reports pdcch-BlindDetectionCA-r15,- Candidate values for pdcch-BlindDetectionMCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15- Candidate values for pdcch-BlindDetectionSCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15- pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15>= pdcch-BlindDetectionCA-r15Otherwise, if N\_(NR-DC,max,r15)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r15 = r15monitoringcapability- Candidate values for pdcch-BlindDetectionMCG-UE-r15 is [0, 1, 2]- Candidate values for pdcch-BlindDetectionSCG-UE-r15 is [0, 1, 2]- pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15 >= N\_(NR-DC,max,r15)^(DL,cells)If the UE reports pdcch-BlindDetectionCA-r16,- Candidate values for pdcch-BlindDetectionMCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16- Candidate values for pdcch-BlindDetectionSCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16- pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r16>= pdcch-BlindDetectionCA-r16Otherwise, if N\_(NR-DC,max,r16)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r16 = r16monitoringcapability- Candidate values for pdcch-BlindDetectionMCG-UE-r16 is [0, 1, 2]- Candidate values for pdcch-BlindDetectionSCG-UE-r16 is [0, 1, 2]- pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16 >= N\_(NR-DC,max,r16)^(DL,cells)If the UE reports pdcch-BlindDetectionCA-r17,- Candidate values for pdcch-BlindDetectionMCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17- Candidate values for pdcch-BlindDetectionSCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17- pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17>= pdcch-BlindDetectionCA-r17Otherwise, if N\_(NR-DC,max,r17)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r17 = r17monitoringcapability- Candidate values for pdcch-BlindDetectionMCG-UE-r17 is [0, 1]- Candidate values for pdcch-BlindDetectionSCG-UE-r17 is [0, 1]- pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17 >= N\_(NR-DC,max,r17)^(DL,cells) | Optional with capability |

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| Ericsson [15] | In RAN1#109-e, the following agreement was made for extending the UE capabilities for multi-slot PDCCH monitoring for CA also to NR-DC:**Agreement*** The UE capability framework agreed in RAN1#108-e for CA is extended to the case of NR-DC considering different combinations of Rel-17 (per-slot group) monitoring, Rel-15 (per-slot) monitoring, and Rel-16 (per-span) monitoring within different cell groups.
* Suggest the contents under the bullets for NR-DC cases 4/5/6/7 in Proposal 2-12.2 in R1-2205280 as possible implementation of this agreement to the spec editors.

As a result of this agreement, the spec editor did extensive updates of 38.213 Section 10 to capture the UE capability framework for NR-DC. In so doing, the spec editor introduced the following UE capabilities that have not yet been captured in the UE capability spreadsheet:* *pdcch-BlindDetectionMCG-UE3*
* *pdcch-BlindDetectionSCG-UE3*

We propose that FGs are added which correspond to these capabilities; it can be further discussed the necessary FG description and candidate values. Since any new FG has ASN.1 impact, it would be wise to define these "place holder" FGs such that RAN2 can at least define the signaling.1. For Rel-17 NR up to 71 GHz, define new feature groups corresponding to the UE capabilities *pdcch-BlindDetectionMCG-UE3* and *pdcch-BlindDetectionSCG-UE3*, respectively, that have been newly added to 38.213 Section 10. RAN1 shall further discuss appropriate descriptions and candidate values for these FGs.
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## NR\_NTN\_solutions

Void

## IoT over NTN

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| 2. LTE\_NBIOT\_eMTC\_NTN | 2-1d | Segmented UL transmission for eMTC  | Single UE capability | 2-1, 2-1a | Yes | N/A | Release 17 eMTC UE cannot communicate via GEO and NGSO NTNs | Per UE | No | No | For UEs supporting communication via GEO and NGSO NTNs, it must indicate this FG is supported. | Optional with capability signallingNote: This UE feature group is applicable only for IoT-NTN cell, for terrestrial cell this feature is not supported | 2. LTE\_NBIOT\_eMTC\_NTN |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-1e | Segmented UL transmission for NB-IoT | Single UE capability | 2-1b, 2-1c | Yes | N/A | Release 17 NB-IoT UE cannot communicate via NGSO NTNs | Per UE | No | No | For UEs supporting communication via NGSO NTNs, it must indicate this FG is supported. | Optional with capability signallingNote: This UE feature group is applicable only for IoT-NTN cell, for terrestrial cell this feature is not supported | 2. LTE\_NBIOT\_eMTC\_NTN |

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| Company | Summary |
| OPPO [8] | In RAN1 meeting #109e, the following agreement was made.Agreement* The single UE capability that governs UE behavior w.r.t gaps between segments for PUSCH, PUCCH and NPUSCH, when the UE performs segmented pre-compensation, is as follows:
* When a single capability is signalled: UE drops one or more of the following durations of uplink transmission between segments (indicated by the capability):
	+ 1 slot (applicable to eMTC)
	+ 1 subframe (applicable to eMTC)
	+ 1 slot (applicable to NB-IoT)
	+ 2 slots (applicable to NB-IoT)
	+ 1 symbol (applicable to both eMTC and NB-IoT)
	+ UE follows legacy behaviour at slot boundaries due to TA adjustment
* When capability is NOT signalled: UE follows legacy behaviour at slot boundaries due to TA adjustment

According to the agreement, it can be seen that the single UE capability may or may not be signalled. When the single UE capability is signaled, then the UE drops one or more symbols/slots/subframes of uplink transmission between segments or follows legacy behaviour based on the indicated capability. When the single UE capability is not signaled, then the UE follows legacy behavior, i.e., performs TA adjustment at slot boundaries. Therefore, the single UE capability should be an optional UE feature rather than a mandatory UE feature. We propose to update the corresponding descriptions for these single UE capability UE features to reflect this agreement.**Proposal: Clarify that the single UE capability should be an optional UE feature and update the UE features for NTN-IoT as follows.**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-1d | Segmented UL transmission for eMTC  | Single UE capability | 2-1, 2-1a | Yes | N/A | Release 17 eMTC UE cannot communicate via GEO and NGSO NTNs | Per UE | No | No | For UEs supporting communication via GEO and NGSO NTNs, it may ~~must~~ indicate this FG is supported. | Optional with capability signallingNote: This UE feature group is applicable only for IoT-NTN cell, for terrestrial cell this feature is not supported |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-1e | Segmented UL transmission for NB-IoT | Single UE capability | 2-1b, 2-1c | Yes | N/A | Release 17 NB-IoT UE cannot communicate via NGSO NTNs | Per UE | No | No | For UEs supporting communication via NGSO NTNs, it may ~~must~~ indicate this FG is supported. | Optional with capability signallingNote: This UE feature group is applicable only for IoT-NTN cell, for terrestrial cell this feature is not supported |

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| 2. LTE\_NBIOT\_eMTC\_NTN | 2-2 | Enhancing timing relationships using a time offset for eMTC | UE receives and applies UE specific K\_offset/K\_mac in timing relationship enhancements | 2-1 , 2-3 | Yes  | N/A | eMTC UE does not know the offset to apply for UL transmission  | per UE | No | No | The K\_offset is a scheduling offset used for the identified timing relationships that need to be modified for IoT NTN. For IoT NTN, support cell-specific Koffset configuration for use during initial access.For IoT NTN, support the use of UE-specific Koffset in CONNECTED mode. | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] |  In RAN1 107e, an agreement was made that the k\_mac is carried in system information. **Agreement**For IoT NTN, the information of K\_mac is carried in system information.K\_mac is a scheduling offset provided by network if downlink and uplink frame timing are not aligned at gNB, and is cell-specific. However, the yellow highlighted wording in current description of component in FG2-2 implies both K\_offset and K\_mac are UE specific which is not aligned with agreement. Considering the difference between FG2-2 and FG2-2a is the application to eMTC or NB-IoT, we propose to change the “/” to comma between the word of K\_offset and K\_mac in the component of FG2-2.

|  |  |  |  |
| --- | --- | --- | --- |
| 2-2 | Enhancing timing relationships using a time offset for eMTC | UE receives and applies UE specific K\_offset/K\_mac in timing relationship enhancements | 2-1 , 2-3 |
| 2-2a | Enhancing timing relationships using a time offset for NB-IoT | UE receives and applies UE specific K\_offset, K\_mac in timing relationship enhancements | 2-1b, 2-3a |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-2 | Enhancing timing relationships using a time offset for eMTC | UE receives and applies UE specific K\_offset, K\_mac in timing relationship enhancements | 2-1 , 2-3 | Yes  | N/A | eMTC UE does not know the offset to apply for UL transmission  | per UE | No | No |  | The K\_offset is a scheduling offset used for the identified timing relationships that need to be modified for IoT NTN. For IoT NTN, support cell-specific Koffset configuration for use during initial access.For IoT NTN, support the use of UE-specific Koffset in CONNECTED mode. | Optional with capability signalling |

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## NR\_IAB\_enh

**Others**

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| Company | Summary |
| Ericsson [15] | In the RAN1#109-e meeting, an updated list of UE features for Rel-17 eIAB was agreed on and summarized in [5]. We address the remaining in relation to DirectionalCollosionHandling-DC-r17.In RAN1#108-e, the following agreements on directional collision handling for Rel-17 eIAB operating under inter-donor and/or intra-donor NR-DC was achieved [6]:

|  |
| --- |
| **Agreement**In order to support the agreed extension of CA TDD conflict resolution rules to IAB nodes operating under NR-DC in Rel-17 (covering both inter-donor and intra-donor NR-DC scenarios)* Introduce new RRC parameter: ***directionalCollisionHandling-r17***
* Update parameter description for ***half-duplexTDD-CA-SameSCS-r16*** in TS38.306 to make it clear that it is applicable for NR-DC for IAB-MT. E.g. “if this field is included in ***ca-ParametersNR-forDC-v1610 for IAB-MT,*** it indicates IAB-MT supports directional collision handling between reference and other cells for half-duplex operation in TDD NR-DC with same SCS across MCG and SCG**”**
 |

In RAN2#118-e meeting, the following RRC correction to eIAB was approved in which a new RRC parameter “directionalCollisionHanding-DC-17” was introduced [7].

|  |  |  |
| --- | --- | --- |
| <TS38.331, unchanged text is omitted> [[ directionalCollisionHandling-r16 ENUMERATED {enabled} OPTIONAL, -- Need R channelAccessConfig-r16 SetupRelease { ChannelAccessConfig-r16 } OPTIONAL -- Need M ]], [[ nr-dl-PRS-PDC-Info-r17 SetupRelease {NR-DL-PRS-PDC-Info-r17} OPTIONAL, -- Need M semiStaticChannelAccessConfigUE-r17 SetupRelease {SemiStaticChannelAccessConfigUE-r17} OPTIONAL, -- Need M additionalPCIList-r17 SEQUENCE (SIZE(1..maxNrofAdditionalPCI-r17)) OF SSB-MTC-AdditionalPCI-r17 OPTIONAL, -- Need R unifiedtci-StateType-r17 ENUMERATED {separateULDL, jointULDL} OPTIONAL, -- Need R uplink-PowerControlToAddModList-r17 SEQUENCE (SIZE (1..maxULTCI-r17)) OF Uplink-powerControl-r17 OPTIONAL, -- Need R uplink-PowerControlToReleaseList-r17 SEQUENCE (SIZE (1..maxULTCI-r17)) OF Uplink-powerControlId-r17 OPTIONAL, -- Need R channelAccessMode2-r17 ENUMERATED {enabled} OPTIONAL, -- Need R timeDomainHARQ-BundlingType1-r17 ENUMERATED {enabled} OPTIONAL, -- Need R nrofHARQ-BundlingGroups-r17 ENUMERATED {n1, n2, n4} OPTIONAL, -- Need R fdmed-ReceptionMulticast-r17 ENUMERATED {true} OPTIONAL, -- Need R moreThanOneNackOnlyMode-r17 ENUMERATED {mode1,mode2} OPTIONAL, -- Need S tci-Info-r17 TCI-Info OPTIONAL, -- Cond TCI\_Info directionalCollisionHandling-DC-r17 ENUMERATED {enabled} OPTIONAL -- Need R ]] **<**Unchanged text is omitted>

|  |
| --- |
| ***directionalCollisionHandling***Indicates that this serving cell is using directional collision handling between a reference and other cell(s) for half-duplex operation in TDD CA with same SCS as specified in TS 38.213 [13], clause 11.1. The half-duplex operation only applies within the same frequency range and cell group.The network only configures this field for TDD serving cells that are using the same SCS. |
| ***directionalCollisionHandling-DC***For the IAB-MT, it indicates that this serving cell is using directional collision handling between a reference and other cell(s) for half-duplex operation in TDD NR-DC with same SCS within same cell group or cross different cell groups. |

  **<**Unchanged text is omitted> |

To reflect the above RAN1 agreement and updated RRC specification, we propose to introduce a new UE capability and corresponding FG (FG9) on directional collision handling in IAB inter-donor and intra-donor DC scenarios:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 31. NR\_IAB\_enh | 31-9 | Directional Collision Handling in DC operation | Support for directional collision handling between MCG and SCG cell(s) of the dual parent nodes for simultaneous operation in inter-donor and/or intra-donor DC operation |  | Yes | 14-5 | The IAB-node is unable to resolve directional collision between MCG and SCG cells in DC operation | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2  | IAB-MT impact | Optional with capability signalling |

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## NR\_DSS

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|  34. NR\_DSS | 34-1 | Cross-carrier scheduling from SCell to PCell/PSCell with search space restrictions (Type A) | Support of Cross-carrier scheduling from sSCell to PCell/PSCell with search space restrictions (Type A)1. Cross-carrier scheduling from sSCell to PCell/PSCell with CIF
2. Search space restrictions: sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and at least following search space sets on PCell/PSCell can only be configured such that UE does not monitor them in overlapping slot of PCell/PSCell and sSCell
	* USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2
	* USS sets for DCI formats 0\_0,1\_0
	* Type3-CSS set(s) for DCI formats 1\_0/0\_0 with C-RNTI/CS-RNTI/MCS-C-RNTI
3. Configuration of scaling factor α for BD and CCE limit handling and PDCCH overbooking handling on P(S)Cell
4. The number of unicast DCI limits for PCell/PSCell scheduling
* Processing K1 unicast DCI scheduling DL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)
* Processing K2 unicast DCI scheduling UL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)
* N is based on pair of (PCell/PSCell SCS, sSCell SCS): N=1 for(15,15), (30,30), (60,60) and N=2 for (15,30), (30,60) and N=4 for (15, 60)
1. Same numerology between sSCell and P(S)Cell or sSCell SCS is larger than P(S)Cell SCS
2. USS set(s) for DCI format 0\_1,1\_1 configured on sSCell for CCS from sSCell to Pcell/PSCell and USS set(s) for DCI format 0\_2,1\_2 configured on sSCell for CCS from sSCell to PCell/PSCell if UE supports FG 11-1 (*dci-Format1-2And0-2-r16*)
3. sSCell USS set(s) (for CCS from sSCell to Pcell/PSCell) and Type0/0A/1/2 CSS sets on Pcell/PSCell can be configured so that the UE monitors them in overlapping slot of Pcell/PSCell and sSCell
	* no simultaneous monitoring between ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’
	* simultaneous monitoring of ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC not scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’
4. PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to PCell/PSCell
5. frame boundary alignment between PCell/PSCell and sSCell
 | 6-5 | Yes | N/A | Cross-carrier scheduling from SCell to PCell/PSCell with search space restrictions (Type A) is not supported | Per BC | No | Applicable to FR1 only | No | Candidate value set: One or more of supported SCS combinations ({P(S)Cell SCS in kHz, sSCell SCS in kHz}) from following set are indicated by the UE: {15,15}, {15,30}, {15, 60}, {30,30}, {30,60},{60,60})Candidate value set 2: frequency band pair(s) for {PCell/PSCell, sSCell}Component 4 candidate values: (K1, K2) = {(1,1) for FDD P(S)Cell; (K1, K2) = (1,2) for TDD P(S)Cell}Component 8 candidate values:Value 1: within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot. Value 2: within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slotNote: The CCS from sSCell to PCell is applicable to FR1 only but there can be other SCells in FR2 configured for the UENote: The SCell configured with Cross-carrier scheduling to PCell/PSCell is referred to as ‘sSCell’Note: Candidate value set 2 only applies for the following value sets of components 1: {30,30}, {30,60},{60,60}Note: A UE supporting this FG does not imply that the UE can be configured with sSCell in shared spectrum | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | Regarding the component bullet 2 for FG 34-1:* *Search space restrictions: sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and at least following search space sets on PCell/PSCell can only be configured such that UE does not monitor them in overlapping slot of PCell/PSCell and sSCell*
	+ *USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2*
	+ *USS sets for DCI formats 0\_0,1\_0*
	+ *Type3-CSS set(s) for DCI formats 1\_0/0\_0 with C-RNTI/CS-RNTI/MCS-C-RNTI*

The wording "at least" is introduced during the discussion. Now the “search space sets on PCell/PSCell” have been determined, so "at least" can be removed.In RAN1#109-e, an additional FG 34-1a is introduced: “Support of monitoring DCI formats 0\_1,1\_1,0\_2 (if supported),1\_2 (if supported) on PCell/PSCell USS set(s)”. It means a UE that supports FG 34-1 but does not support FG 34-1a does not support monitoring DCI formats 0\_1,1\_1,0\_2,1\_2 on PCell/PSCell USS set(s). So, the search space restrictions between sSCell USS set(s) and USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2 on PCell/PSCell can be moved from the component bullet 2 for FG 34-1 to FG 34-1a.***Proposal 3-1: Remove “at least” from bullet 2 for FG 34-1.******Proposal 3-2: Remove “USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2” from bullet 2 for FG 34-1.******Proposal 3-3: Add the following component bullet for FG 34-1:**** ***Not support monitoring DCI formats 0\_1,1\_1,0\_2,1\_2 on PCell/PSCell USS set(s).***

***Proposal 3-4: Add the following component bullet for FG 34-1a:**** ***Search space restrictions: sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and the following search space sets on PCell/PSCell can only be configured such that UE does not monitor them in overlapping slot of PCell/PSCell and sSCell***
* ***USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2***
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| Ericsson [15] | For the component on “PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to Pcell/PSCell”, i.e., component 9 of FG 34-1 and component 7 of FG 34-2, following value sets are currently captured*Value 1: within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot.* *Value 2: within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slot*For UEs supporting FG 3-2(*pdcch-MonitoringSingleOccasion*) or FG 22-12 (*pdcch-MonitoringSingleSpanFirst4Sym-r16*), PDCCH monitoring is not restricted for first 3 symbols of a slot and for such UEs there should be no reason to restrict value1 and value2 to first 3 symbols of sSCell slot as currently captured.

| ***pdcch-MonitoringSingleOccasion***Indicates whether the UE supports receiving PDCCH in a search space configured to be monitored within a single span of any three contiguous OFDM symbols in a slot with the capability of supporting at least 44 blind decodes in a slot for 15 kHz subcarrier spacing. | UE | No | No | FR1 only |
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| ***pdcch-MonitoringSingleSpanFirst4Sym-r16***Indicates whether the UE supports receiving PDCCH in a search space configured to be monitored within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols in a slot with the capability of supporting at least 44 blind decodes in a slot for 15 kHz subcarrier spacing. | UE | No | No | FR1 only |
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We propose to update the value sets as below to remove the unnecessary restriction on PDCCH monitoring occasion(s)on sSCell. 1. For Rel-17 NR DSS, update the value set description for component on “PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to Pcell/PSCell”, i.e., component 9 of FG 34-1 and component 7 of FG 34-2 as shown belowValue 1: within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE does not indicate support of *pdcch-MonitoringSingleOccasion* *or pdcch-MonitoringSingleSpanFirst4Sym-r16*. within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE indicates support of *pdcch-MonitoringSingleSpanFirst4Sym-r16*. within a single span of any three contiguous OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE indicates support of *pdcch-MonitoringSingleOccasion*. Value 2: within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slot if the UE does not indicate support of *pdcch-MonitoringSingleOccasion* or *pdcch-MonitoringSingleSpanFirst4Sym-r16*. within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols of any sSCell slot, if the UE indicates support of *pdcch-MonitoringSingleSpanFirst4Sym-r16*. within a single span of any three contiguous OFDM symbols of any sSCell slot, if the UE indicates support of *pdcch-MonitoringSingleOccasion*
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|  34. NR\_DSS | 34-2 | Cross-carrier scheduling from SCell to PCell/PSCell (Type B) | Support of Cross-carrier scheduling (CCS) from sSCell to PCell/PSCell (Type B)1. Cross-carrier scheduling from sSCell to PCell/PSCell with CIF
2. sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and search space sets on PCell/PSCell can be configured so that the UE monitors them in overlapping slot of PCell/PSCell and sSCell
3. Configuration of scaling factor α for BD and CCE limit handling and PDCCH overbooking handling on P(S)Cell
4. The number of unicast DCI limits for PCell/PSCell scheduling
* Processing K1 unicast DCI scheduling DL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)
* Processing K2 unicast DCI scheduling UL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)
* N is based on pair of (PCell/PSCell SCS, sSCell SCS): N=1 for(15,15), (30,30), (60,60) and N=2 for (15,30), (30,60) and N=4 for (15, 60)
1. Same numerology between sSCell and P(S)Cell or sSCell SCS is larger than P(S)Cell SCS
2. USS set(s) for DCI format 0\_1,1\_1 configured on sSCell for CCS from sSCell to PCell/PSCell and USS set(s) for DCI format 0\_2,1\_2 configured on sSCell for CCS from sSCell to PCell/PSCell if UE supports FG 11-1 (*dci-Format1-2And0-2-r16*)
3. PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to Pcell/PSCell
4. frame boundary alignment between PCell/PSCell and sSCell
 | 6-5  | Yes | N/A | Cross-carrier scheduling from SCell to PCell/PSCell (Type B) is not supported | Per BC | No | Applicable to FR1 only | No | Candidate value set: One or more of supported SCS combinations ({P(S)Cell SCS in kHz, sSCell SCS in kHz}) from following set are indicated by the UE: {15,15}, {15,30}, (15, 60), {30,30}, {30,60},{60,60})Candidate value set 2: frequency band pair(s) for {PCell/PSCell, sSCell}Component 4 candidate values: (K1, K2) = {(1,1) for FDD P(S)Cell; (K1, K2) = (1,2) for TDD P(S)Cell}Component 7 candidate values:Value 1: within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot. Value 2: within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slotNote: The CCS from sSCell to Pcell is applicable to FR1 only but there can be other Scells in FR2 configured for the UENote: The SCell configured with Cross-carrier scheduling to PCell/PSCell is referred to as ‘sSCell’Note: Candidate value set 2 only applies for the following value sets of components 1: {30,30}, {30,60},{60,60}Note: A UE supporting this FG does not imply that the UE can be configured with sSCell in shared spectrum | Optional with capability signalling |

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| Company | Summary |
| Ericsson [15] | For the component on “PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to Pcell/PSCell”, i.e., component 9 of FG 34-1 and component 7 of FG 34-2, following value sets are currently captured*Value 1: within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot.* *Value 2: within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slot*For UEs supporting FG 3-2(*pdcch-MonitoringSingleOccasion*) or FG 22-12 (*pdcch-MonitoringSingleSpanFirst4Sym-r16*), PDCCH monitoring is not restricted for first 3 symbols of a slot and for such UEs there should be no reason to restrict value1 and value2 to first 3 symbols of sSCell slot as currently captured.

| ***pdcch-MonitoringSingleOccasion***Indicates whether the UE supports receiving PDCCH in a search space configured to be monitored within a single span of any three contiguous OFDM symbols in a slot with the capability of supporting at least 44 blind decodes in a slot for 15 kHz subcarrier spacing. | UE | No | No | FR1 only |
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| ***pdcch-MonitoringSingleSpanFirst4Sym-r16***Indicates whether the UE supports receiving PDCCH in a search space configured to be monitored within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols in a slot with the capability of supporting at least 44 blind decodes in a slot for 15 kHz subcarrier spacing. | UE | No | No | FR1 only |
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We propose to update the value sets as below to remove the unnecessary restriction on PDCCH monitoring occasion(s)on sSCell. 1. For Rel-17 NR DSS, update the value set description for component on “PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to Pcell/PSCell”, i.e., component 9 of FG 34-1 and component 7 of FG 34-2 as shown belowValue 1: within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE does not indicate support of *pdcch-MonitoringSingleOccasion* *or pdcch-MonitoringSingleSpanFirst4Sym-r16*. within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE indicates support of *pdcch-MonitoringSingleSpanFirst4Sym-r16*. within a single span of any three contiguous OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE indicates support of *pdcch-MonitoringSingleOccasion*. Value 2: within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slot if the UE does not indicate support of *pdcch-MonitoringSingleOccasion* or *pdcch-MonitoringSingleSpanFirst4Sym-r16*. within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols of any sSCell slot, if the UE indicates support of *pdcch-MonitoringSingleSpanFirst4Sym-r16*. within a single span of any three contiguous OFDM symbols of any sSCell slot, if the UE indicates support of *pdcch-MonitoringSingleOccasion*
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## LTE\_NR\_DC\_enh2

Void

## NR\_pos\_enh

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| 27. NR\_pos\_enh | 27-3-1 | M-sample measurements in RRC\_CONNECTED | The capability to support reporting a measurement based on measuring M=1 or 2 samples (instances) of a DL PRS resource set | 13-1 | No |  | If the UE does not provide the capability, the UE is assumed to support M=4 only | per band | n/a | n/a | n/a | Need for location server to know if the feature is supportedNote: this feature is supported for both UE-assisted and UE based positioning | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | In the current FG 27-3-1, the M-sample measurement in RRC\_CONNECTED state does not differentiate the gap-less and gap-based measurement. However, due to the same reason as argued in the previous section of the paper, different UE architectures may be used for processing PRS within the MG and within the PPW, which results in the need to have different capabilities on the M-sample measurement.

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| 27. NR\_pos\_enh | 27-3-1 | M-sample measurements in RRC\_CONNECTED | The capability to support reporting a measurement based on measuring M=1 or 2 samples (instances) of a DL PRS resource set |

Therefore, we have the following proposal.***Proposal 7-5: Modify FG 27-3-1 and add the following FG 27-3-1a.***

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| 27. NR\_pos\_enh | 27-3-1 | M-sample measurements in RRC\_CONNECTED within the measurement gap | The capability to support reporting a measurement based on measuring M=1 or 2 samples (instances) of a DL PRS resource set within the measurement gap |
| 27. NR\_pos\_enh | 27-3-1a | M-sample measurements in RRC\_CONNECTED within the PRS processing window | The capability to support reporting a measurement based on measuring M=1 or 2 samples (instances) of a DL PRS resource set within the PRS processing window |

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| 27. NR\_pos\_enh | 27-3-2 | DL PRS measurement outside MG and in a PRS processing window | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG and in a PRS processing window2. Support of priority handing options of PRS: Option1, Option2 or Option3* 1. Option 1: UE may indicates support of two priority states.
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
		2. State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
	2. Option 2: UE may indicate support of three priority states
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
		2. State 2: PRS is lower priority than PDCCH and URLLC PDSCH and higher priority than other PDSCH/CSI-RS
			1. Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.
		3. State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
	3. Option 3: UE may indicate support of single priority state
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
 | 13-1 | Yes |  | DL PRS measurement outside MG and in a PRS processing window is not supported | per band | n/a | n/a | n/a | Component 1 candidate values: One or more of {Type 1A, Type 1B, Type 2}Component 2 candidate values: {option1, option2, option3}Need for location server to know if the feature is supportedNote: Component 2 can be reported per supported band for each type supported by the UE, details left to RAN2Note:* Type 1A refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from all DL CCs (per UE) are affected across LTE and NR
* Type 1B refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from a certain band are affected
* Type 2 refers to the determination of prioritization between DL PRS and other DL signals/channels only in DL PRS symbols within the PRS processing window

Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability optionsNote: Within a PRS processing window, UE measurement is inside the active DL BWP with PRS having the same numerology as the active DL BWPNote: Support of configuration of PRS processing window in RRC and support of using DL MAC CE to activate/deactivate the PRS processing window for PRS measurements is part of the FG , but no dedicated signaling is required.A UE that supports FG 27-3-3 must indicate this FG is supported | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | In RAN1#109-e, the following agreements were reached on the timeline for the UE to determine the collision between PRS and other DL signals/channels.

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| **Agreement**The PRS collision detection timeline for the case when PRS is lower priority than the DL signals/channels is define as following.* For an activated type 1A and type 1B PRS processing window
	+ If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS in the PPW no later than [N symbol/T ms] before the start of the PPW, UE expects to receive the DL signals/channels and drop the all DL PRS in the PPW.
* For an activated type 2 PRS processing window
	+ If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS on a PRS symbol no later than [N symbol/T ms] before the PRS symbol, UE expects to receive the DL signals/channels and drop the PRS symbol.

**Agreement**The PRS collision detection timeline for the case when PRS is lower priority than the DL signals/channels is define as following.* For a type 1A and type 1B PRS processing window
	+ If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS in the PPW later than [N symbol/T ms] before the start of the PPW, UE is not required to receive the other DL signals/channels except SSB of higher priority and may receive the DL PRS in the PPW.
* For a type 2 PRS processing window considered active
	+ If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS on a PRS symbol later than [N symbol/T ms] before the PRS symbol, UE is not required to receive the other DL signals/channels except SSB of higher priority and may receive the PRS symbol.
* Note 1: This implies that if the scheduling of other DL signals/channels of higher priority arrives too late, UE may consider the PRS as higher priority than the other DL signals/channels.
* Note 2: If the scheduling of other DL signals/channels of higher priority arrives too late, it is up to UE implementation whether to receive the other DL signals/channels.
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The buffer zone or detection time advance of N symbols or T ms is still under discussion. We think that it can be included as part of the UE capability signaling rather than a fixed value in the specification given the diversified UE implementation options.Between N symbols and T msec, we think that defining only the number of symbols would be sufficient, and as the symbol duration is subject to SCS, having SCS-dependent reporting is preferred.The capability signaling should be added as another component of FG 27-3-2, and for UE only supporting priority option 3, i.e. single priority option that PRS is always higher other DL signals/channels.Therefore, we have the following proposal.***Proposal 7-3: Add the following component to FG 27-3-2.***

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| 27. NR\_pos\_enh | 27-3-2 | DL PRS measurement outside MG and in a PRS processing window | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG and in a PRS processing window2. Support of priority handing options of PRS: Option1, Option2 or Option3* 1. Option 1: UE may indicates support of two priority states.
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
		2. State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
	2. Option 2: UE may indicate support of three priority states
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
		2. State 2: PRS is lower priority than PDCCH and URLLC PDSCH and higher priority than other PDSCH/CSI-RS
			1. Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.
		3. State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
	3. Option 3: UE may indicate support of single priority state
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS

3. The number of symbols prior to the start of the PPW (Type-1A/Type-1B) or to PRS symbol within the PPW (Type-2) that UE determines the collision between a higher priority data and a low priority PRS.* 1. Candidate values {14,28,42,56} for each supported SCS assuming normal CP type.
	2. Note: UE supporting Option 3 in component 2 is not required to report component 3.
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| 27. NR\_pos\_enh | 27-3-3 | DL PRS Processing Capability outside MG - buffering capability | 1. DL PRS buffering capabilitya) Type 1 – sub-slot/symbol level bufferingb) Type 2 – slot level buffering2a. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE3. Max number of DL PRS resources that UE can process in a slot under it | 27-3-2 | No |  | DL PRS measurement outside MG and in a PRS processing window is not supported | Per band | n/a | n/a | n/a |  Component 1 candidate values: {Type 1, Type 2}Component 2a candidate values:1. T: {1, 2, 4, 8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms
2. N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms

Candidate 2b component values:a) N2: {0.125, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 8, 12} msb) T2: {4, 5, 6, 8} msComponent 3 candidate values:FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzFR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHzNeed for location server to know if the feature is supportedNote 1:The (N, T) UE capabilities are interpreted as legacy (N, T) in FG 13-1, and the UE is expected to receive the PRS within the PRS processing window and but the processing of the received PRS may be outside a PRS processing window. The (N2, T2) UE capabilities are interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms [Note 3: UE shall support either or both of component 2a and component 2b]Note 4: A UE shall declare PRS processing capabilities of each of the supported Type-1A, Type-1B, Type-2” capabilities in case it supports multiple types in a bandA UE that supports FG 27-3-2 must indicate this FG is supported | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | In the current FG 27-3-3, the PRS processing capability is based on a bandwidth reported in the first component of FG 13-1.

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| 27. NR\_pos\_enh | 27-3-3 | DL PRS Processing Capability outside MG - buffering capability | 1. DL PRS buffering capabilitya) Type 1 – sub-slot/symbol level bufferingb) Type 2 – slot level buffering2a. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE3. Max number of DL PRS resources that UE can process in a slot under it |

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| 13. NR Positioning | 13-1 | Common DL PRS Processing Capability | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}b) FR2 bands: {50, 100, 200, 400}2. DL PRS buffering capability: Type 1 or Type 2a) Type 1 – sub-slot/symbol level bufferingb) Type 2 – slot level buffering3. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE.a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} msb) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms4. Max number of DL PRS resources that UE can process in a slot under ita) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzb) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHzNote: The above parameters are reported assuming a configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than 30%. |

However, given that the PRS synchronization conditions are more stringent for gapless PRS measurement than the gap-based PRS measurement, UE PRS processing architecture may also be different, resulting in potentially different bandwidth capability.***Observation 7-3: UE PRS processing architecture for gap-less PRS measurement may differ from that for gap-based PRS measurement.***Therefore, we think that UE should be allowed to report a different bandwidth capability than that is reported for FG 13-1.***Proposal 7-4: Add the following component to FG 27-3-3.***

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| 27. NR\_pos\_enh | 27-3-3 | DL PRS Processing Capability outside MG - buffering capability | 1. DL PRS buffering capabilitya) Type 1 – sub-slot/symbol level bufferingb) Type 2 – slot level buffering2a. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE3. Max number of DL PRS resources that UE can process in a slot under it4. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE for PRS measurement outside MG within the PPW.a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}b) FR2 bands: {50, 100, 200, 400} |

In [1], there is one remaining FFS part in Note 3 for FG 27-3-3 on whether UE shall support either or both of component 2a and component 2b.

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|  Component 1 candidate values: {Type 1, Type 2}Component 2a candidate values:1. T: {1, 2, 4, 8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms
2. N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms

Candidate 2b component values:a) N2: {0.125, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 8, 12} msb) T2: {4, 5, 6, 8} msComponent 3 candidate values:FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzFR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHzNeed for location server to know if the feature is supportedNote 1:The (N, T) UE capabilities are interpreted as legacy (N, T) in FG 13-1, and the UE is expected to receive the PRS within the PRS processing window and but the processing of the received PRS may be outside a PRS processing window. The (N2, T2) UE capabilities are interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms [Note 3: UE shall support either or both of component 2a and component 2b]Note 4: A UE shall declare PRS processing capabilities of each of the supported Type-1A, Type-1B, Type-2” capabilities in case it supports multiple types in a bandA UE that supports FG 27-3-2 must indicate this FG is supported |

In our view, component 2b is the advanced PRS processing that can be “activated” only under some conditions. Allowing both 2a and 2b to be reported may offer additional flexibility on the network side when the current deployment cannot easily satisfy the condition of 2b, so that 2a can be the fallback solution.

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| 27. NR\_pos\_enh | 27-3-3 | DL PRS Processing Capability outside MG - buffering capability | 1. DL PRS buffering capabilitya) Type 1 – sub-slot/symbol level bufferingb) Type 2 – slot level buffering2a. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE3. Max number of DL PRS resources that UE can process in a slot under it |

***Observation 7-1: Allowing UE to report both 2a and 2b offers flexibility on the network deployment to allow fallback to 2a when the condition of 2b cannot be met.***When both components are reported, RAN1 should further discuss whether the mode under which UE/network should assume the processing is based on (N, T) as component 2a or based on (N2, T2) as component 2b should be signaled to the UE. In our view, such indication may not be necessarily discussed by RAN1, given that it only impacts the UE PRS measurement latency requirement. It should be up to RAN4 to decided, and RAN1 may provide input only if RAN4 asks RAN1 to do so, similar to the Rx beam sweeping factor.***Observation 7-2: RAN1 should not initiate the discussion on the signaling that indicates whether UE PRS processing is based 2a or 2b for UE supports both components, but wait for RAN4.******Proposal 7-1: Support UE to report either or both from components 2a and 2b in FG 27-3-3.**** ***The signaling from LMF to UE that indicates whether UE PRS processing is based on 2a or 2b is up to RAN4.***
 |
| ZTE [4] | In RAN1#109-e meeting, the following agreement was achieved for UE PRS processing capability in PPW. For PPW Type-1A and Type-1B, UE may report two types of capability signaling, i.e. (N, T) and (N2, T2).

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| **Agreement*** For UE supporting Type-1A or Type-1B PRS processing window, UE may report (N, T) and (N2, N2) in the capability signalling
	+ The reported (N, T) in the capability signalling is similar to the legacy (N, T) in FG 13-1, which assumes to measure the N ms of PRS within a PPW but the processing of the measured PRS may be outside the PRS processing window.
	+ The reported (N2, T2) in the capability signalling assumes to measure and process the N2 ms of PRS only within the PRS processing window length (which covers the T2).
	+ Add the following Note to the corresponding FG in the UE feature spreadsheet
		- Note: The (N2, T2) UE capabilities is interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms
* For UE supporting Type-2 PRS processing window, UE may report (N, T) in the capability signalling similar to the legacy (N, T) in FG 13-1
	+ Assuming the UE to measure the PRS within the PRS processing window and but the processing of the measured PRS may be outside a PRS processing window.
* Note: when the processing time T exceeds the PPW length, other DL data channels/signals that are outside of the PPW but within the periodic T can be received by the UE.
* Discuss in the UE feature session the values {N, T} for all types.
 |

Then, FG 27-3-3 as shown in Appendix was updated based on the agreement accordingly. However, it is still open whether either or both (N, T) and (N2, T2) should be reported. As shown in the agreement, capability signaling (N2, T2) is assumed to measure and process N2 ms of PRS only within the PPW. For example, if gNB configures a longer PPW in which PRS is located in the first N2 ms and the time duration between the last PRS symbol and the end of PPW is not smaller than T2 ms, the actual PRS processing time will be within the PPW. However, if gNB configures a shorter PPW and UE may not be able to completely process all N2 ms of PRS, the actual PRS processing time will be based on the reported capability signaling (N, T). In short, the real PRS processing time depends on the actual PRS and PPW configuration. Therefore, both capability signaling (N, T) and (N2, T2) are useful to let gNB and LMF know the UE capability in the both cases, i.e. shorter PPW and longer PPW and set an appropriate measurement report response time. Further, since PPW is configured by the serving gNB, and the PRS configuration may also be known by the serving gNB based on RAN3’s agreement in Rel-17, it is better to also report FG 27-3-3 to gNB, then gNB can get more information to efficiently decide PPW length and location. ***Proposal 1:*** *For FG 27-3-3, both capability signaling (N, T) and (N2, T2) should be reported.* ***Proposal 2:*** *FG 27-3-3 should also be reported to gNB.*  |
| Qualcomm [12] | The following Note has been captured in brackets: [Note 3: UE shall support either or both of component 2a and component 2b]. We don’t think that a UE should be able to report both capabilities because there is no way for a TRP to signal to the UE whether a specific PPW is configured assuming 2a or 2b capability. Furthermore, we find it unlikely that a device will have both implementations for a given type. Note that a UE can still report it supports multiple types at a given band. **Proposal 1: For FG 27-3-3, remove the Note “[Note 3: UE shall support either or both of component 2a and component 2b]”.**Furthermore, since the PPW is configured by the serving gNB, it should know what are the UE’s PPW PRS Processing Capabilities, otherwise there is no way to make a decision what PPW configuration to use. 27-3-3 is currently being reported to LMF through LPP, however, RAN3 hasn’t agreed a new signaling for the LPP to send the PPW PRS processing capabilities to the gNB, nor it has agreed a new signaling for the LPP to suggest PPW configuration to the UE. Based on the NRPPa [3], Stage 2 description (TS 38.305) features for PPW positioning and the RAN1 UE features list, we make the following observations: **Observation 1: The serving gNB does not know the PPW capabilities (column of 27-3-3 is set to “no”). However the serving gNB is expected to configure the PPW to the UE.****Observation 2: The LMF knows the PPW capabilities of the UE, but it is not informed by the serving gNB what PPW configuration has been configured.** **Observation 3: The LMF knows the PPW capabilities of the UE, but cannot recommend specific PPW configuration to the UE.** **Observation 4: The LMF has knowledge of the PPW capabilities of the UE, but cannot control anything with regards to the PPW configuration. The gNB controls all about the PPW configuration, but doesn’t know what the UE is capable of doing (PRS processing capabilities in 27-3-3).** When the agreement was made in the UE features to set the column “Need for the gNB to know if the feature is supported” of 27-3-3 to “No”, the RAN1 common understanding was that RAN3 will handle the necessary signaling between the NRPPa and the LMF, so that the gNB will have all required information to make educated decisions of what PPW to set. However, in the current specification (Stage 2 and the NRPPa message (which only has the DL-PRS config)) the gNB as no way to decide a proper PPW. The simplest way to address the problem is RAN1 to revert the agreement and set as “Yes” the column on the “Need for the gNB to know if the feature is supported” of this capability. **Proposal 2: For FG 27-3-3, given that there is no PPW configuration recommendation, nor there is PPW PRS processing capabilities from the LMF to the serving gNB, support reporting the PPW PRS processing capabilities (FG 27-3-3) directly to the serving gNB.**

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| 27. NR\_pos\_enh | 27-3-3 | DL PRS Processing Capability outside MG - buffering capability | 1. DL PRS buffering capabilitya) Type 1 – sub-slot/symbol level bufferingb) Type 2 – slot level buffering2a. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE3. Max number of DL PRS resources that UE can process in a slot under it | 27-3-2 | **~~No~~ Yes** |  | DL PRS measurement outside MG and in a PRS processing window is not supported | Per band | n/a | n/a | n/a |  Component 1 candidate values: {Type 1, Type 2}Component 2a candidate values:1. T: {1, 2, 4, 8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms
2. N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms

Candidate 2b component values:a) N2: {0.125, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 8, 12} msb) T2: {4, 5, 6, 8} msComponent 3 candidate values:FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzFR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHzNeed for location server to know if the feature is supportedNote 1:The (N, T) UE capabilities are interpreted as legacy (N, T) in FG 13-1, and the UE is expected to receive the PRS within the PRS processing window and but the processing of the received PRS may be outside a PRS processing window. The (N2, T2) UE capabilities are interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms ~~[Note 3: UE shall support either or both of component 2a and component 2b]~~Note 4: A UE shall declare PRS processing capabilities of each of the supported Type-1A, Type-1B, Type-2” capabilities in case it supports multiple types in a bandA UE that supports FG 27-3-2 must indicate this FG is supported | Optional with capability signaling |

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| NTT Docomo [14] | In our view, component 2a and component 2b would be used in different cases. The component 2a expects the processing duration of the measured PRS may be outside a PPW. The component 2b expects the processing duration of the measured PRS is inside a PPW. In addition, it was agreed that UE reporting the support of Type-1 capability in component 1 needs to report both {N, T} (component 2a) and {N2, T2} (component 2b) while UE reporting the support of Type-2 capability in component 1 needs to report only {N, T} (component 2a). Hence, the UE can support either or both of component 2a and component 2b.**Proposal 3: Remove the bracket in note 3 for FG27-3-3.** |
| Nokia/Nokia Shanghai Bell [16] | * **27-3-3 - DL PRS Processing Capability outside MG - buffering capability**
	+ [Note 3: UE shall support either or both of component 2a and component 2b] – The FG list is not supposed to include components that can be turned on or off. Hence, this note should be removed.
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| 27. NR\_pos\_enh | 27-19 | Spatial relation for positioning SRS in RRC\_INACTIVE state - gNB | Same as*RRC**SpatialRelationsSRS-Pos-r16* | 27-15 | Yes |  | Spatial relation for positioning SRS in RRC\_INACTIVE state is not supported (gNB) | Per band | n/a | n/a | n/a |  | Optional with capability signalling |
| 27. NR\_pos\_enh | 27-19a | Spatial relation for positioning SRS in RRC\_INACTIVE state – location server | Same as *LPP**SpatialRelationsSRS-Pos-r16* | 27-15 | No |  | Spatial relation for positioning SRS in RRC\_INACTIVE state is not supported (location server) | Per band | n/a | n/a | n/a | Need for location server to know if the feature is supported.Support of spatial relation in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon [3] | For FG 27-19 and FG 27-19a on the spatial relation for SRS transmission in RRC\_INACTIVE, we noticed that SRS spatial relation is only applicable to FR2 bands, similar to Rel-16 and FG 27-9.Therefore, we believe that it should be clarified below.***Proposal 7-2: Add FR2-only to the “Need of FR1/FR2 differentiation” column of FG 27-19 and FG 27-19a***

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| **Features** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** |
| FG 27-19 | per band | n/a | n/aFR2 only | n/a |
| FG 27-19a | per band | n/a | n/aFR2 only | n/a |

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## NR\_DL1024QAM\_FR1

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| 36. NR\_DL1024QAM\_FR1 | 36-2 | scalingFactor for 1024QAM | Indicates the scaling factor to be applied to the band in the max data rate calculation as defined in 4.1.2 when support of 1024-QAM is signalled for the band | 36-1 | Yes | N/A |  | Per FS | N/A | Applicable only to FR1 | N/A | Candidate component values: {0.4, 0.75, 0.8, 1.0}If absent, the scaling factor 1 is applied to the band in the max data rate calculation. | Optional with capability signaling |

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| Company | Summary |
| Huawei/HiSilicon [3] | In [1], the following FG 36-2 was agreed with a note on the default value when the FG is absent.

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| 36. NR\_DL1024QAM\_FR1 | 36-2 | scalingFactor for 1024QAM | Indicates the scaling factor to be applied to the band in the max data rate calculation as defined in 4.1.2 when support of 1024-QAM is signalled for the band | 36-1 | Yes | N/A |  | Per FS | N/A | Applicable only to FR1 | N/A | Candidate component values: {0.4, 0.75, 0.8, 1.0}If absent, the scaling factor 1 is applied to the band in the max data rate calculation. | Optional with capability signaling |

However, there are two issues for the note.* + - Issue 1: When this FG is absent, which scaling factor is used depends on whether the UE supports 1024QAM. When UE supports 1024QAM, then scaling factor can be used, otherwise the legacy scaling factor should be used.
		- Issue 2: There is possibility that a 1024QAM-capable UE reports only scaling factor for 1024QAM without the legacy scaling factor. Then if such a UE accesses a pre-Rel-17 gNB, then the gNB would assume absence of scaling factor, which may not be aligned with the intention of UE.

To resolve the above issues, the following is proposed:***Proposal 9-1: Modify FG 36-2 as below with change shown in red***

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| 36. NR\_DL1024QAM\_FR1 | 36-2 | scalingFactor for 1024QAM | Indicates the scaling factor to be applied to the band in the max data rate calculation as defined in 4.1.2 when support of 1024-QAM is signalled for the band | 36-1 | Yes | N/A |  | Per FS | N/A | Applicable only to FR1 | N/A | Candidate component values: {0.4, 0.75, 0.8, 1.0}If absent and the UE supports 36-1 or 36-1a, the scaling factor 1 is applied to the band in the max data rate calculation.The UE reporting this FG should also reports UE feature scalingFactor. | Optional with capability signaling |

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# Discussion Items during RAN1 #110 — First Checkpoint

After review of contributions submitted to RAN1 #110 in this agenda item, the following topics were identified by the moderator for discussion during RAN1 #110.

**General comments**

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| Company | Comments/Questions/Suggestions |
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## NR\_FeMIMO

### FG 23-1-2

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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|  23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI2. Support of up to K SSBRI-RSRP pairs in one report where a pair is associated with a PCI different from serving cell PCI can be reported3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC5. The max number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI6. The max number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is different with SSB time domain positions and periodicity of the serving cell PCI |  | Yes |  | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) is not supported | per band | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}Component 4 candidate values: {1, 2, 4, 8}Note: K is equal to maxNumberNonGroupBeamReportingNote: For the number of configured additional PCIs for inter-cell beam management (component 5 and 6 in FG 23-1-2) and the number of configured additional PCIs for inter-cell MTRP operation (component 2 and 3 in FG 23-4), UE can report one of them or both of them. If only one of the above pairs is reported, it can be used for both inter-cell beam management and inter-cell MTRP operation.Note: component 4 is also counted in FG16-1g/16-1g-1 | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Apple | We are supportive of the addition in principle. Regarding the description of component 5/6, we should align with FG23-4. 5. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI6. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1The candidate values of component 5/6 is also missing, we could reuse FG23-4Component 5 candidate values: {1,2,3,4,5,6,7}Component 6 candidate values: {0,1,2,3,4,5,6,7}Note: case1 and case2 cannot be enabled simultaneously as any configuration that is not based on Case 1 is defined as Case 2 |
| ZTE | We do not support this two additional new components. If our understanding is correct, those two componnents has been discussed before, but failed to be approved. Technically speaking, for inter-cell L1-RSRP measurement, we do not identify a clear additional efforts due to the same or different SSB time domain position/periodcitiy. For instance, for CSI-RS measurement, we also do not have additional/individual requirement for same or different periodicity/offset. |
| Nokia, NSB | We do not support the change. It is NBC and it has been discussed before, but RAN1 has decided differently. |
| LG | We have similar view with ZTE and no need to specify the component 5/6 in this FG since the component 3 is sufficient for the max number of PCI(s) and the corresponding capabilities are included in FG for inter-cell MTRP operation (i.e. FG23-4)  |

### FG 23-3-1c

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 23. NR\_FeMIMO | 23-3-1c | Two PHR reporting | 1. Support of PHR reporting related to M-TRP PUSCH repetition (calculate two PHRs (at least corresponding to the CC that applies m-TRP PUSCH repetitions), each associated with a first PUSCH occasion corresponding to each SRS resource set, and report two PHRs.)2. The maximum number of supported PHR reports across all CCs (including those related to M-TRP PUSCH repetition and the legacy Rel-15/16 PUSCH transmission) | 23-3-1 or 23-3-1-2 | Yes |  | Two PHR reporting is not supported | Per Band | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4, 8,12,16,20,32,48,64}Note: MTRP PHR report is counted as 2 and STRP PHR report is counted as 1. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Apple | We are supportive to introduce component 2But the report type needs to be further discussion, i.e., whether it is per band, or, per BC |
| ZTE | Do NOT support.This component 2 was discussed multiple times in the past, which is NOT captured by any agreements reached before. Technically, from the perspective of NW scheduling, it will negatively impact its flexibility in case of CA operation. If UE memory on the count of PHR calculation and reports is a practical issue to UE vendor, it can be address by gNB implementation itself. All in all, we think it makes no sense to guarantee two PHR reports but limit MTRP operation in CA. |
| Nokia, NSB | Do not support. Change is NBC, and it has been discussed earlier.  |

### FG 23-2-2

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition or SFN PDCCH | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition or SFN PDCCH | 23-2-1 or 23-6-1 or 23-6-2 or 23-6-1-1 | Yes |  | Two QCL TypeD for CORESET monitoring in PDCCH repetition or SFN PDCCH is not supported | Per band | n/a | FR2 only | n/a |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Apple | We are open to discuss how to handle two QCL TypeD for SFN PDCCH |
| ZTE | Open to discuss. |
| Nokia, NSB | OK to discuss further, unclear if needed though. |
| LG | Open to discuss. |

### FG 23-3-1

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based  | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)- sequential mapping for repetitions larger than 2- cyclic mapping for 2 repetitions~~3~~2. Support of two SRS resource sets with usage set to 'codebook'~~4~~3. Supported number of SRS resources in one SRS resource set | 2-14 | Yes |  | Multi-TRP PUSCH repetition (type A) is not supported for codebook based | per FS | n/a | n/a | n/a | Component 3~~4~~ candidate values: {1,2 ,4}Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Apple | We support the TP |
| ZTE | Support this editorial correction. |
| Nokia, NSB | OK |
| LG | We support the TP |

### FG 23-3-1-1

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 23. NR\_FeMIMO | 23-3-1-1 -codebook based  | Multi-TRP PUSCH repetition (type B) | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based - sequential mapping for repetitions larger than 2- cyclic mapping for 2 repetitions2. Support of two SRS resource sets with usage set to ‘codebook’3. Supported number of SRS resources in one SRS resource set | 2-14, 11-5 | Yes |  | Codebook based multi-TRP PUSCH repetition (type B) is not supported | Per FSPC | No | No | No | Component 3 candidate values: {1,2,4}Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Apple | We are okay with the TP |
| ZTE | Ok |
| Nokia, NSB | More clarifications needed, the relationship of these FGs is not obvious. |

### FG 23-5-2

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 23. NR\_FeMIMO | 23-5-2 | MTRP BFR based on two BFD-RS sets | 1. Maximum number of supported measured BFD-RS resources per set per BWP2. The maximum number of CCs per band configured with BFR (including spCell/SCell/MTRP BFR in Rel-15/16/17)3. Supported maximum number of measured BFD-RS resources across two BFD-RS sets per BWP 4. Supported maximum number of NBI-RS resources across two NBI-RS sets per BWP |  | Yes |  | MTRP BFR based on two BFD-RS sets is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {1, 2}Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8, 9}Component 3 candidate values: {2,3,4}Component 4 candidate values: {2, 4, 8, 16, 32, 64}Note: component 3 is also counted in FG 16-1g and 16-1g-1Note: component 4 is also counted in FG 16-1g and 16-1g-1 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Apple | We support the component 4 and the added note  |
| ZTE | Not support. Why we can not just reuse the component 16-1g/16-1g-1 as what we have already agreed. |
| Nokia, NSB | Do not support the NBC change.  |
| LG | Tend to agree with ZTE |

### FG 23-5-2a

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 23. NR\_FeMIMO | 23-5-2a | PUCCH-SR resources for MTRP BFRQ | 1. Max number of PUCCH-SR resources for MTRP BFRQ per cell group |  | Yes |  | PUCCH-SR resources for MTRP BFRQ is not supported | Per UE | No | Yes | No | Component candidate values: {1, 2}~~Note: A UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1~~ | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Apple | We are open to discuss the removal of the note. But this seems to be a controversial topic since Rel-16, i.e., make PUCCH-SR optional  |
| ZTE | Not support. It is a compromise for this NOTE. We can NOT support any futher updare/review. |
| Nokia, NSB | Do not support. |
| LG | Not support. Same view as ZTE. |

### FG 23-7-1c

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 23. NR\_FeMIMO | 23-7-1c | Basic Features of CSI Enhancement for Multi-TRP – number of CPUs |  Number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses | 23-7-1 | Yes |  |  | Per band | n/a | n/a | n/a | Component candidate values: {2,3 ~~[,4,5]~~}Note: Maximum number of CPUs is reported in FG 2-35 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Apple | As compromise, we keep 4 but remove 5 {2,3 ~~[~~,4~~,5]~~} |
| ZTE | Support |
| Nokia, NSB | Support |
| LG | Support |
| Intel | Support |

### New FG for inter-cell beam measurement and reporting

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Introduce the following new FG/row**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-1-2a | Inter-cell beam measurement and reporting  | 1. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI2. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1 | FG23-1-2 | Yes |  |  | per band | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4,5,6,7}Component 2 candidate values: {0,1,2,3,4,5,6,7}Note: case1 and case2 cannot be enabled simultaneously as any configuration that is not based on Case 1 is defined as Case 2 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Apple | This can be discussed together with 3.1.1 (the first issue). Either way would be fine for us. |
| ZTE | Our views have been provided in 3.1.1. |
| Nokia, NSB | Do not support, this has been discussed earlier. |
| LG | Our views are provided in 3.1.1 |

### New FGs for QCL-TypeD properties for multiple overlapping CORESETs

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Introduce the following new FGs/rows**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-6-5 | Support implicit configuration of RS(s) with two TCI states for beam failure detection | Support RS(s) with two TCI states configured implicitly for beam failure detection enhancement for HST |  | Yes | N/A |  | Per band | n/a | N |  |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-6 | QCL-TypeD collision handling with CORESET with 2 TCI states | Support of identifying two QCL-TypeD properties for multiple overlapping CORESETs when a CORESET is activated with two TCI states which overlaps with another CORESET. |  | Yes | N/A |  | Per band | n/a | N |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Apple | We are supportive of both FGs. FG23-6-6 is based on the existing agreement  |
| ZTE | Support |
| LG | Support both FGs. |

### New FG for CSI-IM for CSI enhancement for multi-TRP

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Introduce the following new FG/row**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 23. NR\_FeMIMO | 23-7-6 | Support of CSI-IM for CSI enhancement for multi-TRP | Support CSI-IM for CSI enhancement for Multi-TRP | 23-7-1 | Yes |  |  | Per UE | n/a | Yes | n/a |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Apple | We are supportive  |
| ZTE | The motivation for this component is unclear for us. Generally speaking, for CQI determination, regardless of sTRP/mTRP, CSI-IM should be mandorarily configured. Otherwise, how does the UE determine Rnn? |

## NR\_ext\_to\_71GHz

### FG 24-11

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | 24-4 or 24-5 | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Per BC | N/A | N/A | N/A | Candidate values: {~~[~~4,~~]~~ 5, …, , 16}~~This FG is a working assumption~~  | Optional with capability signaling  |
| 24. NR\_ext\_to\_71GHz | 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {~~[~~4,~~]~~ 5, …, 16}~~This FG is a working assumption~~ | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {~~[~~3,~~]~~ 4, 5, …, 16}~~This FG is a working assumption~~ | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {3, ~~[~~4,~~]~~ 5, …, 16}~~This FG is a working assumption~~ | Optional with capability |

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| Company | Comments/Questions/Suggestions |
| MediaTek | We still think Rel-17 slot-group based PDCCH monitoring and Rel-15 slot based PDCCH monitoring are handled differently in UE implementation. In particular, to achieve power saving in Rel-17 slot-group based PDCCH monitoring, it is necessary to finish PDCCH decoding within Y=1 slots. For 480kHz, Y=1 slots is around 3 symbols of 120kHz and the corresponding PDCCH monitoring is similar to Rel-15 PDCCH monitoring. However, for 960kHz, Y=1 slots is less than 2 symbols of 120kHz, which bring more stringent condition on UE implementation and it is the main reason why we don’t think Rel-17 slot-group based PDCCH monitoring is the same as Rel-15 slot based PDCCH monitoring. Therefore, we still need a smaller CC# to support 960kHz slot-group PDCCH monitoring than 120kHz. To compromise, we propose to have min value of 3 for 24-11 a/c/d/e including a note: For UEs supporting 24-4, the minimum candidate value is 4. We hope this clarifies our positions.  |
| Nokia, NSB | Support in general, except for value 3 in 24-11e. |
| DOCOMO | Although the value ‘3’ in FG24-11e is not preferred, we can support the moderator’s proposal. We do not see the need to support smaller value considering symbol-level limits on PDCCH monitoring occasion.  |
| Ericsson | Support the moderator proposal. For 24-11e, we prefer minimum value 4, but we can compromise to 3 as proposed by the moderator.Regarding the argument by MediaTek, that Y = 1 symbol at 960 kHz is less than 2 symbols at 120 kHz, we don't understand the requirement for the UE finishing decoding within Y = 1 symbol. If it is a power saving argument, then even if it takes 2 symbols at 960 kHz to complete decoding, there is still ¾ of the slot-group for power saving opportunity. or power saving opportunity. |
| Huawei, HiSilicon | We support the moderator’s proposal. To our understanding, the reason to have minimum of 3 CC for 24-11e is due the involvement of Rel-16 monitoring capability which consume more processing capability than Rel-15/17 monitoring capability. .  |
|  |  |

### New FGs for mix of Rel. 15/16/17 PDCCH monitoring capabilities

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Introduce the following new FGs/rows**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11b | Mix of Rel. 17 PDCCH monitoring capability and Rel.15 and Rel.16 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells |  | Yes | N/A | Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells is not supported | Per BC | N/A | N/A | N/A |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11j | Mix of Rel. 17 PDCCH monitoring capability and Rel.15 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability, and Rel-17 monitoring capability on different serving cells |  | Yes | N/A | Rel-15 monitoring capability, and Rel-17 monitoring capability on different serving cells is not supported | Per BC | N/A | N/A | N/A |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11k | Mix of Rel. 17 PDCCH monitoring capability and Rel.16 PDCCH monitoring capability on different carriers | Support Rel-16 monitoring capability, and Rel-17 monitoring capability on different serving cells |  | Yes | N/A | Rel-16 monitoring capability, and Rel-17 monitoring capability on different serving cells is not supported | Per BC | N/A | N/A | N/A |  | Optional with capability |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| ZTE | We do not suppot this proposal, moreover, if FG24-11b/j/k are adopted, prerequisite feature groups for FG24-11 should also be updated. |
| Nokia, NSB | Do not support in principle, further discussions needed to motivate these.  |
| Ericsson | Do not support. We had significant technical discussion on this topic in the last meeting on why it was not necessary to add such FGs, and we concluded that such signaling was not necessary. We're not sure why we're reopening this. |
| Huawei, HiSilicon | Not support.  |

### New FGs for 32 DL/UL HARQ processes

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Introduce the following new FGs/rows**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-8a | 32 DL HARQ processes for FR2-1 | Support 32 HARQ processes in DL for 60/120 kHz |  | Yes | N/A | 32 DL HARQ processes for FR 2-1 is not supported | Per band | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 120 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 60 kHz SCS for DL in FR2-1 | Optional with capability signalling |
|  | 24-8b | 32 DL HARQ processes for FR1 | Support 32 HARQ processes in DL for 15/30/60 kHz |  | Yes | N/A | 32 DL HARQ processes for FR1 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
|  | 24-9a | 32 UL HARQ processes for FR2-1 | Support 32 HARQ processes in UL for 60/120 kHz |  | Yes | N/A | 32 DL HARQ processes for FR 2-1 is not supported | Per band | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 120 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 60 kHz SCS for DL in FR2-1 | Optional with capability signaling |
|  | 24-9b | 32 UL HARQ processes for FR1 | Support 32 HARQ processes in UL for 15/30/60 kHz |  | Yes | N/A | 32 DL HARQ processes for FR1 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| MediaTek | We are not sure why those features are “per band” in the signaling method which are not consistent with what we did on FR2-2. Can propoents clarify?

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| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 120/480/960 kHz | 24-1 | Yes | N/A | 32 DL HARQ processes for FR 2-2 is not supported | ~~FFS~~ Per band | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-8b | 32 DL HARQ processes for FR 2-2 - maximum number of component carriers | Maximum number of component carriers that can be configured with 32 DL HARQ processes  | 24-8 | Yes | N/A |  | Per BC | N/A | N/A | N/A | Candidate component values: {1,2,3,4,6,8,16,32} | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 120/480/960 kHz | 24-1 | Yes | N/A | 32 ~~DL~~UL HARQ processes for FR 2-2 is not supported | ~~FFS~~ Per band | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for ~~DL~~UL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for ~~DL~~UL in FR2-2 | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-9b | 32 UL HARQ processes for FR 2-2 - maximum number of component carriers | Maximum number of component carriers that can be configured with 32 UL HARQ processes | 24-9 | Yes | N/A |  | Per BC | N/A | N/A | N/A | Candidate component values: {1,2,3,4,5,8,16,32} | Optional with capability signalling |

 |
| ZTE | Support the proposal.Besides, we think that similar FGs as FG 24-8b/9b supported in FR2-2 should be also supported in FR 2-1 and FR1.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8b | 32 DL HARQ processes for FR 2-2 - maximum number of component carriers | Maximum number of component carriers that can be configured with 32 DL HARQ processes  | 24-8 | Yes | N/A |  | Per BC | N/A | N/A | N/A | Candidate component values: {1,2,3,4,6,8,16,32} | Optional with capability signalling |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-9b | 32 UL HARQ processes for FR 2-2 - maximum number of component carriers | Maximum number of component carriers that can be configured with 32 UL HARQ processes | 24-9 | Yes | N/A |  | Per BC | N/A | N/A | N/A | Candidate component values: {1,2,3,4,5,8,16,32} | Optional with capability signalling |

 |
| Nokia, NSB | Do not support. This has been discussed over several meetings already and RAN1 has decided against it. It is not clear why we are re-opening that discussion. |
| DOCOMO | We tend to agree with Nokia. No need to discuss this again.  |
| Ericsson | We are open to discuss, but does not seem essential. |
| Huawei, HiSilicon | We support the proposal and also fine to align the structure of FGs as those for FR2-2. As well as the usage in NTN and 60GHz, the extension of 32 HARQ to other FR and SCS can also alleviate HARQ processes starvation in the scenario of FR1+FR2 CA, multiple PDSCH/PUSCH scheduling by single DCI and etc. Considering it is an optional feature, it does not introduce additional complexity to UE which do not report the capability.  |

### New FGs for DC related capabilities

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Introduce the following new FGs/rows**

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|  | 24-11f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells | * Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells
* Supported combination of (*pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*)
 | 24-4 or 24-5 | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | Per BC | N/A | N/A | N/A | If the UE reports *pdcch-BlindDetectionCA-r17*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17* >= *pdcch-BlindDetectionCA-r17*

Otherwise, if is a maximum total number of downlink cells that have SCS configuration and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* or of *pdcch-BlindDetectionSCG-UE-r17* is {1,2,3}, and

*pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= .* | Optional with capability |
|  | 24-11g | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA1, pdcch-BlindDetectionCA3*)If the UE reports *pdcch-BlindDetectionCA-r15*: * the value range of *pdcch-BlindDetectionMCG-UE-r15* is {0, 1, …, *pdcch-BlindDetectionCA-r15* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r15* is {0, 1, …, *pdcch-BlindDetectionCA-r15* - 1}
* *pdcch-BlindDetectionMCG-UE-r15* + *pdcch-BlindDetectionSCG-UE-r15 >= pdcch-BlindDetectionCA-r15.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r15monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r15* is {0,1,2},
* the value range of *pdcch-BlindDetectionSCG-UE-r15* is {0,1,2},
* *pdcch-BlindDetectionMCG-UE-r15* + *pdcch-BlindDetectionSCG-UE-r15 >= .*

If the UE reports *pdcch-BlindDetectionCA-r17*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= pdcch-BlindDetectionCA-r17.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* or of *pdcch-BlindDetectionSCG-UE-r17* is {0,1,2}, and

*pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= .* | Optional with capability |
|  | 24-11h | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA2, pdcch-BlindDetectionCA3*)If the UE reports *pdcch-BlindDetectionCA-r16*: * the value range of *pdcch-BlindDetectionMCG-UE-r16* is {0, 1, …, *pdcch-BlindDetectionCA-r16* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r16* is {0, 1, …, *pdcch-BlindDetectionCA-r16* - 1},
* *pdcch-BlindDetectionMCG-UE-r16* + *pdcch-BlindDetectionSCG-UE-r16 >= pdcch-BlindDetectionCA-r16.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r16* is {0,1},
* the value range of *pdcch-BlindDetectionSCG-UE-r16* is {0,1},
* *pdcch-BlindDetectionMCG-UE-r16*+ *pdcch-BlindDetectionSCG-UE-r16 >= .*

If the UE reports *pdcch-BlindDetectionCA-r17*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= pdcch-BlindDetectionCA-r17.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0,1,2},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0,1,2},

*pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= .* | Optional with capability |
|  | 24-11i | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4 or 24-5 | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | Per BC | N/A | N/A | N/A | One combination of (*pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17*) corresponds to one combination of (*pdcch-BlindDetectionCA1, pdcch-BlindDetectionCA2, pdcch-BlindDetectionCA3*)If the UE reports *pdcch-BlindDetectionCA-r15*: * the value range of *pdcch-BlindDetectionMCG-UE-r15* is {0, 1, …, *pdcch-BlindDetectionCA-r15* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r15* is {0, 1, …, *pdcch-BlindDetectionCA-r15* - 1},
* *pdcch-BlindDetectionMCG-UE-r15* + *pdcch-BlindDetectionSCG-UE-r15 >= pdcch-BlindDetectionCA-r15.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r15monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r15* is {0,1,2},
* the value range of *pdcch-BlindDetectionSCG-UE-r15* is {0,1,2},
* *pdcch-BlindDetectionMCG-UE-r15* + *pdcch-BlindDetectionSCG-UE-r15 >= .*

If the UE reports *pdcch-BlindDetectionCA-r16*: * the value range of *pdcch-BlindDetectionMCG-UE-r16* is {0, 1, …, *pdcch-BlindDetectionCA-r16* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r16* is {0, 1, …, *pdcch-BlindDetectionCA-r16* - 1},
* *pdcch-BlindDetectionMCG-UE-r16* + *pdcch-BlindDetectionSCG-UE-r16 >= pdcch-BlindDetectionCA-r16.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r16* is {0,1},
* the value range of *pdcch-BlindDetectionSCG-UE-r16* is {0,1},
* *pdcch-BlindDetectionMCG-UE-r16*+ *pdcch-BlindDetectionSCG-UE-r16 >= .*

If the UE reports *pdcch-BlindDetectionCA-r17*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0, 1, …, *pdcch-BlindDetectionCA-r17* - 1},
* *pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= pdcch-BlindDetectionCA-r17.*

Otherwise, if is a maximum total number of downlink cells for which the UE is provided *monitoringCapabilityConfig* = *r17monitoringcapability* and the UE is configured on both the MCG and the SCG for NR-DC as indicated in *UE-NR-Capability*: * the value range of *pdcch-BlindDetectionMCG-UE-r17* is {0,1,2},
* the value range of *pdcch-BlindDetectionSCG-UE-r17* is {0,1,2}, and

*pdcch-BlindDetectionMCG-UE-r17* + *pdcch-BlindDetectionSCG-UE-r17 >= .* | Optional with capability |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| ZTE | We support to add FG 24-22f, FG 24-22g, FG 24-22h and FG 24-22i into the UE feature list considering NR-DC operation. However, FG24-11f should be further modified (delete multiple “per span” cause this FG simply describes Rel-17 capability.):Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs ~~per span~~ for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells |
| Nokia, NSB | More discussion is needed to motivated these FGs, and why they are critical at such a late stage. |
| DOCOMO | @Nokia, isn’t it something just to capture WI agreement in the last e-meeting? Is it really problematic due to that the stage is late? |
| Ericsson | Support addition of 24-11f/g/h/i. These FGs are indeed needed, since DC support was added to 38.213 after last meeting. That text refers to several UE capabilities that have not been defined yet, so the specs will be incomplete if these FGs are not added. Agree with ZTE's change above.  |
| Huawei, HiSilicon | The FG has been agreed in general in last meeting copied as below.Agreement* The UE capability framework agreed in RAN1#108-e for CA is extended to the case of NR-DC considering different combinations of Rel-17 (per-slot group) monitoring, Rel-15 (per-slot) monitoring, and Rel-16 (per-span) monitoring within different cell groups.
* Suggest the contents under the bullets for NR-DC cases 4/5/6/7 in Proposal 2-12.2 in R1-2205280 as possible implementation of this agreement to the spec editors.

However, it is not included in LS sent to RAN2 in last meeting and thus not captured in UE feature in RAN2 yet. Considering it is the RAN1 feature, it would be better RAN1 could formally provide the description to RAN2. |

### New FGs for multiple PDSCH/PUSCH scheduling

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Introduce the following new FGs/rows**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-1h | Multiple PDSCH scheduling by single DCI for 60kHz in FR2-1  | 1. Multi-PDSCH scheduling by single DCI for the operation with 60 kHz SCSs in FR2-12. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | Yes | N/A | Multiple PDSCH scheduling by single DCI for 15/30/60kHz is not supported in FR2-1 | Per band | N/A | N/A | N/A |  | Optional with capability signalling | 24. NR\_ext\_to\_71GHz |
| 24. NR\_ext\_to\_71GHz | 24-1i | Multiple PDSCH scheduling by single DCI for for 15/30/60kHz in FR1 | 1. Multi-PDSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs in FR12. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | Yes | N/A | Multiple PDSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 | Per band | N/A | N/A | N/A |  | Optional with capability signalling | 24. NR\_ext\_to\_71GHz |
| 24. NR\_ext\_to\_71GHz | 24-1j | Multiple PUSCH scheduling by single DCI for 60kHz in FR2-1  | 1. Multi-PUSCH scheduling by single DCI for the operation with 60 kHz SCSs with non-contiguous allocation in FR2-1 | Yes | N/A | Multiple PUSCH scheduling by single DCI for 15/30/60kHz is not supported in FR2-1 with non-contiguous allocation | Per band | N/A | N/A | N/A |  | Optional with capability signalling | 24. NR\_ext\_to\_71GHz |
| 24. NR\_ext\_to\_71GHz | 24-1k | Multiple PUSCH scheduling by single DCI for 15/30/60kHz in FR1 | 1. Multi-PUSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs with non-contiguous allocation in FR1 | Yes | N/A | Multiple PUSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 with non-contiguous allocation | Per band | N/A | N/A | N/A |  | Optional with capability signalling | 24. NR\_ext\_to\_71GHz |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| ZTE | We support the proposal suggested by moderator. |
| Nokia, NSB | Do not support, these aspects have been discussed already earlier.  |
| DOCOMO | We tend to agree with Nokia.  |
| Ericsson | Support the moderator's proposal. We think that multi-PDSCH and multi-PUSCH scheduling are generic tools, and there is no reason to restrict to only FR2-2. |
| Huawei, HiSilicon | We support the moderator’s proposal. We share similar view as Ericsson that those FGs are common tools.For multiple PUSCH scheduled by single DCI, it has already been supported for all FRs since Rel-16. The only enhancement in Rel-17 is allowing discontious resource allocation. The extension require marginal effort.There are also discussion in Rel-18 XR on the multiple PDSCH/PUSCH scheduled by single DCI. Extension of FG will similify their work and avoid potential harmonization in the future.  |

## NR\_NTN\_solutions

Void

## IoT over NTN

### FG 2-1d/e

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-1d | Segmented UL transmission for eMTC  | Single UE capability | 2-1, 2-1a | Yes | N/A | Release 17 eMTC UE cannot communicate via GEO and NGSO NTNs | Per UE | No | No | For UEs supporting communication via GEO and NGSO NTNs, it ~~must~~ may indicate this FG is supported. | Optional with capability signallingNote: This UE feature group is applicable only for IoT-NTN cell, for terrestrial cell this feature is not supported |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-1e | Segmented UL transmission for NB-IoT | Single UE capability | 2-1b, 2-1c | Yes | N/A | Release 17 NB-IoT UE cannot communicate via NGSO NTNs | Per UE | No | No | For UEs supporting communication via NGSO NTNs, it ~~must~~ may indicate this FG is supported. | Optional with capability signallingNote: This UE feature group is applicable only for IoT-NTN cell, for terrestrial cell this feature is not supported |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | In our understanding, the cited agreement is related to the different ways to drop slots/symbols/etc for segmented transmission. Nonetheless, regardless of whether the UE needs to perform the dropping or not, the UE has to support segmented transmission. Moreover, the optionality of this FG is already captured in the last column as "Optional with capability signalling". Thus, in our view no change is needed. |
| Nokia, NSB | Do not support. This change would make the sentence meaningless, as it is obvious that all features may be indicated, otherwise they would not be defined in the first place.  |
| Intel | Support the proposal |

### FG 2-2

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. LTE\_NBIOT\_eMTC\_NTN | 2-2 | Enhancing timing relationships using a time offset for eMTC | UE receives and applies UE specific K\_offset,~~/~~K\_mac in timing relationship enhancements | 2-1 , 2-3 | Yes  | N/A | eMTC UE does not know the offset to apply for UL transmission  | per UE | No | No | The K\_offset is a scheduling offset used for the identified timing relationships that need to be modified for IoT NTN. For IoT NTN, support cell-specific Koffset configuration for use during initial access.For IoT NTN, support the use of UE-specific Koffset in CONNECTED mode. | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Ericsson | In our understanding, the proposed change aims at reflecting that “K\_mac” is cell specific. We are ok with the clarification, but to avoid future confusions/misunderstandings, we propose to make the change in a clearer manner as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| 2-2 | Enhancing timing relationships using a time offset for eMTC | UE receives and applies UE specific K\_offset / Cell specific K\_mac in timing relationship enhancements | 2-1 , 2-3 |
| 2-2a | Enhancing timing relationships using a time offset for NB-IoT | UE receives and applies UE specific K\_offset / Cell specific K\_mac in timing relationship enhancements | 2-1b, 2-3a |

 |
| Nokia, NSB | No strong view on this proposal, but Ericsson’s clarification is better indeed. |
| Intel | Agree with the revision from Ericsson |

## NR\_IAB\_enh

### New FG for directional Collision Handling in DC operation

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Introduce the following new FG/row**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 31. NR\_IAB\_enh | 31-9 | Directional Collision Handling in DC operation | Support for directional collision handling between MCG and SCG cell(s) of the dual parent nodes for simultaneous operation in inter-donor and/or intra-donor DC operation |  | Yes | 14-5 | The IAB-node is unable to resolve directional collision between MCG and SCG cells in DC operation | per IAB node | No | No | support mixture of FDD/TDD and/or FR1/FR2  | IAB-MT impact | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Nokia, NSB | Unclear why the new FG would be needed at such a late stage. |

## NR\_DSS

### FG 34-1

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  34. NR\_DSS | 34-1 | Cross-carrier scheduling from SCell to PCell/PSCell with search space restrictions (Type A) | Support of Cross-carrier scheduling from sSCell to PCell/PSCell with search space restrictions (Type A)1. Cross-carrier scheduling from sSCell to PCell/PSCell with CIF
2. Search space restrictions: sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and ~~at least~~ following search space sets on PCell/PSCell can only be configured such that UE does not monitor them in overlapping slot of PCell/PSCell and sSCell
	* ~~USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2~~
	* USS sets for DCI formats 0\_0,1\_0
	* Type3-CSS set(s) for DCI formats 1\_0/0\_0 with C-RNTI/CS-RNTI/MCS-C-RNTI
3. Configuration of scaling factor α for BD and CCE limit handling and PDCCH overbooking handling on P(S)Cell
4. The number of unicast DCI limits for PCell/PSCell scheduling
* Processing K1 unicast DCI scheduling DL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)
* Processing K2 unicast DCI scheduling UL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)
* N is based on pair of (PCell/PSCell SCS, sSCell SCS): N=1 for(15,15), (30,30), (60,60) and N=2 for (15,30), (30,60) and N=4 for (15, 60)
1. Same numerology between sSCell and P(S)Cell or sSCell SCS is larger than P(S)Cell SCS
2. USS set(s) for DCI format 0\_1,1\_1 configured on sSCell for CCS from sSCell to Pcell/PSCell and USS set(s) for DCI format 0\_2,1\_2 configured on sSCell for CCS from sSCell to PCell/PSCell if UE supports FG 11-1 (*dci-Format1-2And0-2-r16*)
3. sSCell USS set(s) (for CCS from sSCell to Pcell/PSCell) and Type0/0A/1/2 CSS sets on Pcell/PSCell can be configured so that the UE monitors them in overlapping slot of Pcell/PSCell and sSCell
	* no simultaneous monitoring between ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’
	* simultaneous monitoring of ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC not scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’
4. PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to PCell/PSCell
5. frame boundary alignment between PCell/PSCell and sSCell
 | 6-5 | Yes | N/A | Cross-carrier scheduling from SCell to PCell/PSCell with search space restrictions (Type A) is not supported | Per BC | No | Applicable to FR1 only | No | Candidate value set: One or more of supported SCS combinations ({P(S)Cell SCS in kHz, sSCell SCS in kHz}) from following set are indicated by the UE: {15,15}, {15,30}, {15, 60}, {30,30}, {30,60},{60,60})Candidate value set 2: frequency band pair(s) for {PCell/PSCell, sSCell}Component 4 candidate values: (K1, K2) = {(1,1) for FDD P(S)Cell; (K1, K2) = (1,2) for TDD P(S)Cell}Component 8 candidate values:Value 1: * within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot if the UE does not indicate support of *pdcch-MonitoringSingleOccasion* or *pdcch-MonitoringSingleSpanFirst4Sym-r16*
* within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE indicates support of *pdcch-MonitoringSingleSpanFirst4Sym-r16*
* within a single span of any three contiguous OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE indicates support of *pdcch-MonitoringSingleOccasion*

Value 2: * within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slot if the UE does not indicate support of *pdcch-MonitoringSingleOccasion* or *pdcch-MonitoringSingleSpanFirst4Sym-r16*
* within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols of any sSCell slot, if the UE indicates support of *pdcch-MonitoringSingleSpanFirst4Sym-r16*
* within a single span of any three contiguous OFDM symbols of any sSCell slot, if the UE indicates support of *pdcch-MonitoringSingleOccasion*

Note: The CCS from sSCell to PCell is applicable to FR1 only but there can be other SCells in FR2 configured for the UENote: The SCell configured with Cross-carrier scheduling to PCell/PSCell is referred to as ‘sSCell’Note: Candidate value set 2 only applies for the following value sets of components 1: {30,30}, {30,60},{60,60}Note: Monitoring DCI formats 0\_1,1\_1,0\_2,1\_2 on PCell/PSCell USS set(s) is not supported Note: A UE supporting this FG does not imply that the UE can be configured with sSCell in shared spectrum | Optional with capability signalling |
|  34. NR\_DSS | 34-1a | Cross-carrier scheduling from SCell to PCell/PSCell with search space restrictions (Type A) for DCI formats 0\_1,1\_1,0\_2,1\_2 | 1) Search space restrictions: sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and the following search space sets on PCell/PSCell can only be configured such that UE does not monitor them in overlapping slot of PCell/PSCell and sSCell2) USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2 | 34-1 | Yes | N/A | Cross-carrier scheduling from SCell to PCell/PSCell with search space restrictions (Type A) is not supported for DCI formats 0\_1,1\_1,0\_2,1\_2 | Per BC | No | Applicable to FR1 only | No |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Apple | We are supportive of the change.  |
| Qualcomm | Regarding the proposed changes on the 2nd column of FG34-1 (removal of “at least” and “USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2” from component 2):* We are OK to remove “at least”.
* We are not OK to remove “USS sets for DCI formats 0\_1, 1\_1, 0\_2, 1\_2”. If there is a potential inconsistency with FG34-1a, just a minor clarification suffices, e.g.: “USS sets for DCI formats 0\_1, 1\_1, 0\_2, 1\_2 (if supported by FG34-1a)”.
* Correspondingly, we are not OK to add “Note: Monitoring DCI formats 0\_1, 1\_1, 0\_2, 1\_2 on PCell/PSCell USS set(s) is not supported”.

Regarding the proposed changes on candidate values of component 8):* We are not OK with the changes.
	+ The existing UE capabilities *pdcch-MonitoringSingleOccasion* and *pdcch-MonitoringSingleSpanFirst4Sym-r16* are only for SCS 15kHz. The proposed changes indicate the UE shall support the features on sSCell even when the UE supports sSCell using SCS 30kHz/60kHz.
	+ If the proposed changes intend to support the case where both P(S)Cell and sSCell use 15kHz and DSS carriers, the use cases of the proposal are not clear. If both P(S)Cell and sCell are DSS carriers, moving PDCCH from P(S)Cell to sSCell does not resolve PDCCH capacity issue. If sSCell is not a DSS carrier, sSCell does not have PDCCH capacity issue to begin with and therefore PDCCH monitoring on sSCell after 3rd OFDM symbol of a slot is not necessary.

Regarding FG34-1a:* We think the proponent intention is to add the descriptions in the existing FG34-1a (not to introduce a new FG34-1a).
* However, due to the aforementioned reasons, we do not think the change is necessary for FG34-1a. If necessary, just a minor clarification on FG34-1 is sufficient, e.g.: “USS sets for DCI formats 0\_1, 1\_1, 0\_2, 1\_2 (if supported by FG34-1a)”.
 |
| ZTE | Ok with the changes |
| Nokia, NSB | Do not support. |

### FG 34-2

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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|  34. NR\_DSS | 34-2 | Cross-carrier scheduling from SCell to PCell/PSCell (Type B) | Support of Cross-carrier scheduling (CCS) from sSCell to PCell/PSCell (Type B)1. Cross-carrier scheduling from sSCell to PCell/PSCell with CIF
2. sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and search space sets on PCell/PSCell can be configured so that the UE monitors them in overlapping slot of PCell/PSCell and sSCell
3. Configuration of scaling factor α for BD and CCE limit handling and PDCCH overbooking handling on P(S)Cell
4. The number of unicast DCI limits for PCell/PSCell scheduling
* Processing K1 unicast DCI scheduling DL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)
* Processing K2 unicast DCI scheduling UL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)
* N is based on pair of (PCell/PSCell SCS, sSCell SCS): N=1 for(15,15), (30,30), (60,60) and N=2 for (15,30), (30,60) and N=4 for (15, 60)
1. Same numerology between sSCell and P(S)Cell or sSCell SCS is larger than P(S)Cell SCS
2. USS set(s) for DCI format 0\_1,1\_1 configured on sSCell for CCS from sSCell to PCell/PSCell and USS set(s) for DCI format 0\_2,1\_2 configured on sSCell for CCS from sSCell to PCell/PSCell if UE supports FG 11-1 (*dci-Format1-2And0-2-r16*)
3. PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to Pcell/PSCell
4. frame boundary alignment between PCell/PSCell and sSCell
 | 6-5  | Yes | N/A | Cross-carrier scheduling from SCell to PCell/PSCell (Type B) is not supported | Per BC | No | Applicable to FR1 only | No | Candidate value set: One or more of supported SCS combinations ({P(S)Cell SCS in kHz, sSCell SCS in kHz}) from following set are indicated by the UE: {15,15}, {15,30}, (15, 60), {30,30}, {30,60},{60,60})Candidate value set 2: frequency band pair(s) for {PCell/PSCell, sSCell}Component 4 candidate values: (K1, K2) = {(1,1) for FDD P(S)Cell; (K1, K2) = (1,2) for TDD P(S)Cell}Component 7 candidate values:Value 1: * within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot if the UE does not indicate support of *pdcch-MonitoringSingleOccasion* or *pdcch-MonitoringSingleSpanFirst4Sym-r16*
* within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE indicates support of *pdcch-MonitoringSingleSpanFirst4Sym-r16*
* within a single span of any three contiguous OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot, if the UE indicates support of *pdcch-MonitoringSingleOccasion*

Value 2: * within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slot if the UE does not indicate support of *pdcch-MonitoringSingleOccasion* or *pdcch-MonitoringSingleSpanFirst4Sym-r16*
* within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols of any sSCell slot, if the UE indicates support of *pdcch-MonitoringSingleSpanFirst4Sym-r16*
* within a single span of any three contiguous OFDM symbols of any sSCell slot, if the UE indicates support of *pdcch-MonitoringSingleOccasion*

Note: The CCS from sSCell to Pcell is applicable to FR1 only but there can be other Scells in FR2 configured for the UENote: The SCell configured with Cross-carrier scheduling to PCell/PSCell is referred to as ‘sSCell’Note: Candidate value set 2 only applies for the following value sets of components 1: {30,30}, {30,60},{60,60}Note: A UE supporting this FG does not imply that the UE can be configured with sSCell in shared spectrum | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| Apple | We are supportive of the change.  |
| Qualcomm | Regarding the proposed changes on candidate values of component 7):* We are not OK with the changes.
	+ The existing UE capabilities *pdcch-MonitoringSingleOccasion* and *pdcch-MonitoringSingleSpanFirst4Sym-r16* are only for SCS 15kHz. The proposed changes indicate the UE shall support the features on sSCell even when the UE supports sSCell using SCS 30kHz/60kHz.
	+ If the proposed changes intend to support the case where both P(S)Cell and sSCell use 15kHz and DSS carriers, the use cases of the proposal are not clear. If both P(S)Cell and sCell are DSS carriers, moving PDCCH from P(S)Cell to sSCell does not resolve PDCCH capacity issue. If sSCell is not a DSS carrier, sSCell does not have PDCCH capacity issue to begin with and therefore PDCCH monitoring on sSCell after 3rd OFDM symbol of a slot is not necessary.
 |
| ZTE | Ok with the changes |
| Nokia, NSB | Do not support |

## LTE\_NR\_DC\_enh2

Void

## NR\_pos\_enh

### FG 27-3-1

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 27. NR\_pos\_enh | 27-3-1 | M-sample measurements in RRC\_CONNECTED within the measurement gap | The capability to support reporting a measurement based on measuring M=1 or 2 samples (instances) of a DL PRS resource set within the measurement gap | 13-1 | No |  | If the UE does not provide the capability, the UE is assumed to support M=4 only | per band | n/a | n/a | n/a | Need for location server to know if the feature is supportedNote: this feature is supported for both UE-assisted and UE based positioning | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-3-1a | M-sample measurements in RRC\_CONNECTED within the PRS processing window | The capability to support reporting a measurement based on measuring M=1 or 2 samples (instances) of a DL PRS resource set within the PRS processing window | 13-1 | No |  | If the UE does not provide the capability, the UE is assumed to support M=4 only | per band | n/a | n/a | n/a | Need for location server to know if the feature is supportedNote: this feature is supported for both UE-assisted and UE based positioning | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| vivo | Not support. We don’t think there is any difference for M-sample PRS measurements within MG and PPW. |
| Qualcomm | We don’t think it is necessary, but if majority wants it, we can accept it |
| CATT | We can live with the the change since UE’s behaviors are different in MG and PPW. |
| Huawei, HiSilicon | For gapless measurement, the PRS is within the BWP, and may meet the requirement of reduced samples.It should be possible that UE is supporting reduced samples for gapless measurement, but not for gap-based measurement. |
| ZTE | Not support. We don’t think M sample should be different for MG and PPW.  |
| Nokia, NSB | Do not support |

### FG 27-3-2

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 27. NR\_pos\_enh | 27-3-2 | DL PRS measurement outside MG and in a PRS processing window | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG and in a PRS processing window2. Support of priority handing options of PRS: Option1, Option2 or Option3* 1. Option 1: UE may indicates support of two priority states.
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
		2. State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
	2. Option 2: UE may indicate support of three priority states
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
		2. State 2: PRS is lower priority than PDCCH and URLLC PDSCH and higher priority than other PDSCH/CSI-RS
			1. Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.
		3. State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
	3. Option 3: UE may indicate support of single priority state
		1. State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS

3. The number of symbols prior to the start of the PPW (Type-1A/Type-1B) or to PRS symbol within the PPW (Type-2) that UE determines the collision between a higher priority data and a low priority PRS | 13-1 | Yes |  | DL PRS measurement outside MG and in a PRS processing window is not supported | per band | n/a | n/a | n/a | Component 1 candidate values: One or more of {Type 1A, Type 1B, Type 2}Component 2 candidate values: {option1, option2, option3}Component 3 candidate values {14,28,42,56} for each supported SCS assuming normal CP type Need for location server to know if the feature is supportedNote: Component 2 can be reported per supported band for each type supported by the UE, details left to RAN2Note: UE supporting Option 3 in component 2 is not required to report component 3Note:* Type 1A refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from all DL CCs (per UE) are affected across LTE and NR
* Type 1B refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from a certain band are affected
* Type 2 refers to the determination of prioritization between DL PRS and other DL signals/channels only in DL PRS symbols within the PRS processing window

Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability optionsNote: Within a PRS processing window, UE measurement is inside the active DL BWP with PRS having the same numerology as the active DL BWPNote: Support of configuration of PRS processing window in RRC and support of using DL MAC CE to activate/deactivate the PRS processing window for PRS measurements is part of the FG , but no dedicated signaling is required.A UE that supports FG 27-3-3 must indicate this FG is supported | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| Vivo | Maybe we can discuss it in AI 8.5 first |
| Qualcomm | It is being discussed in AI 8.5; this component 3 hasn’t been agreed yet.  |
| CATT | We prefer to discuss this issue in AI 8.5 firstly. |
| Huawei, HiSilicon | OK to discuss in AI 8.5 first. |
| ZTE | It is being discussed in AI 8.5.  |
| Nokia, NSB | Do not support. |

### FG 27-3-3

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 27. NR\_pos\_enh | 27-3-3 | DL PRS Processing Capability outside MG - buffering capability | 1. DL PRS buffering capabilitya) Type 1 – sub-slot/symbol level bufferingb) Type 2 – slot level buffering2a. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE3. Max number of DL PRS resources that UE can process in a slot ~~under it~~4. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE for PRS measurement outside MG within the PPW | 27-3-2 | ~~No~~ Yes |  | DL PRS measurement outside MG and in a PRS processing window is not supported | Per band | n/a | n/a | n/a | Component 1 candidate values: {Type 1, Type 2}Component 2a candidate values:1. T: {1, 2, 4, 8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms
2. N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms

Candidate 2b component values:a) N2: {0.125, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 8, 12} msb) T2: {4, 5, 6, 8} msComponent 3 candidate values:FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHzFR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHzComponent 4 candidate values:FR1 bands: {5, 10, 20, 40, 50, 80, 100}FR2 bands: {50, 100, 200, 400}Need for location server to know if the feature is supportedNote 1:The (N, T) UE capabilities are interpreted as legacy (N, T) in FG 13-1, and the UE is expected to receive the PRS within the PRS processing window and but the processing of the received PRS may be outside a PRS processing window. The (N2, T2) UE capabilities are interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms ~~[Note 3: UE shall support either or both of component 2a and component 2b]~~Note 4: A UE shall declare PRS processing capabilities of each of the supported Type-1A, Type-1B, Type-2” capabilities in case it supports multiple types in a bandA UE that supports FG 27-3-2 must indicate this FG is supported | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| vivo | For component 4, we don’t think it is needed, since it is natural for the UE to support only one PRS bandwidth, no matter PRS processing within the MG or within the PPW.Then, we agree to report this UE capability to gNB.For Note 3, we would like to know how to understand capability 2 if note 3 is removed. Whether it means both capability 2a and 2b are supported. If it is, it may not be agreed since it may block the previous agreement that Type-2 only reports capability 2a. In addition, maybe an additional note can be added for Type-2 PPW that is” note5: “only capability 2a can be supported for Type -2 PRS processing capabilities”**Agreement*** For UE supporting Type-1A or Type-1B PRS processing window, UE may report (N, T) and (N2, T2) in the capability signalling
	+ The reported (N, T) in the capability signalling is similar to the legacy (N, T) in FG 13-1, which assumes to measure the N ms of PRS within a PPW but the processing of the measured PRS may be outside the PRS processing window.
	+ The reported (N2, T2) in the capability signalling assumes to measure and process the N2 ms of PRS only within the PRS processing window length (which covers the T2).
	+ Add the following Note to the corresponding FG in the UE feature spreadsheet
		- Note: The (N2, T2) UE capabilities is interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms
* For UE supporting Type-2 PRS processing window, UE may report (N, T) in the capability signalling similar to the legacy (N, T) in FG 13-1
	+ Assuming the UE to measure the PRS within the PRS processing window and but the processing of the measured PRS may be outside a PRS processing window.
* Note: when the processing time T exceeds the PPW length, other DL data channels/signals that are outside of the PPW but within the periodic T can be received by the UE.
* Discuss in the UE feature session the values {N, T} for all types.
 |
| Qualcomm | For component 4, it may not be necessary to us, but if there are strong views, we can accept it. For us it is important to get this capability to be reported to the gNB, otherwise we have doubts how the whole feature is expected to work. For note 3: if we remove it, our untention was to mean means that the UE reports only 2a or 2b but not both. We can keep a note that says tha clearly: Note 3: UE shall support either component 2a and component 2b, but not both for each supported Type in a band.  |
| CATT | We think compomnet 4 is useful since UE PRS processing architecture may be different in MG and PPW.For the note3, we can live with the new proposal from Qualcomm’s comments above, i.e.,Note 3: UE shall support either component 2a and component 2b, but not both for each supported Type in a band. |
| Huawei, HiSilicon | We support component 4.On reporting both component 2a and 2b, we think it is useful, and it is allowed by the LPP specification. |
| ZTE | First, this feature should be reported to gNB as we mentioned in our tdoc because PPW is configured by gNB and gNB should know the corresponding UE capability and then determine a proper PPW length. Second, we don’t think component 4 is needed. The maximum BW should be shared for MG and PPW.  |
| Nokia, NSB | Do not support. |

### FG 27-19

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 27. NR\_pos\_enh | 27-19 | Spatial relation for positioning SRS in RRC\_INACTIVE state – gNB | Same as*RRC**SpatialRelationsSRS-Pos-r16* | 27-15 | Yes |  | Spatial relation for positioning SRS in RRC\_INACTIVE state is not supported (gNB) | Per band | n/a | ~~n/a~~ FR2 only | n/a |  | Optional with capability signalling |
| 27. NR\_pos\_enh | 27-19a | Spatial relation for positioning SRS in RRC\_INACTIVE state – location server | Same as *LPP**SpatialRelationsSRS-Pos-r16* | 27-15 | No |  | Spatial relation for positioning SRS in RRC\_INACTIVE state is not supported (location server) | Per band | n/a | ~~n/a~~ FR2 only | n/a | Need for location server to know if the feature is supported.Support of spatial relation in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
| vivo | OK |
| Qualcomm | OK |
| CATT | OK |
| Huawei, HiSilicon | OK |
| ZTE | OK |

## NR\_DL1024QAM\_FR1

### FG 36-2

After review of contributions submitted to RAN1 #110 in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| 36. NR\_DL1024QAM\_FR1 | 36-2 | scalingFactor for 1024QAM | Indicates the scaling factor to be applied to the band in the max data rate calculation as defined in 4.1.2 when support of 1024-QAM is signalled for the band | 36-1 | Yes | N/A |  | Per FS | N/A | Applicable only to FR1 | N/A | Candidate component values: {0.4, 0.75, 0.8, 1.0}If absent and the UE supports 36-1 or 36-1a, the scaling factor 1 is applied to the band in the max data rate calculation.The UE reporting this FG should also reports UE feature scalingFactor. | Optional with capability signaling |

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| Company | Comments/Questions/Suggestions |
| ZTE | For the first comment, we think it has already reflected by in latest TS 38.306.For the second comment, similar with the FG36-2, the default value of legacy scaling factor is 1, that is, if UE doesn’t report legacy scaling factor, it is assumed to be 1. There is no ambiguity between gNB and UE.So we think the current FG for 1024QAM modulation is workable. Further update is not needed. |
| Ericsson | First change seems not required – it seems to be refleced in 38.306. Perhaps, whats needed is updating the pre-requisite column of 36-2 to 36-1 “or 36-1a”.Second change is not needed, a legacy gNB does not use 36-2 and hence there is no need to mandate that UE should also report legacy scalingFactor capability.  |
| Huawei, HiSilicon | For the first change, the current spec captured in 38.306 as below is not correct, as when FG 36-2 is absent and UE does not support 1024QAM, then the legacy scaling factor should be used.***scalingFactor-1024QAM-FR1-r17***Indicates the scaling factor to be applied to the band in the max data rate calculation as defined in 4.1.2 when support of 1024-QAM for PDSCH is signalled for the band. Value f0p4 indicates the scaling factor 0.4, f0p75 indicates 0.75, and so on. If absent, the scaling factor 1 is applied to the band in the max data rate calculation.For the second change, this is for the case when Rel-17 1024QAM-capable UEs connects to Rel-15/16 gNBs, where the scaling factor will be used by gNB. However, if UE does not report legacy scaling factor, there will be misunderstanding on max data rate between legacy gNB and 1024QAM UEs.Therefore, the two changes are needed. |

# Discussion Items during RAN1 #110 — Second Checkpoint

Based on the comments/questions/suggestions received by the first checkpoint, the following are the revised proposals and/or proposed agreements by the moderator. Companies submitted the following views on the moderator’s proposals.

***[Please submit all comments/questions/suggestions here, late comments/questions/suggestions submitted in Section 3 will not be considered]***

**General comments**

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| Company | Comments/Questions/Suggestions |
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## NR\_FeMIMO

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_ext\_to\_71GHz

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_NTN\_solutions

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## IoT over NTN

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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## NR\_IAB\_enh

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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## NR\_DSS

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## LTE\_NR\_DC\_enh2

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_pos\_enh

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_DL1024QAM\_FR1

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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# Discussion Items during RAN1 #110 — Third Checkpoint

Based on the comments/questions/suggestions received by the second checkpoint, the following are the revised proposals and/or proposed agreements by the moderator. Companies submitted the following views on the moderator’s proposals.

***[Please submit all comments/questions/suggestions here, late comments/questions/suggestions submitted in Section 4 will not be considered]***

**General comments**

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| Company | Comments/Questions/Suggestions |
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## NR\_FeMIMO

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_ext\_to\_71GHz

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_NTN\_solutions

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## IoT over NTN

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_IAB\_enh

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_DSS

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## LTE\_NR\_DC\_enh2

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_pos\_enh

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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## NR\_DL1024QAM\_FR1

### FG

**Proposal: Adopt the following changes highlighted in chromatic fonts, while keeping the yellow highlighting, if any, as shown**

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| Company | Comments/Questions/Suggestions |
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# Summary of Agreements

This Section summarizes the final agreements in RAN1 #110 in this agenda item.

# References

1. R1-2205607, Updated RAN1 UE features list for Rel-17 NR after RAN1 #109-e Week2, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2205610, Updated RAN1 UE features list for Rel-17 LTE after RAN1 #109-e Week2, Moderators (AT&T, NTT DOCOMO, INC.)
3. R1-2205787, On UE features for other Rel-17 work items, Huawei/HiSilicon
4. R1-2205914, Discussion on some remaining issues of Rel-17 UE features, ZTE
5. R1-2206567, Discussion on remaining issues for Rel-17 UE capability, Intel Corporation
6. R1-2206770, Other remaining issues for Rel-17 UE features (RedCap, B52.6GHz), vivo
7. R1-2206809, Views on UE features for Rel-17 NR FeMIMO, Samsung
8. R1-2206856, Discussion on UE features for NTN-IoT, OPPO
9. R1-2206893, Discussion on UE features for RedCap, CMCC
10. R1-2207001, Remaining issues on R17 UE features, MediaTek Inc.
11. R1-2207035, Discussion on UE features for NR above 52.6 GHz, LG Electronics
12. R1-2207214, Other Rel-17 UE features, Qualcomm Incorporated
13. R1-2207319, View on Rel-17 UE features, Apple
14. R1-2207392, Discussion on remaining issues in RAN1 UE features list for Rel-17 NR, NTT DOCOMO, INC.
15. R1-2207576, UE features on Rel-17 Work Items under Agenda Item "Others", Ericsson
16. R1-2207584, On UE features for miscellaneous topics, Nokia/Nokia Shanghai Bell