**3GPP TSG RAN WG1 #102-e R1-20xxxxx**

**e-Meeting, August 17th – 28th, 2020**

**Agenda Item:** 7.2.2.2.5

**Source:** Moderator (LG Electronics)

**Title:** Summary on maintenance of wide-band operation for NR-U

**Document for:** Discussion and decision

# Introduction

This is the summary document for 7.2.2.2.5 on remaining issues of wide-band operation for NR-U, based on the contributions listed in reference section. The identified 8 topics are enumerated. Further details for each issue and preliminary views on the priority for them are provided in Sections 2 to 9. The priority for each specific issue is summarized in Section 10. Text proposals corresponding to sub-issues are collected in Appendix A.

# Issue 1: RAN4 UE feature for intra-cell guard bands

According to LS from RAN4 [11] to inform RAN4 UE features list, the following feature groups are defined for Rel-16 NR-U.

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| --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | **Consequence if the feature is not supported by the UE** |
| [4-1] | Transmission in intra-carrier guardband | Capability of transmission in the intra-band carrier guardband if the UE is scheduled a contiguous allocation that is wider than a 20MHz subband. | None | yes | UE cannot transmit in the guardband, it could only transmit in the subbands |
| [4-2] | Reception in intra-carrier guardband | Capability of reception in the intra-band carrier guardband if the UE is scheduled a contiguous allocation that is wider than a 20MHz subband. | None | yes | UE cannot receive in the guardband, it could only receive in the subbands |

Fujitsu [1] and Nokia [5] pointed out that the above feature groups may lead to several impacts on RAN1 specifications depending on further discussion in RAN1 and/or RAN4.

* Proposal from Fujitsu [1]

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| **Proposal:** **How to update RAN1 specifications to reflect UE capability of transmission in intra-cell guard band can be discussed after RAN4’s final decision.**   * **Assuming UE may be incapable of transmission in intra-cell guard band, a TP is provided above for Clause 6.1.2.2.3 of TS 38.214.** |

* Proposal from Nokia [5]

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| **Proposal-2:** *RAN1 to* *discuss which of below two options to select*   * *Option 1: 4-2 becomes mandatory in RAN4, if UE supports scheduling on more than one sub-band* * *Option 2: RAN1 updates specification such that GBs between allocated RB-sets are scheduled or not based on UE capability.* |

**Comments for priority**

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| --- | --- | --- |
| Company | Priority (High or Low) | Comments |
| LG Electronics | Low | Can wait until RAN4 discussion on UE features (including RAN1’s LS R1-2004965 related to wideband operation modes) is finalized. |
| Sharp | Low | Agree with LG. |
| Qualcomm | Low | Agree with LG. |
| Nokia, NSB | High | Agree, but it would be good to assess potential spec changes if those features would be confirmed in RAN4 |
| Ericsson | Low | Agree with LG. Once a reply from RAN4 is received, these issues can be discussed together. |
| Lenovo, Motorola Mobility | Low | Agree with LG. |
| Samsung | Low | Agree with LG |
| Fujitsu | High | Agree with Nokia. |
| ZTE, Sanechips | Low | Agree with LG. |
| Huawei, HiSilicon | Low | Agree with LG |
| OPPO | Low |  |

# Issue 2: PDCCH candidate dropping per monitoring location

Huawei [3] proposed that if a search space has multiple monitoring locations, UE will subtract PDCCH candidate and non-overlapped CCE per monitoring location in ascending order of RB set where monitoring location is. Therefore, the following proposal was made and the corresponding TP#1 can be found in Appendix A.

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| ***Proposal 1: UE can drop PDCCH BD per monitoring location in a search space. TP#1 is used.*** |

**Comments for priority**

|  |  |  |
| --- | --- | --- |
| Company | Priority (High or Low) | Comments |
| LG Electronics | Low | Seems optimization |
| Sharp | Low | Agree with LG. |
| Qualcomm | Low | Agree with LG |
| Nokia, NSB | Low | Old topic, there was no consensus to optimize BD/CCE overbooking |
| Ericsson | Low | Non-essential optimization. |
| Lenovo, Motorola Mobility | Low | Agree with LG. |
| Samsung | Low | Agree with LG |
| Fujitsu | Low | Agree with LG |
| ZTE, Sanechips | Low | Agree with LG |
| Huawei, HiSilicon | High | It haven’t been not discussed in previous meetings. |
| OPPO | Low |  |

# Issue 3: UL resource allocation type 0 enhancement

Huawei [3] suggested the following proposal to alleviate the waste of at most 15 PRBs considering intra-cell guard bands and uplink resource allocation type 0 and the corresponding TP#2 can be found in Appendix A.

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| ***Proposal 2: For resource allocation type 0, the UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated RBG(s) and union of RB set(s) overlapping with the indicated RBG(s) and intra cell guard bands between the adjacent RB sets overlapping with the indicated RBG(s), if any. The corresponding text proposal is in TP#2.*** |

**Comments for priority**

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| --- | --- | --- |
| Company | Priority (High or Low) | Comments |
| LG Electronics | Low | Similar issue was discussed in DL agenda item and it was concluded that resource allocation type 1 for the other UE can be scheduled to reduce that sort of waste. Nevertheless, if necessary, it would be preferable to discuss under UL signal/channel agenda item (7.2.2.1.3). |
| Sharp | Low | Can be discussed in UL AI. |
| Qualcomm | Low | Seems to be optimization. There may not be strong need to optimize resource allocation type 0 for unlicensed band. |
| Nokia, NSB | Medium | This is related to scheduling of GBs. TYPE-1 RA can resolve efficiency only for contiguous transmissions. |
| Ericsson | Low | No need to optimize UL resource allocation Type 0. Essentially only contiguous (or almost contiguous) allocation is supported in FR1. Hence, Type 1 and Type 2 are expected to be more commonly used for NR-U.  *In frequency range 1, only 'almost contiguous allocation' defined in [8, TS 38.101-1] is allowed as non-contiguous allocation per component carrier for UL RB allocation for CP-OFDM.* |
| Lenovo, Motorola Mobility | Low | No strong need to optimize it. |
| Samsung | Low | No need to optimize UL resource allocation Type 0 |
| Fujitsu | Low | Agree with E///. No need to optimize UL resource allocation Type 0. |
| ZTE, Sanechips | Low | There is no need to optimize UL resource allocation Type0. |
| Huawei, HiSilicon | High | If RAN4 agreed that intra cell guard might not be scheduled, type 0 maybe the only method to schedule PUSCH around guard band when interlace is not used. |
| OPPO | Low |  |

# Issue 4: Clarification of RB set definition

OPPO [7] proposed it should be clarified that the configured RB set shall not be partially overlapped with a LBT subband in unlicensed spectrum.

**Comments for priority**

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| --- | --- | --- |
| Company | Priority (High or Low) | Comments |
| LG Electronics | Low | Can be clarified if supported by majority |
| Sharp | Low | At least for a carrier without intra-cell guard bands where LBT is performed on the active UL BWP (or UL carrier), the clarification is not necessary.  For a carrier with intra-cell guard bands, RAN4 already set restriction on RB set locations which ensures no partial overlap. |
| Qualcomm | Low | Might be a RAN4 issue. Do not see a good location in RAN1 spec to capture this. |
| Nokia, NSB | Low | We believe, that RAN4 RB-set and GB restrictions cover the restriction, and this no need to specify twice |
| Ericsson | Low | Agree with Nokia |
| Lenovo, Motorola Mobility | Low | We think RAN4 can handle that. |
| Samsung | Low | Agree with Nokia |
| Fujitsu | Low | Agree with Nokia |
| ZTE, Sanechips | Low | Agree with Nokia |
| Huawei, HiSilicon | Low | Agree with Nokia |

# Issue 5: Configuration of CSI-RS for tracking

OPPO [7] proposed that the configured CSI-RS resource for tracking in unlicensed band shall be restricted within a RB set.

**Comments for priority**

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| --- | --- | --- |
| Company | Priority (High or Low) | Comments |
| LG Electronics | Low | Up to gNB configuration |
| Sharp | Low | Agree with LG. |
| Qualcomm | Low | Seems to be unnecessary limitation |
| Nokia, NSB | Low | Up to gNB configuration |
| Ericsson | Low | Unnecessary restriction |
| Samsung | Low | Up to gNB configuration |
| Fujitsu | Low | Up to gNB configuration |
| ZTE, Sanechips | Low | Up to gNB configuration |
| Huawei, HiSilicon | Low | Implementation issue |

# Issue 6: RB set indicator in DCI format 2\_0

Qualcomm [9] suggested a proposal to handle the following issues for RB set indicator in DCI format 2\_0

* For the CO duration field transmission at the beginning of a COT, since the encoding for that field needs processing time, the DCI format 2\_0 cannot carry valid available RB set information. A default value is needed to indicate the available RB set information is not yet available. We propose to use all 0 bitmap to indicate that.
* Also need to consider the case that the bitmap is not configured, in which case, the only UE assumption makes sense is assume all RB sets available when the DCI format 2\_0 is detected.

**Comments for priority**

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| --- | --- | --- |
| Company | Priority (High or Low) | Comments |
| LG Electronics | Low | It would be preferable to discuss under DL signal/channel agenda item (7.2.2.1.2), if deemed necessary. |
| Sharp | Low | Agree with LG. |
| Qualcomm | High | We believe this is important, but it is fine to discuss in DL |
| Nokia, NSB | Low | This could be discussed in DL, even we discussed many times before without concensus |
| Ericsson | Low | Same observation as Nokia – was discussed multiple times without consensus in the DL AI. |
| Lenovo, Motorola Mobility | Low | This can be discussed in DL session for further design of DCI format 2\_0 |
| Samsung | Low | Same view with Nokia and Ericsson. |
| Fujitsu | Low | Agree with LG |
| ZTE, Sanechips | Low | Share same view with Nokia, Ericsson and Samsung. This issue had been discussed many times in AI 7.2.2.1.2 DL and no any consensus. |
| Huawei, HiSilicon |  | Can be discussed in DL AI |
| OPPO | High |  |

# Issue 7: Missing RAN1 agreement/conclusion

ZTE [2] proposed to capture the following conclusion made in RAN1#101-e meeting, into TS 38.213.

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| --- |
| Conclusion:  When a configured RB set contains different size of RBs than RB set 0 within the active DL BWP, UE does not expect a CORESET configuration which has CORESET resource not confined within any of the RB set indicated by *freqMonitorLocations-r16*. |

Sharp [8] proposed to capture the following agreement made in RAN1#101-e meeting, into TS 38.214.

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| --- |
| Agreement: (RAN1#101-e)  RRC parameters *intraCellGuardBandDL-r16* and *intraCellGuardBandUL-r16* can be configured at least as UE-specific, per cell per numerology. |

**Comments for priority**

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| --- | --- | --- |
| Company | Priority (High or Low) | Comments |
| LG Electronics | High | Sharp’s TP seems necessary.  For ZTE’s proposal, TP can be prepared if supported by majority. However, if the misconfiguration is to be captured, more generalized statement is required since wide-band CORESET is also not expected to be overlapped with intra-cell guard bands. |
| Sharp | High |  |
| Qualcomm | High | For ZTE proposal, we understand the intention, but the TP might not be accurate. Agree with LG that a better way to capture is stating coresets are not overlapping with intra-cell guardband.  For Sharp proposal, the current text seems to be fine. is used in later part of the text and we don’t believe it will cause any confusion. |
| Nokia, NSB | LOW | Non of the TPs is essential. With respect to SHARP proposal, GBs are now only in UE-specific cell configuration IE in TS38.331 to our understanding, and RAN2 is discussing to make it SCS specific. |
| Ericsson | Low | Sharp proposal: The RAN1 agreement is already captured by RAN2 – the two parameters have been moved to ServingCellConfig which provides UE-specific configurations for a serving cell.  ZTE proposal: This was captured as a conclusion in the last meeting since the consensus was that this should not be spec-impacting. There was resistance to including mis-configurations. |
| Samsung | Low | For ZTE proposal, it was discussed and concluded to be captured as conclusion w/o TP in the last meeting. |
| Fujitsu | Low |  |
| ZTE, Sanechips | High | For our proposal, we think that it is necessary to be captured in the current spec to reduce the risk of implementation error. But specific TP can be further discussed and determined for more accurate presentation this conclusion. |
| Huawei, HiSilicon | High | The intention of ZTE’s proposal is fine. The text can be polished. |
| OPPO | High |  |

# Issue 8: RRC parameter name and notation alignment

The following RRC parameters are suggested to be aligned with them in TS 38.331.

* *freqMonitorLocations-r16* (by ZTE [2])
* *intraCellGuardBandsDL-r16 / intraCellGuardBandsUL-r16* (by ZTE [2], Lenovo [4], Nokia [5])

Ericsson [6] proposed the following editorials in TS 38.214 Section 7 and the corresponding TP can be found in Appendix.

* There can be some ambiguity since the same index s is used to index intra-cell guard bands and RB sets, even though the number of guard bands is one less than the number of RB sets. This can be easily corrected by using different indices.
* The formatting of the variables in this section is not consistent with other specs, e.g., 38.211. Subscripts and superscripts should not be in italics, e.g., should be and should be . These can be highlighted and left to the editor to correct.

**Comments for priority**

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| Company | Priority (High or Low) | Comments |
| LG Electronics | High, but editorial | For RRC parameter and notation alignment, TP can be directly provided to the editor.  For Ericsson’s proposal, consensus seems necessary especially for the first issue. |
| Sharp | Low, but | We can quickly agree with this. |
| Qualcomm | Low | Editorial |
| Nokia, NSB | High | Specification editor could be notified to fix those |
| Ericsson | High | Specification editor can fix the formatting issues (editorial).  RAN1 should agree on a TP for the indexing issue, i.e., using different index for GBs and RB sets to avoid potential ambiguity. |
| Lenovo, Motorola Mobilit | High | Just editorial change, yes, we can quick agree that. |
| Samsung | Low | Editorial, editor can fix it accordingly |
| Fujitsu | High, but | Editorial |
| ZTE, Sanechips | High | Seems it can be handled and corrected by the editor. |
| Huawei， HiSilicon | Low | Editorial |
| OPPO | Low | Leave for editor to fix |

# Summary on the priority for the remaining issues

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| Issue | HIGH priority | LOW priority |
| Issue 1: RAN4 UE feature for intra-cell guard bands | Nokia, NSB, Fujitsu | LG Electronics, Sharp, Qualcomm, Ericsson, Lenovo, Motorola Mobility, Samsung, ZTE, Sanechips, OPPO |
| Issue 2: PDCCH candidate dropping per monitoring location | Huawei, HiSilicon | LG Electronics, Sharp, Qualcomm, Nokia, NSB, Ericsson, Lenovo, Motorola Mobility, Samsung, Fujitsu, ZTE, Sanechips, OPPO |
| Issue 3: UL resource allocation type 0 enhancement | Nokia, NSB (medium), Huawei, HiSilicon | LG Electronics, Sharp, Qualcomm, Ericsson, Lenovo, Motorola Mobility, Samsung, Fujitsu, ZTE, Sanechips, OPPO |
| Issue 4: Clarification of RB set definition |  | LG Electronics, Sharp, Qualcomm, Nokia, NSB, Ericsson, Lenovo, Motorola Mobility, Samsung, Fujitsu, ZTE, Sanechips, Huawei, HiSilicon |
| Issue 5: Configuration of CSI-RS for tracking |  | LG Electronics, Sharp, Qualcomm, Nokia, NSB, Ericsson, Samsung, Fujitsu, ZTE, Sanechips, Huawei, HiSilicon |
| Issue 6: RB set indicator in DCI format 2\_0 | Qualcomm, , OPPO | LG Electronics, Sharp, Nokia, NSB, Ericsson, Lenovo, Motorola Mobility, Samsung, Fujitsu, ZTE, Sanechips |
| Issue 7: Missing RAN1 agreement/ conclusion | LG Electronics, Sharp, Qualcomm, ZTE, Sanechips  Huawei, HiSilicon, OPPO | Nokia, NSB, Ericsson, Samsung, Fujitsu |
| Issue 8: RRC parameter name and notation alignment | LG Electronics (but editorial), Nokia, NSB (inform/task specification editor), Ericsson, Lenovo, Motorola Mobility(editorial change), Fujitsu(editorial), ZTE, Sanechips(handled and corrected by the editor) | Sharp, Qualcomm, Samsung (editorial), Huawei, HiSilicon, OPPO |

# Reference

1. R1-2005538 Remaining issue on wideband operation Fujitsu
2. R1-2005604 Remaining issues on the wideband operation for NR-U ZTE, Sanechips
3. R1-2005813 Maintenance on the wideband operation procedures Huawei, HiSilicon
4. R1-2005829 Text proposals for wideband operation for NR-U Lenovo, Motorola Mobility
5. R1-2005906 Remaining issues on Wideband operation in NR-U Nokia, Nokia Shanghai Bell
6. R1-2005918 Wideband operation Ericsson
7. R1-2006024 Discussion on the remaining issues of wide-band operations OPPO
8. R1-2006556 Remaining corrections for wideband operation for NR-U Sharp
9. R1-2006767 TP for Wideband operation for NR-U operation Qualcomm Incorporated
10. R1-2005225 LS on Rel-16 RAN4 UE features lists for NR and LTE RAN4, NTT DOCOMO

# Appendix A: Text proposals corresponding to sub-issues

## Issue 1

### From Fujitsu [1],

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| --------------------------------- Text Proposal for Clause 6.1.2.2.3 of TS 38.214------------------------------  \*\*\* Unchanged text omitted \*\*\*  6.1.2.2.3 Uplink resource allocation type 2  In uplink resource allocation of type 2, the resource block assignment information defined in [5, TS 38.212] indicates to a UE a set of up to *M* interlace indices, and for DCI 0\_0 monitored in a UE-specific search space and DCI 0\_1 a set of up to contiguous RB sets, where *M* and interlace indexing are defined in Clause 4.4.4.6 in [4, TS 38.211]. For DCI 0\_0 monitored in a UE-specific search space and DCI 0\_1, if the UE indicates the capability of transmission in intra-cell guard bands, the UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated interlaces and the union of the indicated set of RB sets and intra-cell guard bands defined in Clause 7 between the indicated RB sets, if any. Otherwise, the UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated interlaces and the indicated set of RB sets. For DCI 0\_0 monitored in a common search space, the UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated interlaces and a single uplink RB set of the active UL BWP. For DCI 0\_0 monitored in a CSS with CRC scrambled by an RNTI other than TC-RNTI, the uplink RB set is the lowest indexed one amongst uplink RB set(s) that intersects the lowest-indexed CCE of the PDCCH in which the UE detects the DCI 0\_0 in the active downlink BWP. If there is no intersection, the uplink RB set is RB set 0 in the active uplink BWP. For DCI 0\_0 monitored in a CSS with CRC scrambled by TC-RNTI, the uplink RB set is the same one in which the UE transmits the PRACH associated with the RAR UL grant.  \*\*\* Unchanged text omitted \*\*\*  ------------------------------------------------ End Text Proposal -------------------------------------------------- |

## Issue 2

### From Huawei [3],

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| **TP#1: TS38.213**  **10.1 UE procedure for determining physical downlink control channel assignment**  \*\*\* Unchanged text is omitted \*\*\*  Denote by  the set of non-overlapping CCEs for search space set  and by  the cardinality of  where the non-overlapping CCEs for search space set  are determined considering the allocated PDCCH candidates for monitoring for the CSS sets and the allocated PDCCH candidates for monitoring for all search space sets , .  Set  Set  Set  while  AND  allocate  PDCCH candidates for monitoring to USS set  ;  ;  ;  end while  if *freqMonitorLocations-r16* is configured, there are monitoring locations in frequency domain in the search space set Denote by the set of non-overlapping CCEs in each monitoring location of search space set and by the cardinality of where the non-overlapping CCEs in each monitoring location of search space set are determined considering the allocated PDCCH candidates for monitoring for the CSS sets and the allocated PDCCH candidates for monitoring for all search space sets .  Set  ;  Set ;  Set ;  While AND  Set ;  While AND AND  end while  allocate PDCCH candidates for monitoring to USS set  ;  ;    end while  \*\*\* Unchanged text is omitted \*\*\* |

## Issue 3

### From Huawei [3],

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| **TP#2: TS38.214**  6.1.2.2.1 Uplink resource allocation type 0  In uplink resource allocation of type 0, the resource block assignment information includes a bitmap indicating the Resource Block Groups (RBGs) that are allocated to the scheduled UE where a RBG is a set of consecutive virtual resource blocks defined by higher layer parameter *rbg-Size* configured in *pusch-Config* and the size of the bandwidth part as defined in Table 6.1.2.2.1-1. For operation with shared spectrum channel access mechanism, The UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated RBGs and the union of RB sets overlapping with the indicated RBGs and intra-cell guard bands defined in Clause 7 between the adjacent RB sets overlapping with the indicated RBGs, if any.  \*\*\* Unchanged text is omitted \*\*\* |

## Issue 4

### From OPPO [7],

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| ----------------------------------------TP1: Start of 38.214 section 7 --------------------------------------  7 UE procedures for transmitting and receiving on a carrier with intra-cell guard bands  For operation with shared spectrum channel access, when the UE is configured with any of *intraCellGuardBandUL-r16* for UL carrier and *intraCellGuardBandDL-r16* for DL carrier, the UE is provided with intra-cell guard bands on a carrier, each defined by start CRB and size in number of CRBs, and , provided by higher layer parameters *startCRB-r16* and *nrofCRBs-r16*, respectively. The subscript *x* is set to DL and UL for the downlink and uplink, respectively. Where there is no risk of confusion, the subscript *x* can be dropped. The intra-cell guard bands separate RB sets, each defined by start and end CRB, and , respectively. UE does not expect that *nrofCRBs-r16* is configured with non-zero value smaller than the applicable intra-cell guard bands as specified in [8, TS 38.101-1] corresponding to and carrier size . UE determines , , and the remaining start and end CRBs as and . The RB set *s* consists of resource blocks where . When the UE is not configured with *intraCellGuardBandUL-r16,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . When the UE is not configured with *intraCellGuardBandDL-r16,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . For either or both DL and UL, if the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] contains no intra-cell guard bands, the number of RB sets for the carrier is .  For a carrier, the UE expects , and where for a BWP *i* configured by *BWP-DownlinkCommon* or *BWP-DownlinkDedicated* for the DL BWP, or *BWP-UplinkCommon* or *BWP-UplinkDedicated* for the UL BWP. Within the BWP *i*, RB sets are numbered in increasing order from 0 to where is the number of RB sets contained in the BWP *i* and RB set 0 within the BWP *i* corresponds to RB set in the carrier and RB set within the BWP *i* corresponds to RB set in the carrier.  When a UE is provided with *nrofCRBs-r16=*0 for all intra-cell guard band(s) on a carrier, the UE is indicated that no intra-cell guard-bands are configured for the carrier, and expects . For , the UE expects the number of RBs within a RB set is between 100 and 110. For , the UE expects the number of RBs within a RB set is between 50 and 55 except for at most one RB set which may contain 56 RBs.  For a carrier with intra-carrier guard band(s), the UE does not expect to receive a RB set configuration by *intraCellGuardBandDL-r16* or *intraCellGuardBandUL-r16* partially overlapping with a channel on which a channel access procedure is performed in shared spectrum [TS 37.213].  ----------------------------------------End of 38.214 section 7 -------------------------------------- |

## Issue 5

### From OPPO [7],

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| ----------------------------------------TP2: Start of 38.214 section 5.1.6.1.1 --------------------------------------  5.1.6.1.1 CSI-RS for tracking  **<Unchanged text is omitted>**  Each CSI-RS resource, defined in Subclause 7.4.1.5.3 of [4, TS 38.211], is configured by the higher layer parameter *NZP-CSI-RS-Resource* with the following restrictions:  - the time-domain locations of the two CSI-RS resources in a slot, or of the four CSI-RS resources in two consecutive slots (which are the same across two consecutive slots), as defined by higher layer parameter *CSI-RS-resourceMapping*, is given by one of  - , , or for frequency range 1 and frequency range 2,  - , , , , , or for frequency range 2.  - a single port CSI-RS resource with density given by Table 7.4.1.5.3-1 from [4, TS 38.211] and higher layer parameter *density* configured by *CSI-RS-ResourceMapping.*  - the bandwidth of the CSI-RS resource, as given by the higher layer parameter *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 52 and resource blocks, or is equal to resource blocks. For operation with shared spectrum channel access, *freqBand* configured by *CSI-RS-ResourceMapping*, is the minimum of 48 and resource blocks within a RB set, or is equal to resource blocks.  **<Unchanged text is omitted>**  ----------------------------------------End of 38.214 section 5.1.6.1.1 -------------------------------------- |

## Issue 6

### From Qualcomm [9],

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| ============TP for 38.213 Section 11.1.1====================================  --Unchanged part omitted------------------------  For each serving cell in the set of serving cells, the UE can be provided:  - an identity of the serving cell by *servingCellId*  - a location of a SFI-index field in DCI format 2\_0 by *positionInDCI*  - a set of slot format combinations by *slotFormatCombinations*, where each slot format combination in the set of slot format combinations includes  - one or more slot formats indicated by a respective *slotFormats* for the slot format combination, and  - a mapping for the slot format combination provided by *slotFormats* to a corresponding SFI-index field value in DCI format 2\_0 provided by *slotFormatCombinationId*  - for unpaired spectrum operation, a reference SCS configuration  by *subcarrierSpacing* and, when a supplementary UL carrier is configured for the serving cell, a reference SCS configuration  by *subcarrierSpacing2* for the supplementary UL carrier  - for paired spectrum operation, a reference SCS configuration  for a DL BWP by *subcarrierSpacing* and a reference SCS configuration  for an UL BWP by *subcarrierSpacing2*  - a location of an available RB set indicator field in DCI format 2\_0 that is  - one bit, if *intraCellGuardBandDL-r16* for the serving cell indicates no intra-cell guard-bands are configured, where a value of '1' indicates that the serving cell is available for receptions, a value of '0' indicates that the serving cell is not available for receptions, by *availableRB-SetPerCell-r16*, and the serving cell remains available or unavailable for reception until the end of the indicated channel occupancy duration  - a bitmap having a one-to-one mapping with the RB sets [6, TS 38.214] of the serving cell, if *intraCellGuardBandDL-r16* for the serving cell indicates intra-cell guard-bands are configured, where the bitmap includes bits and is the number of RB sets in the serving cell, a value of '1' indicates that an RB set is available for receptions, a value of '0' indicates that an RB set is not available for receptions, by *availableRB-SetPerCell-r16*, and an RB set remains available or unavailable for receptions until the end of the indicated channel occupancy duration. When all bits in the bitmap are ‘0’, in the *availableRB-SetPerCell-r16*, the availability for all RB sets for reception are considered as unknown, till another DCI format 2\_0 is received.  - When *availableRB-SetPerCell-r16* is not configured for a serving cell configured with *CO-DurationPerCell-r16* or *slotFormatCombinations*, the UE considered all RB sets available for reception when the DCI format 2\_0 is detected  - a location of a channel occupancy duration field in DCI format 2\_0, by *CO-DurationPerCell-r16*, that indicates a remaining channel occupancy duration for the serving cell starting from a first symbol of a slot where the UE detects the DCI format 2\_0 by providing a value from *CO-DurationList-r16*. The channel occupancy duration field includes bits, where is the number of values provided by *CO-DurationList-r16*. If *CO-DurationPerCell-r16* is not provided, the remaining channel occupancy duration for the serving cell is a number of slots, starting from the slot where the UE detects the DCI format 2\_0, that the SFI-index field value provides corresponding slot formats  - a location of a search space set group switching field in DCI format 2\_0, by *SearchSpaceSwitchTrigger-r16*, that indicates a group from two groups of search space sets for PDCCH monitoring for scheduling on the serving cell as described in Clause 10.4.  --Unchanged part omitted------------------------  =============================================================== |

## Issue 7

### From ZTE [2],

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| ---------------------------------------------- < Start of TP#1 for 38.213 [1]> --------------------------------------------  10.1 UE procedure for determining physical downlink control channel assignment  < Unchanged parts are omitted >  For each CORESET in a DL BWP of a serving cell, a respective *frequencyDomainResources* provides a bitmap.  - if a CORESET is not associated with any search space set configured with *freqMonitorLocation-r16*, the bits of the bitmap have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the DL BWP bandwidth of PRBs with starting common RB position , where the first common RB of the first group of 6 PRBs has common RB index if *rb-Offset-r16* is not provided, or the first common RB of the first group of 6 PRBs has common RB index where is provided by *rb-Offset-r16.*  - if a CORESET is associated with at least one search space set configured with *freqMonitorLocation-r16*, the first bits of the bitmap have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in each RB set in the DL BWP bandwidth of PRBs with starting common RB position [6, TS 38.214], where the first common RB of the first group of 6 PRBs has common RB index and *k* is indicated by *freqMonitoringLocations-r16* if provided for a search space set; otherwise, . , is a number of available PRBs in the RB set 0 for the DL BWP, and is provided by *rb-Offset-r16* or if *rb-Offset-r16* is not provided.For each RB set , the UE does not expect the common RB + is not in the RB set .  < Unchanged parts are omitted >  -------------------------------------------------- < End of text proposal> ---------------------------------------------------- |

### From Sharp [8],

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| -------- beginning of text proposal for TS 38.214  7 UE procedures for transmitting and receiving on a carrier with intra-cell guard bands  For operation with shared spectrum channel access, when the UE is configured with any of *intraCellGuardBandUL-r16* for subcarrier spacing configuration corresponding to UL carrier and *intraCellGuardBandDL-r16* for subcarrier spacing configuration corresponding to DL carrier, the UE is provided with intra-cell guard bands on a carrier, each defined by start CRB and size in number of CRBs, and , provided by higher layer parameters *startCRB-r16* and *nrofCRBs-r16*, respectively. The subscript *x* is set to DL and UL for the downlink and uplink, respectively. Where there is no risk of confusion, the subscript *x* can be dropped. The intra-cell guard bands separate RB sets, each defined by start and end CRB, and , respectively. UE does not expect that *nrofCRBs-r16* is configured with non-zero value smaller than the applicable intra-cell guard bands as specified in [8, TS 38.101-1] corresponding to and carrier size . UE determines , , and the remaining start and end CRBs as and . The RB set *s* consists of resource blocks where . When the UE is not configured with *intraCellGuardBandUL-r16* for subcarrier spacing configuration corresponding to UL carrier*,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . When the UE is not configured with *intraCellGuardBandDL-r16* for subcarrier spacing configuration corresponding to DL carrier*,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . For either or both DL and UL, if the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] contains no intra-cell guard bands, the number of RB sets for the carrier is .  For a carrier, the UE expects , and where for a BWP *i* configured by *BWP-DownlinkCommon* or *BWP-DownlinkDedicated* for the DL BWP, or *BWP-UplinkCommon* or *BWP-UplinkDedicated* for the UL BWP. Within the BWP *i*, RB sets are numbered in increasing order from 0 to where is the number of RB sets contained in the BWP *i* and RB set 0 within the BWP *i* corresponds to RB set in the carrier and RB set within the BWP *i* corresponds to RB set in the carrier.  When a UE is provided with *nrofCRBs-r16=*0 for all intra-cell guard band(s) on a carrier, the UE is indicated that no intra-cell guard-bands are configured for the carrier, and expects . For , the UE expects the number of RBs within a RB set is between 100 and 110. For , the UE expects the number of RBs within a RB set is between 50 and 55 except for at most one RB set which may contain 56 RBs.  -------- Unchanged contents are omitted  --------- end of text proposal |

## Issue 8

### From ZTE [2],

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| **Proposal 2: Correct the parameters in TS 38.213 to align with the parameter “*freqMonitorLocations-r16*” in TS 38.331, and the TP#2 can be adopted.**  ---------------------------------------------- < Start of TP#2 for 38.213 [1]> --------------------------------------------  10.1 UE procedure for determining physical downlink control channel assignment  < Unchanged parts are omitted >  For each CORESET in a DL BWP of a serving cell, a respective *frequencyDomainResources* provides a bitmap.  - if a CORESET is not associated with any search space set configured with *freqMonitorLocations-r16*, the bits of the bitmap have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the DL BWP bandwidth of PRBs with starting common RB position , where the first common RB of the first group of 6 PRBs has common RB index if *rb-Offset-r16* is not provided, or the first common RB of the first group of 6 PRBs has common RB index where is provided by *rb-Offset-r16.*  - if a CORESET is associated with at least one search space set configured with *freqMonitorLocations-r16*, the first bits of the bitmap have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in each RB set in the DL BWP bandwidth of PRBs with starting common RB position [6, TS 38.214], where the first common RB of the first group of 6 PRBs has common RB index and *k* is indicated by *freqMonitor~~ing~~Locations-r16* if provided for a search space set; otherwise, . , is a number of available PRBs in the RB set 0 for the DL BWP, and is provided by *rb-Offset-r16* or if *rb-Offset-r16* is not provided.  < Unchanged parts are omitted >  - if search space set is a CSS set  - an indication by *dci-Format0-0-AndFormat1-0* to monitor PDCCH candidates for DCI format 0\_0 and DCI format 1\_0  - an indication by *dci-Format2-0* to monitor one or two PDCCH candidates, or to monitor one PDCCH candidate per RB set if the UE is provided *freqMonitorLocations-r16* for the search space set, for DCI format 2\_0 and a corresponding CCE aggregation level  - an indication by *dci-Format2-1* to monitor PDCCH candidates for DCI format 2\_1  - an indication by *dci-Format2-2* to monitor PDCCH candidates for DCI format 2\_2  - an indication by *dci-Format2-3* to monitor PDCCH candidates for DCI format 2\_3  - an indication by *dci-Format2-4* to monitor PDCCH candidates for DCI format 2\_4  - an indication by *dci-Format2-6* to monitor PDCCH candidates for DCI format 2\_6  < Unchanged parts are omitted >  - a bitmap by *freqMonitorLocations-r16*, if provided, to indicate an index of one or more RB sets for the search space set , where the MSB in the bitmap corresponds to RB set in the DL BWP. For RB set indicated in the bitmap, the first PRB of the frequency domain monitoring location confined within the RB set is given by , where is the index of first common RB of the RB set [6, TS 38.214], and is provided by *rb-Offset-r16* or if *rb-Offset-r16* is not provided. For each RB set with a corresponding value of 1 in the bitmap, the frequency domain resource allocation pattern for the monitoring location is determined based on the first bits in *frequencyDomainResources* provided by the associated CORESET configuration.  < Unchanged parts are omitted >  -------------------------------------------------- < End of text proposal> ----------------------------------------------------  **Proposal 3: Correct the parameters in TS 38.214 to align with the parameters “*intraCellGuardBandsDL-r16*” and “*intraCellGuardBandsUL-r16*” in TS 38.331, and the TP#3 can be adopted.**  ---------------------------------------------- < Start of TP#3 for 38.214 [3]> --------------------------------------------  7 UE procedures for transmitting and receiving on a carrier with intra-cell guard bands  For operation with shared spectrum channel access, when the UE is configured with any of *intraCellGuardBandsUL-r16* for UL carrier and *intraCellGuardBandsDL-r16* for DL carrier, the UE is provided with intra-cell guard bands on a carrier, each defined by start CRB and size in number of CRBs, and , provided by higher layer parameters *startCRB-r16* and *nrofCRBs-r16*, respectively. The subscript *x* is set to DL and UL for the downlink and uplink, respectively. Where there is no risk of confusion, the subscript *x* can be dropped. The intra-cell guard bands separate RB sets, each defined by start and end CRB, and , respectively. UE does not expect that *nrofCRBs-r16* is configured with non-zero value smaller than the applicable intra-cell guard bands as specified in [8, TS 38.101-1] corresponding to and carrier size . UE determines , , and the remaining start and end CRBs as and . The RB set *s* consists of resource blocks where . When the UE is not configured with *intraCellGuardBandsUL-r16,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . When the UE is not configured with *intraCellGuardBandsDL-r16,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . For either or both DL and UL, if the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] contains no intra-cell guard bands, the number of RB sets for the carrier is .  For a carrier, the UE expects , and where for a BWP *i* configured by *BWP-DownlinkCommon* or *BWP-DownlinkDedicated* for the DL BWP, or *BWP-UplinkCommon* or *BWP-UplinkDedicated* for the UL BWP. Within the BWP *i*, RB sets are numbered in increasing order from 0 to where is the number of RB sets contained in the BWP *i* and RB set 0 within the BWP *i* corresponds to RB set in the carrier and RB set within the BWP *i* corresponds to RB set in the carrier.  When a UE is provided with *nrofCRBs-r16=*0 for all intra-cell guard band(s) on a carrier, the UE is indicated that no intra-cell guard-bands are configured for the carrier, and expects . For , the UE expects the number of RBs within a RB set is between 100 and 110. For , the UE expects the number of RBs within a RB set is between 50 and 55 except for at most one RB set which may contain 56 RBs.  -------------------------------------------------- < End of text proposal> ---------------------------------------------------- |

### From Lenovo [4],

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| -----------------------------------------------< BEGIN TEXT PROPOSAL >-------------------------------------------------  7 UE procedures for transmitting and receiving on a carrier with intra-cell guard bands  For operation with shared spectrum channel access, when the UE is configured with any of *intraCellGuardBandsUL-r16* for UL carrier and *intraCellGuardBandsDL-r16* for DL carrier, the UE is provided with intra-cell guard bands on a carrier, each defined by start CRB and size in number of CRBs, and , provided by higher layer parameters *startCRB-r16* and *nrofCRBs-r16*, respectively. The subscript *x* is set to DL and UL for the downlink and uplink, respectively. Where there is no risk of confusion, the subscript *x* can be dropped. The intra-cell guard bands separate RB sets, each defined by start and end CRB, and , respectively. UE does not expect that *nrofCRBs-r16* is configured with non-zero value smaller than the applicable intra-cell guard bands as specified in [8, TS 38.101-1] corresponding to and carrier size . UE determines , , and the remaining start and end CRBs as and . The RB set *s* consists of resource blocks where . When the UE is not configured with *intraCellGuardBandsUL-r16,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . When the UE is not configured with *intraCellGuardBandsDL-r16,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . For either or both DL and UL, if the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] contains no intra-cell guard bands, the number of RB sets for the carrier is .  For a carrier, the UE expects , and where for a BWP *i* configured by *BWP-DownlinkCommon* or *BWP-DownlinkDedicated* for the DL BWP, or *BWP-UplinkCommon* or *BWP-UplinkDedicated* for the UL BWP. Within the BWP *i*, RB sets are numbered in increasing order from 0 to where is the number of RB sets contained in the BWP *i* and RB set 0 within the BWP *i* corresponds to RB set in the carrier and RB set within the BWP *i* corresponds to RB set in the carrier.  When a UE is provided with *nrofCRBs-r16=*0 for all intra-cell guard band(s) on a carrier, the UE is indicated that no intra-cell guard-bands are configured for the carrier, and expects . For , the UE expects the number of RBs within a RB set is between 100 and 110. For , the UE expects the number of RBs within a RB set is between 50 and 55 except for at most one RB set which may contain 56 RBs.  -----------------------------------------------< END TEXT PROPOSAL >------------------------------------------------- |

### From Ericsson [6],

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| ---------------------------------------------- Text Proposal (TP#1) for 38.214, Section 7 ----------------------------------------  \*\*\* Unchanged text omitted \*\*\*  7 UE procedures for transmitting and receiving on a carrier with intra-cell guard bands  Note to editor: to be consistent with other specs, e.g., 38.211, the subscripts/superscripts in the highlighted variables should be formatted so they are not italicized, e.g., should be and should be .  For operation with shared spectrum channel access, when the UE is configured with any of *intraCellGuardBandUL-r16* for UL carrier and *intraCellGuardBandDL-r16* for DL carrier, the UE is provided with intra-cell guard bands on a carrier, each defined by start CRB and size in number of CRBs, and , provided by higher layer parameters *startCRB-r16* and *nrofCRBs-r16*, respectively, where . The subscript *x* is set to DL and UL for the downlink and uplink, respectively. Where there is no risk of confusion, the subscript *x* can be dropped. The intra-cell guard bands separate RB sets, each defined by start and end CRB, and , respectively. UE does not expect that *nrofCRBs-r16* is configured with non-zero value smaller than the applicable intra-cell guard bands as specified in [8, TS 38.101-1] corresponding to and carrier size . UE determines , , and the remaining start and end CRBs for as and . The RB set with index *s* consists of resource blocks where . When the UE is not configured with *intraCellGuardBandUL-r16,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . When the UE is not configured with *intraCellGuardBandDL-r16,* the UE determines the CRB indices for the intra-cell guard band(s), if any, and corresponding RB set(s) according to the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] corresponding to and carrier size . For either or both DL and UL, if the nominal intra-cell guard band and RB set pattern as specified in [8, TS 38.101-1] contains no intra-cell guard bands, the number of RB sets for the carrier is .  For a carrier, the UE expects , and where for a BWP *i* configured by *BWP-DownlinkCommon* or *BWP-DownlinkDedicated* for the DL BWP, or *BWP-UplinkCommon* or *BWP-UplinkDedicated* for the UL BWP. Within the BWP *i*, RB sets are numbered in increasing order from 0 to where is the number of RB sets contained in the BWP *i* and RB set 0 within the BWP *i* corresponds to RB set in the carrier and RB set within the BWP *i* corresponds to RB set in the carrier.  When a UE is provided with *nrofCRBs-r16=*0 for all intra-cell guard band(s) on a carrier, the UE is indicated that no intra-cell guard-bands are configured for the carrier, and expects . For , the UE expects the number of RBs within a RB set is between 100 and 110. For , the UE expects the number of RBs within a RB set is between 50 and 55 except for at most one RB set which may contain 56 RBs.  \*\*\* Unchanged text omitted \*\*\*  ----------------------------------------------------------- End Text Proposal ----------------------------------------------------------- |

# Appendix B: Previous agreements

Agreement: (RAN1#92bis)

* At least for band where absence of Wi-Fi cannot be guaranteed (e.g. by regulation), LBT can be performed in units of 20 MHz.
  + FFS: details on how to perform LBT for as single carrier with bandwidth greater than 20 MHz, i.e., integer multiples of 20 MHz.

Agreement: (RAN1#94bis)

* NR-U should support that a serving cell can be configured with bandwidth larger than 20 MHz.
  + For DL operation, the following options for BWP-based operation within a carrier with bandwidth larger than 20 MHz can be considered.
    - Option 1a: Multiple BWPs configured, multiple BWPs activated, transmission of PDSCH on one or more BWPs
    - Option 1b: Multiple BWPs configured, multiple BWPs activated, transmission of PDSCH on single BWP
    - Option 2: Multiple BWPs can be configured, single BWP activated, gNB transmits PDSCH on a single BWP if CCA is successful at gNB for the whole BWP
    - Option 3: Multiple BWPs can be configured, single BWP activated, gNB transmits PDSCH on parts or whole of single BWP where CCA is successful at gNB
  + Note: CCA is declared to be successful or not in multiples of 20 MHz.
  + FFS for UL operation including some or all of above options can be applied
* Note: Capture the following in TR only after further discussion for down-selecting from the options in RAN1#95.

Agreement: (RAN1#95)

* For wideband operation for both DL and UL,
  + Bandwidth larger than 20 MHz can be supported with multiple serving cells.
  + NR-U should support that a serving cell can be configured with bandwidth larger than 20 MHz.
* For DL operation, the following options for BWP-based operation within a carrier with bandwidth larger than 20 MHz can be considered.
  + Option 1a: Multiple BWPs configured, multiple BWPs activated, transmission of PDSCH on one or more BWPs
  + Option 1b: Multiple BWPs configured, multiple BWPs activated, transmission of PDSCH on single BWP
  + Option 2: Multiple BWPs can be configured, single BWP activated, gNB transmits PDSCH on a single BWP if CCA is successful at gNB for the whole BWP
  + Option 3: Multiple BWPs can be configured, single BWP activated, gNB transmits PDSCH on parts or whole of single BWP where CCA is successful at gNB
* For UL operation, the following options for BWP-based operation within a carrier with bandwidth larger than 20 MHz can be considered.
  + Option 1a: Multiple BWPs configured, multiple BWPs activated, transmission of PUSCH on one or more BWPs
  + Option 1b: Multiple BWPs configured, multiple BWPs activated, transmission of PUSCH on single BWP
  + Option 2: Multiple BWPs can be configured, single BWP activated, UE transmits PUSCH on a single BWP if CCA is successful at UE for the whole BWP
  + Option 3: Multiple BWPs can be configured, single BWP activated, UE transmits PUSCH on parts or whole of single BWP where CCA is successful at UE
* It is noted that CCA is declared to be successful or not in multiples of 20 MHz.
* Detailed design and potential selection from the above options can be further discussed when specifications are developed considering protocol and RF aspects.

Agreement: (RAN1#AH1901)

* For wideband operation in DL with a single serving cell operation within a carrier with bandwidth larger than 20 MHz
  + Multiple BWPs can be configured, single BWP activated, gNB may transmit PDSCH on parts or whole of single active BWP where CCA is successful at gNB (i.e., option 2 and 3 from previous agreement)
    - FFS: Restrictions on supportable gaps and combinations of gaps between discontiguous blocks where
      * each block spans contiguous (one or) multiple successful LBT sub-bands
      * each gap spans one or multiple contiguous unsuccessful LBT sub-bands
    - FFS: Transmission bandwidth adaptation delay, potentially different delay for e.g., different number of supported gaps, different transmission bandwidths and different positions of the LBT sub-bands where transmissions occur
    - FFS: Limit on the occupied LBT sub-bands due to regulation and coexistence considerations (not intended to imply that regulation and coexistence considerations will not be addressed)
    - FFS: Whether/how to indicate gNB’s transmitted LBT sub-bands
    - FFS: Enhancements to PDCCH/PDSCH configuration/transmission for the parts of BWP where gNB does not transmit due to CCA failure
* Send LS to RAN4 to inform above decision with the description that RAN1 requires RAN4’s feedback on the first three FFS parts in addition to what was requested in earlier LSs.

Agreement: (RAN1#AH1901)

Operation with multiple active BWPs for a carrier on unlicensed bands is not supported for DL or UL at least in Rel-16 NR-U WI.

* Inform RAN2 of this decision

**Agreement:** (RAN4#90bis)

* It is feasible to operate single carrier wideband operation when when LBT is successful in all LBT sub-bands
  + FFS whether guardbands are needed in between LBT sub-bands or not
* Mode 2 (Single wideband carrier when LBT is successful in a subset of the LBT sub-bands which are contiguous) is feasible at least if PRBs within the guardband of two contiguous LBT sub-bands are not scheduled by gNB.
  + FFS filter adaptation time if PRBs within the guardband of two contiguous LBT sub-bands are scheduled by gNB.
  + is feasible at least for WiFi-like requirements for in-carrier leakage (e.g. 20dbr).
  + FFS what regional regulatory requirements apply in LBT sub-bands where LBT fails.
    - RAN4 will investigate the feasibility whether regional regulatory requirements are met or not for in-carrier leakage.
* Mode 3 (Single wideband carrier when LBT is successful in a subset of the LBT sub-bands which are non-contiguous)
  + is feasible at least if PRBs within the guardband of two contiguous LBT sub-bands are not scheduled by gNB.
  + is feasible at least for WiFi-like requirements for in-carrier leakage (e.g. 20dbr).
  + FFS what regional regulatory requirements apply in LBT sub-bands where LBT fails.
    - RAN4 will investigate the feasibility whether regional regulatory requirements are met or not for in-carrier leakage.
  + FFS what level of in-carrier leakage and blocking requirements can be met at the BS and UE
  + FFS how to specify this in RAN4
  + FFS filter adaptation time if PRBs within the guardband of two contiguous LBT sub-bands are scheduled by gNB.

Agreement: (RAN1#96bis)

For UL transmissions in a serving cell with carrier bandwidth greater than LBT bandwidth, for the case where UE performs CCA before UL transmission, support at least Alt. 1 among the following alternatives

* Alt. 1: UE transmits the PUSCH only if CCA is successful at UE in all LBT bandwidths of the scheduled PUSCH.
* Alt. 2: UE transmits the PUSCH in all or a subset of LBT bandwidths of the scheduled PUSCH for which CCA is successful at the UE.
  + Decision on whether this alternative is supported will depend on feedback from RAN4
  + FFS on restrictions to the subset of LBT bandwidths, e.g., only contiguous LBT bandwidths allowed, based on feedback from RAN4
* Necessity of guard bands within the scheduled PUSCH should be determined by RAN4
* FFS: Whether this applies also to configured grant PUSCH
* FFS: Whether this applies also to PUCCH

Agreement: (RAN1#96bis)

* Support a mechanism for a UE to detect gNB is transmitting across
* Multiple carriers
* Multiple LBT bandwidths in a carrier.
* The following mechanisms are to be considered:
* Option 1: Explicit indication via PDCCH
  + FFS: The type of PDCCH (e.g., group common PDCCH or UE-specific PDCCH)
  + FFS: Signaling details of the indication
* Option 2: Explicit indication via selection of a PDCCH DM-RS sequence from a set of PDCCH DM-RS sequences
  + FFS: Details of the indication
* Option 3: Via UE implementation, i.e., implicit method based on NR-based signal such as DM-RS and/or corresponding PDCCH detection
  + FFS: Which signals/channels or combination of signals/channels could be used by the UE
* Note: Above options are not mutually exclusive

Agreement: (RAN1#97)

When GC-PDCCH is configured, explicit indication via GC-PDCCH is supported as a mechanism to inform the UE that one or more carriers and/or LBT bandwidths are not available or available for DL reception, at least for slot(s) that are not at the beginning of DL transmission burst.

* FFS: Signalling details of the indication, including e.g., the time domain validity of the indication
* FFS: Whether and how to support the mechanism at the beginning of DL transmission burst
* FFS: Whether and how to handle the case when GC-PDCCH is not configured or not received by the UE

Conclusion: (RAN1#97)

A UE can receive a PDSCH scheduled within an LBT bandwidth or over multiple LBT bandwidths as per Rel-15 and current agreements in Rel-16.

Conclusion: (RAN1#98)

The following are unchanged from Rel-15 for PDCCH.

* The maximum number of monitored PDCCH candidates per slot and per serving cell.
* The maximum number of non-overlapped CCEs per slot and per serving cell.
* CCE-to-REG mapping rule and hashing function.

Agreement: (RAN1#98)

For CORESET configuration in a serving cell with carrier bandwidth greater than LBT bandwidth,

* For the case where a CORESET is confined within a LBT bandwidth, the search space set configuration associated with the CORESET can have multiple monitoring locations in the frequency domain (per LBT bandwidth)
  + Send an LS to RAN2 informing them of this agreement and providing clarifications on the above if necessary
* Note: For scenarios in which gNB transmits PDCCH/PDSCH on a single BWP if CCA is successful at gNB for the whole BWP, CORESET(s) need not all be confined within an LBT bandwidth, and no specification impact is foreseen

Agreement: (RAN1#98bis)

For a search space set configuration associated with multiple monitoring locations in the frequency domain (as per the previous agreement defining such a search space set associated with a CORESET confined within an LBT bandwidth):

* PRBs allocated by *frequencyDomainResources* in the CORESET configuration are confined within one of LBT bandwidths within the BWP corresponding to the CORESET.
* Within the search space set configuration associated with the CORESET, each of the one or more monitoring locations in the frequency domain corresponds to (and is confined within) an LBT bandwidth and has a frequency domain resource allocation pattern that is replicated from the pattern configured in the CORESET.
* CORESET parameters other than frequency domain resource allocation pattern are identical for each of the one or more monitoring locations in the frequency domain.
* Include this and the prior agreement on this issue in an LS to RAN2

Agreement: (RAN1#98bis)

The intra-carrier guard bands on a carrier can be semi-statically adjusted with an RB level granularity. The RAN4 minimum guard band requirements are used as the guard bands when no semi-static adjustment is applied.

* The guard bands adjustments do not affect the already agreed restrictions on PUCCH resource allocation.
* FFS: Whether and how to handle the case where the intra-carrier guard bands are part of a resource allocation

Agreement: (RAN1#98bis)

* For UL transmissions in a serving cell with carrier bandwidth greater than the LBT bandwidth, for the case where UE performs CCA before UL transmission, UE transmits on the UL only if CCA is successful at UE in all LBT bandwidths that overlap with the resource allocation for the UL transmission
* The UE is not expected to receive resource allocations in discontiguous LBT bandwidths within a wideband carrier
  + This does not preclude such resource allocation in discontiguous LBT bandwidths being supported by specifications managed by RAN1 in Rel-16.

Agreement: (RAN1#99)

UE determines the number of RB sets (corresponding to LBT bandwidths) and the available PRBs in each RB set, both for DL and UL, based on,

* If configured, the RRC parameters *intraCellGuardBandDL-r16* and *intraCellGuardBandUL-r16* (if UL is configured)configure the lists of intra-carrier guard-bands per cell, e.g.,
  + If *intraCellGuardBandDL-r16* or *intraCellGuardBandUL-r16* are given as {, }, …, {, } where *GB* is given by CRB index, the UE determines
    - The number of RB sets for a cell: N
    - The available PRBs in each RB set: [, -1] for RB set #1, [+1, -1] for RB set #2,…, [+1, ] for RB set#N, where and corresponds to starting and ending RB index of cell, respectively.
    - Note: {, }, …, {, } may be provided separately for DL and UL
* If *intraCellGuardBandDL-r16* is not configured, then {, }, …, {, } is derived from the RAN4 specifications
  + Note: This supersedes a previous agreement
* If *intraCellGuardBandUL-r16* is not configured, then {, }, …, {, } is derived from the RAN4 specifications
  + Note: This supersedes a previous agreement
* Note: This addresses the FFS in sections 5.1.2.2 and 6.1.2.2 in 38.214.

Agreement: (RAN1#99)

For the frequency domain resource allocation that is provided with *frequencyDomainResources* in CORESET configuration,

* Introduce a new RRC parameter *rb-Offset* (with the value range of 0,1,…,5) in *ControlResoureSet* IE.
  + If *rb-Offset* is not configured, *rb-Offset* is 0
* The bits of the 45-bit bitmap *frequencyDomainResources* have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the BWP with the starting PRB position as {the first PRB index in the BWP + *rb-Offset*} for a CORESET.
* FFS: For multi-cluster CORESET configuration, *rb-Offset* also applies to the RB offset between the starting PRB index of the first 6 PRB group and the first PRB index in each RB set. Full 6 PRB groups are counted till the end of the RB set. The bits in *frequencyDomainResources* sequentially maps to the 6 RB groups in all RB sets in the BWP.
* Note: Cluster above implies a group of resource blocks that are not contiguous in frequency

Conclusion: (RAN1#99)

For a legacy CORESET configuration, the UE can expect to process PDCCH as per Rel-15 behaviour

Agreement: (RAN1#99)

For a search space set configuration with multiple monitoring locations in the frequency domain,

* Within the *SearchSpace* IE, the agreed RRC parameter *freqMonitorLocations-r16* provides a bitmap (where the first bit in the bitmap corresponds to the first RB set in the BWP, and the second bit corresponds to the second RB set, and so on). For a RB set indicated in the bitmap, the first PRB of the frequency domain monitoring location confined within the RB set is aligned with {the first PRB of the RB set + *rb-Offset* provided by the associated CORESET configuration}.
* The frequency domain resource allocation pattern for each monitoring location is determined based on the first A bits in *frequencyDomainResources* provided by the associated CORESET configuration, where A = floor({the number of available PRBs in the first RB set (accounting for *rb-Offset*) for the BWP}/6).

Agreement: (RAN1#99)

* The RRC parameters *intraCellGuardBandDL-r16* and *intraCellGuardBandUL-r16* include a mechanism to indicate that no intra-carrier guard-bands are configured
  + Note: This configuration may be used for the case where transmission only occurs in a BWP if LBT is successful in all RB sets within the BWP
* For a carrier with intra-carrier guard bands, the UE does not expect that the dedicated BWP is configured to include parts of a RB set.

Agreement: (RAN1#99)

If a UE is configured with a CSI-RS spanning over multiple LBT bandwidths,

* The UE assumes that the CSI-RS is not transmitted if the UE is monitoring DCI format 2\_0 carrying an LBT BW indication and detects the DCI format 2\_0 indicating any of corresponding LBT bandwidths is not available for DL reception.

Agreement: (RAN1#99)

For CSI-RS for tracking in unlicensed spectrum,

* Text proposal for section 5.1.6.1.1 in TS 38.214:
  + The bandwidth of the CSI-RS resource, as given by the higher layer parameter freqBand configured by CSI-RS-ResourceMapping, is the minimum of 48 and NBWP,i size resource blocks, or is equal to NBWP,i size resource blocks.

Agreement: (RAN1#100-e)

* If CORESET p is not configured with rb-offset, and is not associated with any search space set configured withfreqMonitorLocation-r16,
  + The bits of the 45-bit bitmap *frequencyDomainResources* of the CORESET *p* have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the DL BWP with the starting common RB position , where the first common RB of the first group of 6 consecutive RBs has common RB index , i.e., same as in Rel-15.
* If CORESET p is not configured with rb-offset, and is associated with at least one search space set configured with freqMonitorLocation-r16,
  + The bits of the first A bits of the 45-bit bitmap *frequencyDomainResources* of the CORESET *p* have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the DL BWP with the starting common RB position , where the first common RB of the first group of 6 consecutive RBs has common RB index , where the UE assumes the default value *rb-Offset* = 0.
* If CORESET p is configured with rb-offset, and is not associated with any search space set configured with freqMonitorLocation-r16,
  + The bits of the 45-bit bitmap *frequencyDomainResources* of the CORESET *p* have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the DL BWP with the starting common RB position , where the first common RB of the first group of 6 consecutive RBs has common RB index .
* If CORESET p is configured with rb-offset, and is associated with at least one search space set configured with freqMonitorLocation-r16,
  + The bits of the first A bits of the 45-bit bitmap *frequencyDomainResources* of the CORESET *p* have a one-to-one mapping with non-overlapping groups of 6 consecutive PRBs, in ascending order of the PRB index in the DL BWP with the starting common RB position , where the first common RB of the first group of 6 consecutive RBs has common RB index .
* Note: A bits in above bullets is defined as floor({the number of available PRBs in the first RB set (accounting for *rb-Offset*) for the BWP}/6), as per previous agreement.
* TS 38.213 editor to implement this agreement

Agreement: (RAN1#100bis-e)

For a DL cell without intra-cell guard bands

* The bit-width of available RB-set indicator (if configured) in DCI format 2\_0 is equal to 1
* UE does not expect to be configured with search space with *freqMonitorLocations-r16*

Agreement: (RAN1#100bis-e)

To support UL bandwidth part wider than 20 MHz with no intra-cell guard band, UE can be configured with zero GBs by setting GB width to 0 when configuring intraCellGuardBandUL-r16 (e.g., such gNB creates 4 RB-sets in 80MHz UL carrier).

* Inform RAN2 of this agreement

Agreement: (RAN1#100bis-e)

For an UL carrier without intra-cell guard bands when the parameter *useInterlacePUCCH-PUCCH* is configured in any of *BWP-UplinkCommon* and *BWP-UplinkDedicated*:

* The UL carrier can be configured with non-overlapping RB set(s)
* For each RB set except for RB set 0, the starting CRB index is given by *startCRB-r16*
  + For RB set 0, the starting CRB index is given by 
* The UE expects *nrofCRBs-r16* set to 0 for all GBs between two adjacent RB sets within the UL carrier.
* The UE expects N RBs contained in each interlace of each RB set, wherein 10 <= N <= 11.
  + For 30 kHz SCS, the number of RBs within any RB set is between 50 and 55, and for 15 kHz SCS, the number of RBs within any RB set is between 100 and 110
* Note: This configuration may be used for the case where transmission only occurs in a BWP if LBT is successful in all RB sets within the BWP (from RAN1#99 agreement)
* Note: It’s up to gNB’s configuration to fulfill RAN4 requirement with  e.g., on maximum transmission bandwidth configuration, spectral emission mask, and so on.
* Note: In order to reuse existing PUCCH/PUSCH resource allocation mechanisms, this proposal applies to all supported carrier bandwidths except 10 MHz
* FFS: Whether BWP can be configured to be partially overlapping with a RB set

Agreement: (RAN1#100bis-e)

The number of PDCCH candidates per aggregation level configured by *nrofCandidates* or *nrofCandidates-SFI* within a *SearchSpace* IE applies to each of RB sets configured by *freqMonitorLocations-r16*.

* *nrofCandidates-SFI* is 1 for a search space configured with freqMonitorLocations-r16

Agreement: (RAN1#101-e)

RRC parameters *intraCellGuardBandDL-r16* and *intraCellGuardBandUL-r16* can be configured at least as UE-specific, per cell per numerology.

Agreement: (RAN1#101-e)

For a DL carrier where no intra-cell guard bands are configured with *intraCellGuardBandDL-r16*,

* The DL carrier can be configured with non-overlapping RB set(s).



* For each RB set except for RB set 0, the starting CRB index is given by *startCRB-r16* and



* + For RB set 0, the starting CRB index is given by



* The UE expects nrofCRBs-r16 set to 0 for all guard bands between two adjacent RB sets within the DL carrier.
* For 30 kHz SCS, the number of RBs within any RB set is between 50 and 55, and for 15 kHz SCS, the number of RBs within any RB set is between 100 and 110
  + For 30 kHz SCS, the UE may be configured with *intraCellGuardBandDL-r16* such that one of the RB sets contain 56 PRBs

Agreement: (RAN1#101-e)

For an UL carrier without intra-cell guard bands when the parameter *useInterlacePUCCH-PUCCH* is configured in any of *BWP-UplinkCommon* and *BWP-UplinkDedicated*,

* The UE does not expect that UL BWP within the UL carrier is configured to include parts of an RB set.
* For 30 kHz SCS, the UE may be configured with *intraCellGuardBandUL-r16* such that one of the RB sets contain 56 PRBs
  + Note: the number of RBs for the other RB sets is between 50 and 55 as previously agreed
* The UL carrier can be configured with non-overlapping RB set(s) if *intraCellGuardBandUL-r16* is provided.



* This agreement and the corresponding agreement from RAN1#100bis-e also apply to the case when *useInterlacePUCCH-PUCCH* is not configured in either of *BWP-UplinkCommon* and *BWP-UplinkDedicated*

Agreement: (RAN1#101-e)

For *IntraCellGuardBand-r16*, the number of entries of *GuardBand-r16* is from 1 to 4.

Agreement: (RAN1#101-e)

For *GuardBand-r16*, the value range of *startCRB-r16* is from 0 to 274.

* Note: This requires the change from and to and , respectively, in TS 38.214 Section 7.



Agreement: (RAN1#101-e)

For *GuardBand-r16*, the value range of *nrofCRBs-r16* is from 0 to 15.

* UE does not expect that *nrofCRBs-r16* is configured with non-zero value smaller than the default guard band size defined in RAN4 specifications.

Agreement: (RAN1#101-e)

When *intraCellGuardBandUL-r16/intraCellGuardBandDL-r16* is absent for an UL/DL carrier and the default configuration in 38.101-1 indicates that there are no intra-cell guard bands for the carrier (i.e., 20 MHz carrier), then the number of RB sets for the carrier is 1 with index 0. When interlacing is configured for the UL carrier, the BWP spans the whole carrier, and the RB set index is 0 within the UL BWP.

Conclusion: (RAN1#101-e)

When a configured RB set contains different size of RBs than RB set 0 within the active DL BWP, UE does not expect a CORESET configuration which has CORESET resource not confined within any of the RB set indicated by *freqMonitorLocations-r16*.