**3GPP TSG RAN WG1 #107bis-e R1-2nnnnn**

**e-Meeting, January 17th – 25th, 2022**

**Agenda Item: 8.15.2**

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

**Title: Summary of UE features for supporting NR from 52.6 GHz to 71 GHz**

**Document for:** **Discussion/Decision**

# Introduction

This document presents the summary of email discussion/approval [107bis-e-R17-UE-features-52-71GHz-01] during RAN1 #107bis-e. According to the Chairman’s Notes:

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| [107bis-e-R17-UE-features-52-71GHz-01] Email discussion UE features for supporting NR from 52.6 GHz to 71 GHz – Ralf (AT&T)* 1st check point: January 20
* Final check point: January 25
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The following was discussed and/or agreed during RAN1 #107bis-e within the scope of [107bis-e-R17-UE-features-52-71GHz-01]. All proposals are based on the latest RAN1 UE features list for Rel-17 NR in [1].

# Summary of Contributions Submitted to RAN1 #107bis-e

The following is the moderator’s summary of contributions submitted to RAN1 #107bis-e in this agenda item.

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|  24. NR\_ext\_to\_71GHz | 24-1 | Basic FR2-2 DL support |  1. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2 for non-initial access |  |  |  | FR2-2 is not supported | [per UE][per band] |  |  |  |  | Optional with capability signallingA UE that supports FR2-2 must indicate this FG is supported |

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| Company | Summary |
| Huawei/HiSilicon [2] | “Type”: In the current table, the column of type is still pending on per band or per UE. Considering the basic FR2-2 DL support is identical for both licensed and unlicensed band operation, it is not necessary to differentiate the capability for individual band in frequency range 2-2. Moreover, the text of “A UE that supports FR2-2 must indicate this FG is supported” in the column of “Mandatory/Optional” also imply the capability report of this FG should be per UE. **Proposal: The capability of FG24-1 should be per UE.**

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|  | 24-1 | Basic FR2-2 DL support |  1. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2 for non-initial access |  |  |  | FR2-2 is not supported | per UE |  |  |  |  | Optional with capability signallingA UE that supports FR2-2 must indicate this FG is supported |

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| vivo [3] |  |
| Samsung [4] | RAN and RAN1 have agreed to support 120 kHz SCS as the default numerology for supporting NR from 52.6 GHz to 71 GHz, and support 480 kHz and 960 kHz as optional numerologies subject to UE’s capability. Based on this principle, basic support for NR from 52.6 GHz to 71 GHz with 120 kHz SCS should be a mandatory UE feature, with the type of the UE feature as per band. Meanwhile, only essential operation with 120 kHz SCS should be considered as component(s) of the basic support, wherein essential operation can be understood as the minimum set of features supporting development scenarios in FR2-2. Considering there are agreed development scenarios with DL only or UL only on FR2-2, it’s beneficial to distinguish DL and UL as two separate basic FR2-2 feature groups, without using each other as a prerequisite feature group.**Proposal: For FG 24-1 and 24-1a, keep current formulation to separate DL and UL operations as two basic FGs.** |
| NTT DOCOMO, INC. [5] | For FG24-1, we think its type (or granularity) can be per UE, not per band. This FG will be the most basic feature for UE supporting 52.6 – 71 GHz, i.e., it will imply the support of a 52.6 – 71 GHz band itself and some basic RAN1 features. We believe “the support of a 52.6 – 71 GHz band” can be reported via another signalling defined in RAN4 (i.e., similar to bandNR). Therefore, we believe the only thing a UE needs to report via the FG24-1 would be “the UE supports basic FR2-2 DL in a band indicated by the RAN4 capability signalling”. Assuming RAN4 capability will be defined per band, it would be sufficient to have FG24-1 per UE.

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|  24. NR\_ext\_to\_71GHz | 24-1 | Basic FR2-2 DL support | 1. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2 for non-initial access |  |  |  | FR2-2 is not supported | per UE |  |  |  |  | Optional with capability signallingA UE that supports FR2-2 must indicate this FG is supported |

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| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] |  |
| Apple [11] | FG 24-1 can be a per-band feature (similar to 24-2 and NR-U FG 10-1) |
| MediaTek Inc. [12] |  |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

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|  24. NR\_ext\_to\_71GHz | 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 1392. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | [24-1] |  |  |  |  |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

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| Company | Summary |
| Huawei/HiSilicon [2] | • “Prerequisite”: In RAN1#107e, RAN1 agreed to have separate FG for DL and UL because some UE operating in LAA mode in unlicensed band may only receiving downlink traffic and not necessarily to support UL transmission. So FG24-1should be Prerequisite to FG24-1a.• “Type”: Considering LAA mode only applies to unlicensed band operation, the basic FR2-2 UL support may be different between licensed band and unlicensed band. So, FG24-1a should be per band.• “Mandatory/Optional”: The sentence of “[A UE that supports FR2-2 must indicate this FG is supported]” in the column of “Mandatory/Optional” should be deleted because there is UE only operating with SDL mode in LAA.**Proposal: For FG24-1a, remove bracket on “[FG24-1]” in column “Prerequisite”. The FG should be per band and not necessarily to be supported by all UE support FR2-2.**

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|  | 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 1392. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | 24-1 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

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| vivo [3] |  |
| Samsung [4] | RAN and RAN1 have agreed to support 120 kHz SCS as the default numerology for supporting NR from 52.6 GHz to 71 GHz, and support 480 kHz and 960 kHz as optional numerologies subject to UE’s capability. Based on this principle, basic support for NR from 52.6 GHz to 71 GHz with 120 kHz SCS should be a mandatory UE feature, with the type of the UE feature as per band. Meanwhile, only essential operation with 120 kHz SCS should be considered as component(s) of the basic support, wherein essential operation can be understood as the minimum set of features supporting development scenarios in FR2-2. Considering there are agreed development scenarios with DL only or UL only on FR2-2, it’s beneficial to distinguish DL and UL as two separate basic FR2-2 feature groups, without using each other as a prerequisite feature group.**Proposal: For FG 24-1 and 24-1a, keep current formulation to separate DL and UL operations as two basic FGs.** |
| NTT DOCOMO, INC. [5] | For FG24-1a, whether to define this as another basic FG is still FFS. While we are open to discuss on this issue, we feel there may be a type of UE which supports DL reception only in FR2-2 to achieve more DL traffic. Therefore, the part with bracket in the last column can be removed in our view. If it is removed, we think it would be reasonable to define FG24-1 as a prerequisite FG. For Type, we prefer to define it per UE because of the same reason for FG24-1, while we would be ok with defining per band.

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|  24. NR\_ext\_to\_71GHz | 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 1392. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | 24-1 |  |  |  | per UE |  |  |  |  | Optional with capability signalling |

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| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] |  |
| Apple [11] | FG 24-1a should have FG 24-1 as a pre-requisite. |
| MediaTek Inc. [12] | We suggest to have separated UL and DL basic features to enable operation in a cell not configured with uplink. Proposal: Modify FG 24-1a as follows

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| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-1a | Basic FR2-2 UL support | ~~1. Support 120KHz SCS reception for non-initial access~~~~2. Support multi-RB PUCCH format 0/1 for 120 kHz~~3. PRACH with 120KHz SCS and length 1394. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | [24-1] | Optional with capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |

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| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH [with/without shared spectrum channel access] | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | [24-1a] |  |  |  |  |  |  |  | FFS: whether to split this FG for SA and DC | Optional [with/without]capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

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| Company | Summary |
| Huawei/HiSilicon [2] | • “Feature group”: In RAN1#107e, there is different interpretation on the objective to support of wideband PRACH in the WID[2] as copied below. To our understanding, the highlighted text “for operation in shared spectrum” is applied for both PRACH sequence of L=571 and 1151 and non-consecutive RO. In addition, according to RAN1 discussion, the main motivation to introduce longer PRACH sequence is to make full use of UE TX power under the restriction of power spectrum density required by regional unlicensed band regulations. On the other side, concentrating the transmit power in narrower bandwidth by power control mechanism is more efficient than introducing long PRACH sequence in licensed band. So the support of wideband PRACH should only be applied for shared spectrum operation, which is identical in NRU Rel-16. • “Type”: It should be per band and only be applied to band with shared spectrum channel access. • “Mandatory/Optional”: In NRU Rel-16, the support of wideband PRACH (FG10-27) is “Optional with capability signaling”. Considering the similar motivation to introducing such FGs, FG24-1b and 24-4b should be optional with capability signaling. As there might be UE do not support uplink at all, the text of “[A UE that supports FR2-2 must indicate this FG is supported]” is not necessary.**Proposal: The FG24-1b and 24-4b (wideband PRACH) should be per band and only applied with operation in shared spectrum. It is optional with capability signaling and not necessary to be supported for all UE claiming to support FR2-2.**

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|  | 24-1b | Wideband PRACH with shared spectrum channel access | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | 24-1a |  |  |  | Per band |  |  |  | * + FFS: whether to split this FG for SA and DC
 | Optional withcapability signalling |

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| vivo [3] | After RAN1#107-e, it is not decided yet applicable spectrum type of the following feature groups, i.e. with/without shared spectrum access. The motivation of wideband PRACH and multi-RB PUCCH is mainly from PSD limitation on unlicensed band. Therefore, there is no need to extend them to licensed band.**Proposal: FG 24-1b, 24-1c, 24-4b and 24-5c are only applicable to the scenarios without shared spectrum access.** |
| Samsung [4] | Wideband PRACH is motivated by operation with shared spectrum channel access, but in general applicable to both operations with and without shared spectrum channel access. It may not be needed as basic FG, since PRACH with sequence length 139 was supported as basic FG for all the SCSs. Multi-RB PUCCH format is an enhancement considered for operation with shared spectrum channel access only, as identified in RP-213637, so it should not be included as the basic FG. **Proposal: FG 24-1b and 24-1c should not be included as basic UL FGs, and FG 24-1c should be for operation with shared spectrum channel access only.** |
| NTT DOCOMO, INC. [5] | FG24-1b still has some FFS points:* On whether to define this FG explicitly or not (or whether to define it with capability signalling or not), since we need to consider UEs supporting DC operation but not supporting SA in 52.6 – 71 GHz, we believe it should be explicitly defined as optional with capability signalling. Otherwise, NW may not obtain information on UE capability related to DC, e.g., support of wideband PRACH.
* On whether to define this as another basic FG, similar to FG24-1a, we think it may not a basic feature assuming there may be UE supporting DL reception only in 52.6 – 71 GHz. And then, FG24-1 should be the prerequisite FG.
* For UE supporting SA, this FG is deemed necessary to deal with PSD requirement in a certain local regulation. Therefore, it can be noted that a UE that supports SA in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported.
* On whether to split this FG for SA and DC, we actually do not see the need to have such separation. We generally believe the number of FGs should be minimized to avoid having too much signalling overhead.
* To align with many other FGs, we suggest adding “for 120 kHz” at the end of the name. On the other hand, we do not see the need of the part with bracket in the name. If an FG is applicable only to either licensed or unlicensed band, such restriction can be described in the column of Note, in a similar manner to Rel-16 NR-U UE features.
* We think it would be reasonable to define FG24-1a as a prerequisite FG.
* We think it would be ok to define this FG per band.

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | 24-1a |  |  |  | per band |  |  |  |  | Optional withcapability signallingA UE that supports SA for 120 kHz SCS in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported  |

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| ZTE/Sanechips [6] | For PRACH supported in FR 2-2, it is agreed that 120kHz PRACH SCS is supported with sequence length L=139,571, 1151 in RAN1 #104 e-meeting. In addition, according to the revised WID, we can observe that wideband PRACH is not limited to operation with shared spectrum. The revised WID objective is as follows:

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| * Physical layer aspects including [RAN1]:
	+ Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum
 |

“operation in shared spectrum” mentioned in the above objective is just to apply to RO configuration for non-consecutive RACH occasions (RO) in time domain, not for PRACH sequence lengths. Consequently, the PRACH sequence lengths part of this objective applies to both operation with/without shared spectrum. With this consideration, we propose to remove wording “[with/without shared spectrum channel access]” from the FG 24-1b if wideband PRACH is supported as a separate feature group.However, from coverage performance point of view, we think that longer sequence has good performance, which is benefit for the coverage in FR2-2. Thus, we have no see any strongly motivation to separate PRACH length = 571 and 1151 with length =139 and propose to merge FG 24-1b into FG 24-1a and FG 24-1 is a prerequisite of FG 24-1a . Note that the same method used for 120kHz PRACH SCS can be applied to 480 kHz PRACH SCS.**Proposal: If FG 24-1b is supported as a separate feature, it is proposed to modify FG 24-1b as follows:**

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| Index | Feature group | Components | Prerequisite feature groups |
| 24-1b | Wideband PRACH ~~[with/without shared spectrum channel access]~~ | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz   | ~~[~~24-1a~~]~~ |

**Proposal: Propose to merge FG 24-1b into FG 24-1a and FG 24-1 is a prerequisite of FG 24-1a , as follows:**

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| Index | Feature group | Components | Prerequisite feature groups |
| 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 139/571/11512. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | ~~[~~24-1~~]~~ |
| ~~24-1b~~ | ~~Wideband PRACH [with/without shared spectrum channel access]~~ | ~~Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz~~  | ~~[24-1a]~~ |

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| Qualcomm Incorporated [7] |  |
| OPPO [8] | In the last version, there is a bracket for wideband PRACH, which includes with and without shared spectrum channel access. In our opinion, the feature of wideband PRACH is not needed and motivated in the case where PSD limitation is not imposed. This is not necessarily tighted with channel access method or unlicensed/licensed band. This should be clearly mentioned in the UE feature list. **Proposal: for FG24-1b, replacing [with/without shared spectrum channel access] with [for region where PSD limitation is imposed].** |
| Intel Corporation [9] |  |
| Ericsson [10] | In RAN1#107-e there was some discussion on whether or not to split the PRACH-related FGs into separate FGs, one for standalone and one for dual-connectivity (DC); however, we don't see why this would be necessary. In our view, these FGs are relevant for both Scenarios B and C listed above, i.e., any scenario in which an UL carrier is deployed in FR2-2, since wideband PRACH can be transmitted on an SCell in a CA/DC deployment, PSCell in a DC deployment, or PCell in a standalone deployment. Instead of splitting these FGs, the UL-related FGs 24-1a/4a can be made as pre-requisites for the wideband PRACH-related FGs.We understand that for Scenario C (standalone deployment), there is no mechanism to indicate UE capability for wideband PRACH during initial access; however, if a network indicates in SIB1 that wideband PRACH should be used, and the UE does not support it, the UE simply cannot access the system. However, even if the network indicates legacy PRACH (L = 139), it is still useful for the UE to indicate capability for wideband PRACH after initial access from the perspective that the network can capture statistics on UE support for wideband PRACH. Note that the same is true for multi-RB PUCCH if indicated in SIB1 for initial access. If a significant fraction of the UE fleet supports wideband PRACH/multi-RB PUCCH, then the feature can be activated. This can be useful for an operator to decide which features should be deployed and when in a network. Hence, in our view the feature should still be specified as "Optional with capability signaling." Furthermore, if the UE indicates capability for wideband PRACH/multi-RB PUCCH after initial access, such a UE can be handed over to a target cell in which these feature(s) is/are being used even if the source cell is not.Proposal: For the wideband PRACH-related FG 24-1b do not split this into separate FGs for SA/DC. The FG should be specified as "Optional with capability signaling." Support the following change to the FG list:

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| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-1b | Wideband PRACH [with/without shared spectrum channel access] | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | [24-1a] | ~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

For FGs 1b/1c/4b/4c/5 related to wideband PRACH multi-RB PUCCH, the FG names currently include the wording "with/without shared spectrum channel access". These are generic "tools in the toolbox" hence this wording should not be included in the FG name. After further discussion in RAN1, if there is some need to restrict to operation only with shared spectrum channel access, then the above note can be added to the FG. However, we observe that at least for wideband PRACH, the following WID objective [3] does not restrict to operation only with shared spectrum channel access; it applies for both with and without shared spectrum channel access.* Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum

Regarding multi-RB PUCCH, the WID objective is as follows* Support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation.

Which indeed refers to a PSD limitation for operation with shared spectrum channel access; however, there may be PSD limitations even for operation without shared spectrum channel access in FR2-2. Based on the above discussion we propose the following.**Proposal: In the FG name for wideband PRACH and multi-RB PUCCH-related FGs 1b/1c/4b/4c/5, remove the wording "with/without shared spectrum channel access" from the FG name. Later, if there is a need to introduce some restriction, it can be done with the same note as described for the channel access-related FGs. Support the following changes to the FG list:**

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-1b | Wideband PRACH ~~[with/without shared spectrum channel access]~~ | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | [24-1a] | FFS: whether to split this FG for SA and DC | Optional [with/without]capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

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| Apple [11] | FG 24-1b “Wideband PRACH” should be agreed on. |
| MediaTek Inc. [12] | Whether the FG 24-1b and FG 24-4b should be included as basic FR2-2 UL FGs was discussed in RAN1 #107-e meeting. Some company mentioned that PRACH is a fundamental channel in initial access and supporting such feature as basic functionality is necessary. However, the motivation of introducing such FG is to comply with regulation, which varies based on different regions. Therefore, we prefer to allow UE to have the option on whether to support the FG based on different regulations.Regarding whether FG 24-1b and FG 24-4b should be FGs for shared spectrum only or not, it is not feasible to have the option to support wideband PRACH in shared spectrum but not in licensed spectrum and vice versa. Therefore, we prefer to have a generic FG for wideband PRACH.We also prefer to include FR2-2 in the naming of the FG to distinguish this FG from the one introduced in sub6 NRU.Proposal: Modify FG 24-1b and FG24-4b as follows

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| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH [for 120kHz in FR2-2] ~~[with/without shared spectrum channel access]~~ | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz ~~/480kHz~~.  |  | Optional ~~[~~with~~/without]~~capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |

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| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] | Confirm the FGFeature can be support with or without shared spectrum channel access. No need to separate the FG though, per band indication is sufficient.  |

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|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz [with/without shared spectrum channel access] | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | [24-1a] |  |  |  |  |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

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| Company | Summary |
| Huawei/HiSilicon [2] | • “Feature group”: According to the WID, it is clearly stated that such feature is for unlicensed band only as copied below. From technical perspective, the introduction of multi RB is trying to make use of the total TX power under PSD limitation in unlicensed band.• “Type”: They should be per band and only be applied to band with shared spectrum channel access. • “Mandatory/Optional”: In NRU Rel-16, the support of PRB interlace mapping for PUCCH (FG10-3a) is “per band” and “Optional with capability signaling”. Considering the similar motivation to introducing such FG, FG24-1c should also be “per band” and “optional with capability signaling”. As there might be UE do not support uplink at all, the text of “[A UE that supports FR2-2 must indicate this FG is supported]” is not necessary.**Proposal: The FG24-1c, 24-4c and 24-5c should be per band and only be applied with shared spectrum channel access. They should be optional with capability signaling and not necessary to be supported for all UE claiming to support FR2-2.**

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|  | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz with shared spectrum channel access | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] | After RAN1#107-e, it is not decided yet applicable spectrum type of the following feature groups, i.e. with/without shared spectrum access. The motivation of wideband PRACH and multi-RB PUCCH is mainly from PSD limitation on unlicensed band. Therefore, there is no need to extend them to licensed band.**Proposal: FG 24-1b, 24-1c, 24-4b and 24-5c are only applicable to the scenarios without shared spectrum access.** |
| Samsung [4] | Wideband PRACH is motivated by operation with shared spectrum channel access, but in general applicable to both operations with and without shared spectrum channel access. It may not be needed as basic FG, since PRACH with sequence length 139 was supported as basic FG for all the SCSs. Multi-RB PUCCH format is an enhancement considered for operation with shared spectrum channel access only, as identified in RP-213637, so it should not be included as the basic FG. **Proposal: FG 24-1b and 24-1c should not be included as basic UL FGs, and FG 24-1c should be for operation with shared spectrum channel access only.** |
| NTT DOCOMO, INC. [5] | For FG24-1c, we believe the same handling as for FG24-1b can be applied, i.e.,* It should be defined as optional with capability signalling, while it can be noted that a UE that supports SA in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported.
* We do not see the need of the part with bracket in the name. If an FG is applicable only to either licensed or unlicensed band, such restriction can be described in the column of Note, in a similar manner to Rel-16 NR-U UE features.
* We think it would be reasonable to define FG24-1a as a prerequisite FG.
* We think it would be ok to define this FG per band.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a |  |  |  | per band |  |  |  |  | Optional with capability signallingA UE that supports SA for 120 kHz SCS in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported |

 |
| ZTE/Sanechips [6] | According to the revised WID, enhancement for PUCCH format 0/1/4 is limited to operation with shared spectrum irrespective to SCS. The revised WID objective is as follows:

|  |
| --- |
| * Physical layer aspects including [RAN1]:
	+ Support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation
 |

Based on the above objective, we propose to remove “without shared spectrum channel access” related description and yellow highlight and brackets from FG 24-1c, FG 24-4c and FG 24-5c. Preferably, we recommend the following change to the title of FG 24-1c, FG 24-4c and FG 24-5c. Besides, FG 24-1a is a prerequisite of FG 24-1c, so remove brackets and yellow highlight of FG 24-1a.**Proposal: Modify FG 24-1c, FG 24-4c and FG 24-5c as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz for operation with~~/without~~ shared spectrum channel access~~]~~  | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | ~~[~~24-1a~~]~~ |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | Similar reasoning is applied for this FG and the condition with PSD limitation should be mentioned. **Proposal: for FG24-1c, replacing [with/without shared spectrum channel access] with [for region where PSD limitation is imposed].** |
| Intel Corporation [9] |  |
| Ericsson [10] | For FGs 1b/1c/4b/4c/5 related to wideband PRACH multi-RB PUCCH, the FG names currently include the wording "with/without shared spectrum channel access". These are generic "tools in the toolbox" hence this wording should not be included in the FG name. After further discussion in RAN1, if there is some need to restrict to operation only with shared spectrum channel access, then the above note can be added to the FG. However, we observe that at least for wideband PRACH, the following WID objective [3] does not restrict to operation only with shared spectrum channel access; it applies for both with and without shared spectrum channel access.* Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum

Regarding multi-RB PUCCH, the WID objective is as follows* Support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation.

Which indeed refers to a PSD limitation for operation with shared spectrum channel access; however, there may be PSD limitations even for operation without shared spectrum channel access in FR2-2. Based on the above discussion we propose the following.**Proposal: In the FG name for wideband PRACH and multi-RB PUCCH-related FGs 1b/1c/4b/4c/5, remove the wording "with/without shared spectrum channel access" from the FG name. Later, if there is a need to introduce some restriction, it can be done with the same note as described for the channel access-related FGs. Support the following changes to the FG list:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz ~~[with/without shared spectrum channel access]~~ | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | [24-1a] |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

 |
| Apple [11] | FG 24-1c should have FG 24-1a as a pre-requisite. |
| MediaTek Inc. [12] | Similar to our comments on wideband PRACH, the multi-RB PUCCH FGs should be considered as optional FGs due to the different regulation requirements in different areas. Proposal: Update FG 24-1c, FG24-4c, and FG24-5c as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2~~[with/without shared spectrum channel access]~~ | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz |  | Optional with capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |

 |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] | Can be combined with 24-1aFeature can be support with or without shared spectrum channel access. No need to separate the FG though, per band indication is sufficient.  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | [24-1] |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | 24-1 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | We are fine with them as they are. So, we suggest removing all brackets for them.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | 24-1 |  |  |  | per band |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] |  |
| Apple [11] | FG 24-1d should have FG 24-1 as a pre-requisite. |
| MediaTek Inc. [12] |  |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | [24-1a] |  |  |  |  |  |  |  |  | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS
 | 24-1a |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | We are fine with them as they are. So, we suggest removing all brackets for them.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a |  |  |  | per band |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] |  |
| Apple [11] | FG 24-1e should have FG 24-1a as a pre-requisite. |
| MediaTek Inc. [12] |  |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB support for SA/DC in FR2-2 | 1. Support 120KHz SSB for SA/DC in FR2-2 | [24-1, 24-1a] | N/A | N/A | 120KHz SSB based stand-alone in FR2-2 is not supported | N/A | N/A | N/A | N/A | per bandFFS: whether to split this FG for SA and DC | Optional [with/without] capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Prerequisite”: Both downlink and uplink are required to fulfill the initial access procedure for SA and DC. The bracket for 24-1 and 24-1a in the column of “prerequisite” should be removed.• “Mandatory/Optional”: The sentence of “[A UE that supports FR2-2 must indicate this FG is supported]” is not necessary as some LAA UE may not support SA/DC mode in FR2-2.**Proposal: Support to have 24-1 and 24-1a as prerequisite for 24-2. Delete “[A UE that supports FR2-2 must indicate this FG is supported]” in the column of “Mandatory/Optional” in FG24-2**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-2 | 120KHz SSB support for SA/DC in FR2-2 | 1. Support 120KHz SSB for SA/DC in FR2-2 | 24-1, 24-1a | N/A | N/A | 120KHz SSB based stand-alone in FR2-2 is not supported | N/A | N/A | N/A | N/A | per bandFFS: whether to split this FG for SA and DC | Optional [with/without] capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | * At this moment, we do not see the need to split this FG for SA and DC.
* Considering a UE supporting DC but not supporting SA with 120 kHz SCS, it should be optional with capability signalling.
* We do not think all the UEs that support 52.6 – 71 GHz support SA/DC operations. Therefore, the part with bracket in the last column should be removed in our view.
* It can be noted that a UE that supports SA in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB support for SA/DC in FR2-2 | 1. Support 120KHz SSB for SA/DC in FR2-2
 | 24-1, 24-1a | N/A | N/A | 120KHz SSB based stand-alone in FR2-2 is not supported | N/A | N/A | N/A | N/A | per band | Optional with capability signallingA UE that supports SA for 120 kHz SCS in a band in 52.6 – 71 GHz must indicate this FG is supported. |

 |
| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | In the current description, FG 24-2 is for SA/DC in FR2-2. However, this FG is a bit overlapped with FG 24-1, where support SSB for 120kHz for non-initial access is already described. Therefore, a more logically straightforward way is to replace SA/DC with initial access. Alternatively, we can simply remove the DC case and only keep SA. **Proposal: For FG 24-2, replacing SA/DC with initial access; or simply removing DC.** |
| Intel Corporation [9] |  |
| Ericsson [10] | There was also some discussion on whether or not to split the standalone-related FG 24-2 into separate FGs, one for standalone and one for DC. Following the same logic as above for wideband PRACH, we don't think this FG should be split. Furthermore, we think the name for the FGs should be changed to remove the wording "SSB support for SA/DC" replacing it with "SSB support for initial access on PCell in FR2-2" This is complementary to the component description for the basic FG 24-1 which specifies "SSB for non-initial access."Proposal: For the standalone related FG 24-2, do not split this into separate FGs for SA/DC. The FG should be specified as "Optional with capability signaling". Support the following change to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-2 | 120KHz SSB support for ~~SA/DC~~ initial access on PCell in FR2-2 | 1. Support 120KHz SSB for ~~SA/DC~~ initial access on PCell in FR2-2 | [24-1, 24-1a] | per band~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~ capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

 |
| Apple [11] | FG 24-2 should have FG 24-1 and FG 24-1a as pre-requisites. FG 24-2 should be split for SA and DCFG 24-2 should be Optional WITH capability signaling. |
| MediaTek Inc. [12] |  |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] | No need to split the capability into SA and DC |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB support for SA/DC in FR2-2 | 1. Support 480KHz SSB for SA/DC in FR2-2 | 24-1[, 24-2, 24-4] | FFS |  |  | [per UE][per band] |  |  |  | FFS: whether to split this FG for SA and DC | Optional [with/without] capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Prerequisite”: According to the WID, A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access). FG24-2 (120 kHz SSB based stand-alone support for SA/DC in FR2-2) should be the prerequisite for FG24-3. Assuming both 24-1 and 24-1a are prerequisite of 24-2 as proposed in proposal 5, the 24-1 is not necessary to be the prerequisite of 24-3 anymore. In order to fulfill whole initial access procedure with 480 kHz SCS, both DL and UL with 480 kHz SCS should be supported. Thus 24-4 and 24-4a should be prerequisite of 24-3. **Proposal: FG24-2, 24-4 and 24-4a should be the prerequisite for FG24-3. FG24-1 is not necessary to be prerequisite as it is already involved in 24-2.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-3 | 480KHz SSB support for SA/DC in FR2-2 | 1. Support 480KHz SSB for SA/DC in FR2-2 | 24-2, 24-4, 24-4a | FFS |  |  |  per band |  |  |  | FFS: whether to split this FG for SA and DC | Optional [with/without] capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | * At this moment, we do not see the need to split this FG for SA and DC.
* Considering a UE supporting DC but not supporting SA with 480 kHz SCS, it should be optional with capability signalling.
* For Type, our preference is per UE, while we would be open to discuss.
* In addition to FG24-1, 24-2 and 24-4, FG24-4a should be a prerequisite FG.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB support for SA/DC in FR2-2 | 1. Support 480KHz SSB for SA/DC in FR2-2 | 24-1, 24-2, 24-4, 24-4a | FFS |  |  | [per UE] |  |  |  |  | Optional with capability signallingA UE that supports SA for 480 kHz SCS in a band in 52.6 – 71 GHz must indicate this FG is supported. |

 |
| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] | According to the same logic as presented in Section 2.1.2 for 120 kHz, we propose to not split the wideband PRACH and standalone FGs into separate FGs.Proposal: For the standalone related FGs 24-3, do not split this into separate FGs for SA/DC. The FG should be specified as "Optional with capability signaling". Support the following change to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-3 | 480KHz SSB support for ~~SA/DC~~ initial access on PCell in FR2-2 | 1. Support 480KHz SSB for ~~SA/DC~~ initial access on PCell in FR2-2 | 24-1[, 24-2, 24-4] | ~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~ capability signalling |

 |
| Apple [11] | FG 24-3 should have FG 24-4 as a pre-requisite. No need for 24-2 as a pre-requisite.FG 24-3 should be a per-band featureFG 24-3 should be split for SA and DC |
| MediaTek Inc. [12] |  |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with X=4 slots FFS: 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements | 24-1 | Yes |  |  | [Per UE/band] |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Component”: According to the agreement in RAN1#107e, the multi slot PDCCH monitoring capability with (X,Y) = (4,1) is mandatory support for 480kHz SCS. So the description for the 2nd component should be updated as “Multiple-slot PDCCH monitoring for 480KHz with (X,Y)=(4,1)”. Considering the reduced monitoring occasion within X slot group, support of multi PDSCH/PUSCH scheduling with single DCI is essential to maintain the peak throughput. We support to remove FFS before the 3rd component.**Proposal: Clarify the 2nd component by defining multiple slot PDCCH monitoring with (X,Y)=(4,1). Support to have multi PDSCH scheduling by single DCI as component of FG24-4.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with X=4 slots 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements | 24-1 | Yes |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] | For multi-PDSCH scheduling and corresponding HARQ enhancements, it is not decided yet whether it is a separate FG or a component of 480/960 kHz support. In our view, there is no critical requirement for multi-PDSCH scheduling even when multi-slot PDCCH monitoring is used for 480/960 kHz. The only drawback is data rate loss brought by multi-slot PDCCH monitoring but the system still works. Therefore, separate optional multi-PDSCH scheduling capability is more flexible. In this way, to enhance data rate further, UE has flexibility to increase PDCCH monitoring complexity with smaller X value or support multi-PDSCH scheduling.**Proposal: List multi-PDSCH scheduling by single DCI as a separate FG from 24-4 and 24-5.** |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | * We believe component 3 should be included as it is. It is an essential feature when the UE supports multi-slot PDCCH monitoring with X=4 for 480 kHz SCS.
* Our preference is to define its Type as per UE, while we would be open to discuss.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with X=4 slots 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements | 24-1 | Yes |  |  | Per UE |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] | For FG 24-4/4a and FG 24-5/5a, they are associated with multi-PDSCH/PUSCH scheduling with 480 kHz and 960 kHz, respectively. Further, according to the approved UE feature list, we can observe that multi-PUSCH scheduling by single DCI is listed as a component for supporting “480 kHz SCS support for UL” in FG 24-4a. However, “multi-PDSCH/PUSCH scheduling by single DCI” is not a component for FG 24-4, 24-5 and 24-5a. During the discussion of PDSCH/PUSCH enhancement for above 52.6 GHz, we have no see any difference between 480kHz and 960 kHz in agreement/conclusion for multi-PDSCH/PUSCH scheduling by single DCI. Therefore, referring to FG 24-4a, multi-PDSCH scheduling by single DCI also should be a component for FG 24-4 and 24-5 and multi -PUSCH scheduling by single DCI also should be a component for FG 24-5a.From the signlling overhead point of view, it is recommended to support multi-PDSCH/PUSCH scheduling by single DCI. But this does not mean that multi-PDSCH/PUSCH scheduling by single DCI must be regarded as a basic function for supporting 480 kHz and 960 kHz SCS DL/UL. Only support single-PDSCH/PUSCH scheduling by single DCI can work for 480 kHz and 960 kHz SCS DL/UL. Therefore, we propose that multi-PDSCH/PUSCH scheduling by single DCI can be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a.**Proposal: Propose “multi-PDSCH/PUSCH scheduling by single DCI” to be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a, that is:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with X=4 slots ~~FFS: 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements~~ | 24-1 |
| 24-4x | Multiple PDSCH scheduling by single DCI for 480 kHz | 1. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS
2. HARQ enhancements
 |  |

In RAN1#107 e-meeting, multi-slot PDCCH monitoring capability is agreed to be supported in FR 2-2. The following agreement was made:* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)

FG24-4, FG 24-4f, FG24-5 and FG24-5f should be modified accordingly. For FG24-2, It should be clearly clarified that only (X,Y) = (4,1) is mandatorily supported for SCS 480 kHz. Besides, optional capability (X,Y) = (4,2) for SCS 480 kHz can be added in FG24-4f while deleting X=[2] slots since there is no agreement on supporting this additional value. Similarly, we need to clarify that only (X,Y) = (8,1) is mandatorily supported for SCS 960 kHz in FG 24-5 while (X,Y) = (8,4), (4,2), (4,1) is optionally supported for SCS 960 kHz in FG 24-5f. **Proposal: According the agreement on multi-slot PDCCH monitoring capability made in RAN1 #107 e-meeting, modify FG24-4, FG 24-4f, FG24-5 and FG24-5f as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with (X,Y) = (4,1) ~~X=4 slots~~ ~~FFS: 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements~~ | 24-1 |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | In the current description, component 4 and component 5 are simultaneously supported under the same FG. This is not friendly to UE implementation in particular if this FG is per UE or per band. We have a strong preference to split these two components to two FGs. **Proposal: Split FG 24-4 component 4 and 5 into two FGs separately.** |
| Intel Corporation [9] | Since a UE capable of multi-slot monitoring mandatorily supports Y=1, The item 2 of FG 24-4 should be updated to reflect the default combination (X, Y), i.e. (4, 1). Further, the restriction on the number/position of spans for group (1) SS could be captured in item 2 too. On the other hand, it is expected certain restriction on the span(s) of group (2) SS will be specified, which is helpful for UE complexity reduction. We provide our views on the group (2) SS in a companion document [2]. FFS point regarding group (2) SS could be added to 24-4 for now. Regarding item 3 of FG 24-4, if multi-PDSCH/PUSCH scheduling is not supported, it is impractical to schedule all DL/UL slots to a UE since it is agreed that only one unicast DL assignment and UL grant can be processed by the UE in a slot group. Therefore, we prefer to include item 3 in 24-4.**Proposal: Updated to reflect RAN1 agreements till now and include necessary FFS points*** Item 2: update to reflect the default combination (X, Y) = (4, 1) and add necessary FFS points for group (2) SS.
* Item 3: Items should be included in 24-4.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with combination (X, Y) = (4, 1) ~~slots~~. For Y=1, support maximum two monitoring occasions in the Y=1 slot with a distance of at least 4 symbols for group (1) SS. For Y>1, support one span in the beginning 3 symbols in each of the Y slots for group (1) SS. FFS group (2) SS. 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements | 24-1 | [Per UE/band] |  | Optional with capability signalling |

 |
| Ericsson [10] | As can be seen above, Component #2 of basic FG 24-4 relates to multi-slot PDCCH monitoring for 480 kHz SCS. The following agreement was made in RAN1#107-e on multi-slot monitoring capability, and the highlighted text is relevant for 480 kHz SCS. Since this text has not been captured in 38.213, it needs to be captured in the appropriate places in the UE feature list with sufficient detail according to the agreement, considering both what is mandatory for the UE to support and what is optional. **Agreement*** For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS
	+ A SS is monitored within Y consecutive slots within a slot group of X slots
	+ The Y consecutive slots can be located anywhere within the slot group of X slots
		- Note: There is no requirement to align the Y consecutive slots across UEs or with slot n0
	+ The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups
	+ BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots
* For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS
	+ SS monitoring locations can be anywhere within a slot group of X slots, with the following exception
		- BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.
* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)
			* Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8
* A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slots
	+ For Y>1: FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)
	+ For 960 kHz SCS For Y=1: FG3-5b with *set1* = (7, 3)
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ The following supersedes FG3-5b and FG3-1 definition:
	+ Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD
	+ Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD

Proposal: Multi-slot PDCCH monitoring capability for 480 kHz SCS is captured for mandatory (Xs,Ys) = (4,1) by updating Component 2 of FG 24-4. Optional (Xs,Ys) = (4,2) is captured in new FG 24-4g. FG 24-4f is removed since there is no correspoinding RAN1 agreement. Support the following changes to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-4 | 480KHz SCS support for DL | 1. 480KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with ~~X=4~~ (Xs,Ys) = (4,1) slots 3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with *set2* = (4, 3) and (7, 3) symbols4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes Component 6 of FG 3-5b) FFS: 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements | 24-1, 3-5b |  | Optional with capability signallingA UE that supports 480 kHz SCS must indicate this FG is supported |
| ~~24-4f~~ | ~~Enhanced PDCCH monitoring for 480KHz~~ | ~~Multiple-slot PDCCH monitoring for 480KHz with X=[2] slots~~ |  |  | ~~Optional with capability signalling~~ |
| 24-4g | Enhanced multi-slot PDCCH monitoring for 480 kHz | 1. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,2) slots2. Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-13. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes the corresponding component of FG 3-1)4. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-1) | 24-4, 3-1 |  | Optional with capability signalling |

Due to the short slot length with 480 kHz SCS, it has been agreed that multi-slot PDCCH monitoring capability is mandatory which means that that the UE will monitor once per 4 slots. Single-slot monitoring is not supported. To compensate the loss in scheduling flexibility, multi-PDSCH/PUSCH scheduling has been agreed in RAN1, and in our view multi-slot PDCCH monitoring and multi-PxSCH scheduling go hand-in-hand. Without these two features together, it will be impossible to sustain high throughput, thus removing one of the main motivations for supporting large SCS in FR2-2. For this reason, we propose that multi-PDSCH scheduling is a component within the basic FG 24-4 and that multi-PUSCH scheduling is a component of FG 24-4a.1. Multi-PDSCH scheduling with single DCI is a component of the FG 24-4 (Basic DL support) for 480 kHz SCS. Multi-PUSCH scheduling with single DCI is a component of FG 24-4a (UL support). Support the following changes to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with X=4 slots ~~FFS:~~ 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements | 24-1 |  | Optional with capability signallingA UE that supports 480 kHz SCS must indicate this FG is supported |

 |
| Apple [11] | FG 24-4 component item 4 should be updated based on agreement in RAN1 #107-e as follows Components: Definition of X : Multi-slot PDCCH monitoring is based on slots within a slot group. Each slot group consists of X consecutive slots. Slot groups are consecutive and non-overlappingDefinition of Y: For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS, a SS is monitored within Y consecutive slots within a slot group of X slots. The Y consecutive slots can be located anywhere within the slot group of X slots. The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups. BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots.For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS: SS monitoring locations can be anywhere within a slot group of X slots, with the following exception. BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.Multiple-slot PDCCH monitoring for 480KHz with (X, Y)= (4,1) slotsFG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot. Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822).Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDDProcessing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDDIn FG 24-4, remove brackets on component item 5 “5. Multi-PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancementsFG 24-4 should be a per-band feature |
| MediaTek Inc. [12] | In RAN1 #107-e meeting, multi-slot PDCCH monitoring framework and the associated UE capability have been agreed. For 480kHz, RAN1 only agreed on supporting (X,Y)=(4,1) as basic UE capability and (X,Y)=(4,2) as advanced UE capability. Therefore, we propose to update the component description of FG 24-4 and FG 24-4f accordingly and remove the support of X=2. Proposal: Update FG24-4 and FG24-4f as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | ~~1. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~2. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access~~3. 480KHz for SSB monitoring [for non-initial access]~~4. Multiple-slot PDCCH monitoring for 480KHz with (X,Y)=(4,1)~~X=[4] slots~~ ~~[FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]~~~~5. PRACH with 480KHz and length 139/[571]~~~~FFS: 6. Support multi-RB PUCCH format 0/1/4 for 480 kHz~~~~FFS: 7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 480 kHz SCS~~[5. Multi-PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements] |  |  |

We suggest to add separated FGs for the enhancements of both multi-PDSCH and multi-PUSCH scheduled by single DCI instead of including those FGs as basic FGs. We also suggest to add the notion of FR2-2 in this FG such that it can be differentiated from the existing multi-PUSCH feature introduced for Rel-16 NR-U and for FR2-1.Proposal: Remove multi-PDSCH scheduling from FG24-4 and add FGs for multi-PDSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-4d | Multiple PDSCH scheduling by single DCI for 480 kHz in FR2-2 | 1. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS
2. HARQ enhancements
 |  | Optional |

 |
| LG Electronics [13] |

|  |  |  |  |
| --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with X=4 slots 3. Multi-PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements |

 |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS |  |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] |  |
| ZTE/Sanechips [6] | For FG 24-4/4a and FG 24-5/5a, they are associated with multi-PDSCH/PUSCH scheduling with 480 kHz and 960 kHz, respectively. Further, according to the approved UE feature list, we can observe that multi-PUSCH scheduling by single DCI is listed as a component for supporting “480 kHz SCS support for UL” in FG 24-4a. However, “multi-PDSCH/PUSCH scheduling by single DCI” is not a component for FG 24-4, 24-5 and 24-5a. During the discussion of PDSCH/PUSCH enhancement for above 52.6 GHz, we have no see any difference between 480kHz and 960 kHz in agreement/conclusion for multi-PDSCH/PUSCH scheduling by single DCI. Therefore, referring to FG 24-4a, multi-PDSCH scheduling by single DCI also should be a component for FG 24-4 and 24-5 and multi -PUSCH scheduling by single DCI also should be a component for FG 24-5a.From the signlling overhead point of view, it is recommended to support multi-PDSCH/PUSCH scheduling by single DCI. But this does not mean that multi-PDSCH/PUSCH scheduling by single DCI must be regarded as a basic function for supporting 480 kHz and 960 kHz SCS DL/UL. Only support single-PDSCH/PUSCH scheduling by single DCI can work for 480 kHz and 960 kHz SCS DL/UL. Therefore, we propose that multi-PDSCH/PUSCH scheduling by single DCI can be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a.**Proposal: Propose “multi-PDSCH/PUSCH scheduling by single DCI” to be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a, that is:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~3. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS~~ |  |
| 24-4a\_x | Multiple PUSCH scheduling by single DCI for 480 kHz | Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS |  |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-4 |  | Optional with capability signalling |

 |
| Apple [11] |  |
| MediaTek Inc. [12] | Proposal: Remove multi-PUSCH scheduling from FG24-4a and FG24-5a and add FGs for multi-PUSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-4e | Multiple PUSCH scheduling by single DCI for 480 kHz in FR2-2 | 1. Multi- PUSCH scheduling by single DCI for the operation with 480 kHz SCS
2. HARQ enhancements
 |  | Optional |

 |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] | Add 24-4 (480kHz DL SCS) as pre-requisite. |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz [with/without shared spectrum channel access] | PRACH with 480KHz and length 571  |  |  |  |  |  |  |  |  | FFS: whether to split this FG for SA and DC[Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH] | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Feature group”: In RAN1#107e, there is different interpretation on the objective to support of wideband PRACH in the WID[2] as copied below. To our understanding, the highlighted text “for operation in shared spectrum” is applied for both PRACH sequence of L=571 and 1151 and non-consecutive RO. In addition, according to RAN1 discussion, the main motivation to introduce longer PRACH sequence is to make full use of UE TX power under the restriction of power spectrum density required by regional unlicensed band regulations. On the other side, concentrating the transmit power in narrower bandwidth by power control mechanism is more efficient than introducing long PRACH sequence in licensed band. So the support of wideband PRACH should only be applied for shared spectrum operation, which is identical in NRU Rel-16. • “Type”: It should be per band and only be applied to band with shared spectrum channel access. • “Mandatory/Optional”: In NRU Rel-16, the support of wideband PRACH (FG10-27) is “Optional with capability signaling”. Considering the similar motivation to introducing such FGs, FG24-1b and 24-4b should be optional with capability signaling. As there might be UE do not support uplink at all, the text of “[A UE that supports FR2-2 must indicate this FG is supported]” is not necessary.**Proposal: The FG24-1b and 24-4b (wideband PRACH) should be per band and only applied with operation in shared spectrum. It is optional with capability signaling and not necessary to be supported for all UE claiming to support FR2-2.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4b | Wideband PRACH for 480 kHz with shared spectrum channel access | PRACH with 480KHz and length 571  |  |  |  |  | Per band |  |  |  | FFS: whether to split this FG for SA and DC[Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH] | Optional with capability signalling |

 |
| vivo [3] | After RAN1#107-e, it is not decided yet applicable spectrum type of the following feature groups, i.e. with/without shared spectrum access. The motivation of wideband PRACH and multi-RB PUCCH is mainly from PSD limitation on unlicensed band. Therefore, there is no need to extend them to licensed band.**Proposal: FG 24-1b, 24-1c, 24-4b and 24-5c are only applicable to the scenarios without shared spectrum access.** |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | * At this moment, we do not see the need to split this FG for SA and DC.
* We do not see the need of the part with bracket in the name. If an FG is applicable only to either licensed or unlicensed band, such restriction can be described in the column of Note, in a similar manner to Rel-16 NR-U UE features.
* It can be noted that a UE that supports SA for 480 kHz SCS in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz | PRACH with 480KHz and length 571  |  |  |  |  |  |  |  |  |  | Optional with capability signallingA UE that supports SA for 480 kHz SCS in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported. |

 |
| ZTE/Sanechips [6] | For PRACH supported in FR 2-2, it is agreed that 120kHz PRACH SCS is supported with sequence length L=139,571, 1151 in RAN1 #104 e-meeting. In addition, according to the revised WID, we can observe that wideband PRACH is not limited to operation with shared spectrum. The revised WID objective is as follows:

|  |
| --- |
| * Physical layer aspects including [RAN1]:
	+ Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum
 |

“operation in shared spectrum” mentioned in the above objective is just to apply to RO configuration for non-consecutive RACH occasions (RO) in time domain, not for PRACH sequence lengths. Consequently, the PRACH sequence lengths part of this objective applies to both operation with/without shared spectrum. With this consideration, we propose to remove wording “[with/without shared spectrum channel access]” from the FG 24-1b if wideband PRACH is supported as a separate feature group.However, from coverage performance point of view, we think that longer sequence has good performance, which is benefit for the coverage in FR2-2. Thus, we have no see any strongly motivation to separate PRACH length = 571 and 1151 with length =139 and propose to merge FG 24-1b into FG 24-1a and FG 24-1 is a prerequisite of FG 24-1a . Note that the same method used for 120kHz PRACH SCS can be applied to 480 kHz PRACH SCS.**Proposal: If FG 24-4b is supported as a separate feature, it is proposed to modify FG 24-4b as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-4b | Wideband PRACH for 480 kHz ~~[with/without shared spectrum channel access]~~ | PRACH with 480KHz and length 571 | 24-4b |

**Proposal: Propose to merge FG 24-4b into FG 24-4a, as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 139/5712. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-4a |
| ~~24-4b~~ | ~~Wideband PRACH for 480 kHz [with/without shared spectrum channel access]~~ | ~~PRACH with 480KHz and length 571~~ | ~~24-4b~~ |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | Similar to FG 24-1c, the wideband PRACH as well as PUCCH design were motivated by the power limitation issue due to PSD limitation. Technically speaking, this limitation is not related to shared channel access. Note that there might be the same that shared channel access is used but there is no PSD limication imposed. Thus, no need for wideband PRACH or PUCCH. **Proposal: For FG 24-4b, FG 24-4c, FG 24-5c, replacing [with/without shared spectrum channel access] with [for region where PSD limitation is imposed].** |
| Intel Corporation [9] |  |
| Ericsson [10] | According to the same logic as presented in Section 2.1.2 for 120 kHz, we propose to not split the wideband PRACH and standalone FGs into separate FGs.Proposal: For the wideband PRACH-related FGs 24-4b do not split this into separate FGs for SA/DC. This FGs should be specified as "Optional with capability signaling." Support the following change to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-4b | Wideband PRACH for 480 kHz [with/without shared spectrum channel access] | PRACH with 480KHz and length 571  |  | ~~FFS: whether to split this FG for SA and DC~~[Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH] | Optional with capability signalling |

For FGs 1b/1c/4b/4c/5 related to wideband PRACH multi-RB PUCCH, the FG names currently include the wording "with/without shared spectrum channel access". These are generic "tools in the toolbox" hence this wording should not be included in the FG name. After further discussion in RAN1, if there is some need to restrict to operation only with shared spectrum channel access, then the above note can be added to the FG. However, we observe that at least for wideband PRACH, the following WID objective [3] does not restrict to operation only with shared spectrum channel access; it applies for both with and without shared spectrum channel access.* Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum

Regarding multi-RB PUCCH, the WID objective is as follows* Support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation.

Which indeed refers to a PSD limitation for operation with shared spectrum channel access; however, there may be PSD limitations even for operation without shared spectrum channel access in FR2-2. Based on the above discussion we propose the following.**Proposal: In the FG name for wideband PRACH and multi-RB PUCCH-related FGs 1b/1c/4b/4c/5, remove the wording "with/without shared spectrum channel access" from the FG name. Later, if there is a need to introduce some restriction, it can be done with the same note as described for the channel access-related FGs. Support the following changes to the FG list:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-4b | Wideband PRACH for 480 kHz ~~[with/without shared spectrum channel access]~~ | PRACH with 480KHz and length 571  |  | FFS: whether to split this FG for SA and DC[Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH] | Optional with capability signalling |

 |
| Apple [11] | FG-24-4b: Split FG into SA and DC. |
| MediaTek Inc. [12] | Whether the FG 24-1b and FG 24-4b should be included as basic FR2-2 UL FGs was discussed in RAN1 #107-e meeting. Some company mentioned that PRACH is a fundamental channel in initial access and supporting such feature as basic functionality is necessary. However, the motivation of introducing such FG is to comply with regulation, which varies based on different regions. Therefore, we prefer to allow UE to have the option on whether to support the FG based on different regulations.Regarding whether FG 24-1b and FG 24-4b should be FGs for shared spectrum only or not, it is not feasible to have the option to support wideband PRACH in shared spectrum but not in licensed spectrum and vice versa. Therefore, we prefer to have a generic FG for wideband PRACH.We also prefer to include FR2-2 in the naming of the FG to distinguish this FG from the one introduced in sub6 NRU.Proposal: Modify FG 24-1b and FG24-4b as follows

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2~~[with/without shared spectrum channel access]~~ | PRACH with 480KHz and length 571  |  |  |

 |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] | Feature can be support with or without shared spectrum channel access. No need to separate the FG though, per band indication is sufficient. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz [with/without shared spectrum channel access] | Support multi-RB PUCCH format 0/1/4 for 480 kHz |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Feature group”: According to the WID, it is clearly stated that such feature is for unlicensed band only as copied below. From technical perspective, the introduction of multi RB is trying to make use of the total TX power under PSD limitation in unlicensed band.• “Type”: They should be per band and only be applied to band with shared spectrum channel access. • “Mandatory/Optional”: In NRU Rel-16, the support of PRB interlace mapping for PUCCH (FG10-3a) is “per band” and “Optional with capability signaling”. Considering the similar motivation to introducing such FG, FG24-1c should also be “per band” and “optional with capability signaling”. As there might be UE do not support uplink at all, the text of “[A UE that supports FR2-2 must indicate this FG is supported]” is not necessary.**Proposal: The FG24-1c, 24-4c and 24-5c should be per band and only be applied with shared spectrum channel access. They should be optional with capability signaling and not necessary to be supported for all UE claiming to support FR2-2.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz with shared spectrum channel access | Support multi-RB PUCCH format 0/1/4 for 480 kHz |  |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | * We do not see the need of the part with bracket in the name. If an FG is applicable only to either licensed or unlicensed band, such restriction can be described in the column of Note, in a similar manner to Rel-16 NR-U UE features.
* It can be noted that a UE that supports SA for 480 kHz SCS in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz  | Support multi-RB PUCCH format 0/1/4 for 480 kHz |  |  |  |  |  |  |  |  |  | Optional with capability signallingA UE that supports SA for 480 kHz SCS in a band with shared spectrum channel access in 52.6 – 71 GHz must indicate this FG is supported. |

 |
| ZTE/Sanechips [6] | According to the revised WID, enhancement for PUCCH format 0/1/4 is limited to operation with shared spectrum irrespective to SCS. The revised WID objective is as follows:

|  |
| --- |
| * Physical layer aspects including [RAN1]:
	+ Support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation
 |

Based on the above objective, we propose to remove “without shared spectrum channel access” related description and yellow highlight and brackets from FG 24-1c, FG 24-4c and FG 24-5c. Preferably, we recommend the following change to the title of FG 24-1c, FG 24-4c and FG 24-5c. Besides, FG 24-1a is a prerequisite of FG 24-1c, so remove brackets and yellow highlight of FG 24-1a.**Proposal: Modify FG 24-1c, FG 24-4c and FG 24-5c as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz for operation with~~/without~~ shared spectrum channel access~~]~~ | Support multi-RB PUCCH format 0/1/4 for 480 kHz |  |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | Similar to FG 24-1c, the wideband PRACH as well as PUCCH design were motivated by the power limitation issue due to PSD limitation. Technically speaking, this limitation is not related to shared channel access. Note that there might be the same that shared channel access is used but there is no PSD limication imposed. Thus, no need for wideband PRACH or PUCCH. **Proposal: For FG 24-4b, FG 24-4c, FG 24-5c, replacing [with/without shared spectrum channel access] with [for region where PSD limitation is imposed].** |
| Intel Corporation [9] |  |
| Ericsson [10] | For FGs 1b/1c/4b/4c/5 related to wideband PRACH multi-RB PUCCH, the FG names currently include the wording "with/without shared spectrum channel access". These are generic "tools in the toolbox" hence this wording should not be included in the FG name. After further discussion in RAN1, if there is some need to restrict to operation only with shared spectrum channel access, then the above note can be added to the FG. However, we observe that at least for wideband PRACH, the following WID objective [3] does not restrict to operation only with shared spectrum channel access; it applies for both with and without shared spectrum channel access.* Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum

Regarding multi-RB PUCCH, the WID objective is as follows* Support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation.

Which indeed refers to a PSD limitation for operation with shared spectrum channel access; however, there may be PSD limitations even for operation without shared spectrum channel access in FR2-2. Based on the above discussion we propose the following.**Proposal: In the FG name for wideband PRACH and multi-RB PUCCH-related FGs 1b/1c/4b/4c/5, remove the wording "with/without shared spectrum channel access" from the FG name. Later, if there is a need to introduce some restriction, it can be done with the same note as described for the channel access-related FGs. Support the following changes to the FG list:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz ~~[with/without shared spectrum channel access]~~ | Support multi-RB PUCCH format 0/1/4 for 480 kHz |  |  | Optional with capability signalling |

 |
| Apple [11] |  |
| MediaTek Inc. [12] | Similar to our comments on wideband PRACH, the multi-RB PUCCH FGs should be considered as optional FGs due to the different regulation requirements in different areas. Proposal: Update FG 24-1c, FG24-4c, and FG24-5c as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | Support multi-RB PUCCH format 0/1/4 for 480 kHz |  | Optional with capability signalling |

 |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] | Feature can be support with or without shared spectrum channel access. No need to separate the FG though, per band indication is sufficient.  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4f | Enhanced PDCCH monitoring for 480KHz | Multiple-slot PDCCH monitoring for 480KHz with X=[2] slots |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Component”: In RAN1#107e, there is no consensus to introduce multi slot PDCCH monitoring capability with slot group of X=2 slots. Instead, Y=2 is supported as optional capability for the slot group of X=4 slots. So the component should be updated.**Proposal: The component of FG24-4f should be changed to support the optional capability with (X,Y)=(4,2)**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4f | Enhanced PDCCH monitoring for 480KHz | Multiple-slot PDCCH monitoring for 480KHz with (X,Y)=(4,2) |  |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | We believe additional agreement in WI would be necessary, otherwise it has to be removed. |
| ZTE/Sanechips [6] | In RAN1#107 e-meeting, multi-slot PDCCH monitoring capability is agreed to be supported in FR 2-2. The following agreement was made:* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)

FG24-4, FG 24-4f, FG24-5 and FG24-5f should be modified accordingly. For FG24-2, It should be clearly clarified that only (X,Y) = (4,1) is mandatorily supported for SCS 480 kHz. Besides, optional capability (X,Y) = (4,2) for SCS 480 kHz can be added in FG24-4f while deleting X=[2] slots since there is no agreement on supporting this additional value. Similarly, we need to clarify that only (X,Y) = (8,1) is mandatorily supported for SCS 960 kHz in FG 24-5 while (X,Y) = (8,4), (4,2), (4,1) is optionally supported for SCS 960 kHz in FG 24-5f. **Proposal: According the agreement on multi-slot PDCCH monitoring capability made in RAN1 #107 e-meeting, modify FG24-4, FG 24-4f, FG24-5 and FG24-5f as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| ~~24-4f~~ | ~~Enhanced PDCCH monitoring for 480KHz~~ | ~~Multiple-slot PDCCH monitoring for 480KHz with X=[2] slots~~ |  |
| 24-4f | Enhanced PDCCH monitoring for 480KHz | Multiple-slot PDCCH monitoring for 480KHz with (X,Y) = (4,2) ~~X=[2] slots~~ |  |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] | X=2 for SCS 480kHz was in bracket in the agreement from RAN1#106bis-e. However, it is not captured in the agreement in RAN1#107-e due to short of GTW meeting time. We still believe it is necessary to support X=2 for SCS 480kHz. As comparison, X=4 for SCS 960kHz was already agreed, which has a duration of slot group equals to half slot of SCS 120kHz. To allow the same flexibility on PDCCH transmission, the same shortened duration of slot group, i.e., X=2 for SCS 480kHz should be supported. If an agreement can not be made in the UE feature session, it is fine to come back to 24-4f after it is concluded in main session. The agreed optional combination (X, Y), i.e., (4, 2) could be captured in 24-4f. **Proposal: Updated to reflect RAN1 agreements till now and include necessary FFS points*** Item 1: revise to capture combination (X, Y) = (2, 1)
* Capture agreed combination (X, Y) = (4, 2)

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| 24-4f | Enhanced PDCCH monitoring for 480KHz | 1. Multiple-slot PDCCH monitoring for 480KHz with combination (X, Y) = (2, 1)~~X=[2] slots~~2. Multiple-slot PDCCH monitoring for 480KHz with combination (X, Y) = (4, 2) | 24-4 |  |  | Optional with capability signalling |

 |
| Ericsson [10] |  |
| Apple [11] | FG 24-4f should be modified based on agreement in RAN1 #107-e as follows FGEnhanced PDCCH monitoring for 480KHz with X = 4 and Y = 2Components: Multiple-slot PDCCH monitoring for 480KHz with (X, Y)= (4,2) slotsFG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)Optional with capability signalingPrerequisite is FG 24-4For PDCCH monitoring the following behavior should be captured:The configurable values for multi-slot PDCCH monitoring operation should be same as the reported X value(s). The UE is not expected to handle a scenario in which they are different, and a UE might report its monitoring capability for more than one (X,Y) combination.For each SCS 480 kHz, the minimum configurable multi-slot PDCCH monitoring periodicity is the smallest value X that a UE supports when reporting its PDCCH monitoring capabilities for the corresponding SCS and are UE specific*.*

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| **Agreement**For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SSA SS is monitored within Y consecutive slots within a slot group of X slotsThe Y consecutive slots can be located anywhere within the slot group of X slotsNote: There is no requirement to align the Y consecutive slots across UEs or with slot n0The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groupsBD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slotsFor Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSSSS monitoring locations can be anywhere within a slot group of X slots, with the following exceptionBD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.Supported combinations of (X,Y)A UE capable of multi-slot monitoring mandatorily supportsFor SCS 480 kHz: (X,Y) = (4,1)For SCS 960 kHz: (X,Y) = (8,1)A UE capable of multi-slot monitoring optionally supportsFor SCS 480 kHz: (X,Y) = (4,2)For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slotsFor Y>1: FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)For 960 kHz SCS For Y=1: FG3-5b with *set1* = (7, 3)[FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot[FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]The following supersedes FG3-5b and FG3-1 definition:Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDDProcessing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD |

 |
| MediaTek Inc. [12] | In RAN1 #107-e meeting, multi-slot PDCCH monitoring framework and the associated UE capability have been agreed. For 480kHz, RAN1 only agreed on supporting (X,Y)=(4,1) as basic UE capability and (X,Y)=(4,2) as advanced UE capability. Therefore, we propose to update the component description of FG 24-4 and FG 24-4f accordingly and remove the support of X=2. Proposal: Update FG24-4 and FG24-4f as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-4f | Enhanced PDCCH monitoring for 480KHz | Multiple-slot PDCCH monitoring for 480KHz with ~~X=[2] slots~~ (X,Y)=(4,2) |  | Optional |

 |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with X=8 slotsFFS: 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1 | Yes |  |  | [Per UE/band] |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Component”: According to the agreement in RAN1#107e, the multi slot PDCCH monitoring capability with (X,Y) = (8,1) is mandatory support for 960kHz SCS. So the description for the 2nd component should be updated as “Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(8,1)”. Considering the reduced monitoring occasion within X slot group, support of multi PDSCH/PUSCH scheduling with single DCI is essential to maintain the peak throughput. We support to remove FFS before the 3rd component.**Proposal: Clarify the 2nd component by defining multiple slot PDCCH monitoring with (X,Y)=(8,1). Support to have multi PDSCH scheduling by single DCI as component of FG24-5.**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with X=8 slots3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1 | Yes |  |  | Per UE |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] | For multi-PDSCH scheduling and corresponding HARQ enhancements, it is not decided yet whether it is a separate FG or a component of 480/960 kHz support. In our view, there is no critical requirement for multi-PDSCH scheduling even when multi-slot PDCCH monitoring is used for 480/960 kHz. The only drawback is data rate loss brought by multi-slot PDCCH monitoring but the system still works. Therefore, separate optional multi-PDSCH scheduling capability is more flexible. In this way, to enhance data rate further, UE has flexibility to increase PDCCH monitoring complexity with smaller X value or support multi-PDSCH scheduling.**Proposal: List multi-PDSCH scheduling by single DCI as a separate FG from 24-4 and 24-5.** |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | We believe they should be defined in the same manner as for FG24-4, except for the aspects related to SA/DC support since no support of SA/DC with 960 kHz SCS was agreed.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with X=8 slots3. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1 | Yes |  |  | Per UE |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] | For FG 24-4/4a and FG 24-5/5a, they are associated with multi-PDSCH/PUSCH scheduling with 480 kHz and 960 kHz, respectively. Further, according to the approved UE feature list, we can observe that multi-PUSCH scheduling by single DCI is listed as a component for supporting “480 kHz SCS support for UL” in FG 24-4a. However, “multi-PDSCH/PUSCH scheduling by single DCI” is not a component for FG 24-4, 24-5 and 24-5a. During the discussion of PDSCH/PUSCH enhancement for above 52.6 GHz, we have no see any difference between 480kHz and 960 kHz in agreement/conclusion for multi-PDSCH/PUSCH scheduling by single DCI. Therefore, referring to FG 24-4a, multi-PDSCH scheduling by single DCI also should be a component for FG 24-4 and 24-5 and multi -PUSCH scheduling by single DCI also should be a component for FG 24-5a.From the signlling overhead point of view, it is recommended to support multi-PDSCH/PUSCH scheduling by single DCI. But this does not mean that multi-PDSCH/PUSCH scheduling by single DCI must be regarded as a basic function for supporting 480 kHz and 960 kHz SCS DL/UL. Only support single-PDSCH/PUSCH scheduling by single DCI can work for 480 kHz and 960 kHz SCS DL/UL. Therefore, we propose that multi-PDSCH/PUSCH scheduling by single DCI can be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a.**Proposal: Propose “multi-PDSCH/PUSCH scheduling by single DCI” to be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a, that is:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with X=8 slots~~FFS: 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements~~ |  |
| 24-5x | Multiple PDSCH scheduling by single DCI for 960 kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS
2. HARQ enhancements
 |  |

In RAN1#107 e-meeting, multi-slot PDCCH monitoring capability is agreed to be supported in FR 2-2. The following agreement was made:* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)

FG24-4, FG 24-4f, FG24-5 and FG24-5f should be modified accordingly. For FG24-2, It should be clearly clarified that only (X,Y) = (4,1) is mandatorily supported for SCS 480 kHz. Besides, optional capability (X,Y) = (4,2) for SCS 480 kHz can be added in FG24-4f while deleting X=[2] slots since there is no agreement on supporting this additional value. Similarly, we need to clarify that only (X,Y) = (8,1) is mandatorily supported for SCS 960 kHz in FG 24-5 while (X,Y) = (8,4), (4,2), (4,1) is optionally supported for SCS 960 kHz in FG 24-5f. **Proposal: According the agreement on multi-slot PDCCH monitoring capability made in RAN1 #107 e-meeting, modify FG24-4, FG 24-4f, FG24-5 and FG24-5f as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (X,Y) = (8,1) ~~X=8 slots~~ |  |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | In the current description, component 4 and component 5 are simultaneously supported under the same FG. This is not friendly to UE implementation in particular if this FG is per UE or per band. We have a strong preference to split these two components to two FGs. **Proposal: Split FG 24-5 component 4 and 5 into two FGs separately.** |
| Intel Corporation [9] | The observation on FG 24-4 generally applies to FG 24-5 too.Since a UE capable of multi-slot monitoring mandatorily supports Y=1, The item 2 of FG 24-4 should be updated to reflect the default combination (X, Y), i.e. (4, 1). Further, the restriction on the number/position of spans for group (1) SS could be captured in item 2 too. On the other hand, it is expected certain restriction on the span(s) of group (2) SS will be specified, which is helpful for UE complexity reduction. We provide our views on the group (2) SS in a companion document [2]. FFS point regarding group (2) SS could be added to 24-4 for now. Regarding item 3 of FG 24-4, if multi-PDSCH/PUSCH scheduling is not supported, it is impractical to schedule all DL/UL slots to a UE since it is agreed that only one unicast DL assignment and UL grant can be processed by the UE in a slot group. Therefore, we prefer to include item 3 in 24-4.**Proposal: Updated to reflect RAN1 agreements till now and include necessary FFS points*** Item 2: update to reflect the default combination (X, Y) = (8, 1) and add necessary FFS points for group (2) SS.
* Item 3: Item 3 should be included in 24-5.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with combination (X, Y) = (8, 1)~~X=8 slots~~. For Y=1, support maximum two monitoring occasions in the Y=1 slot with a distance of at least 7 symbols for group (1) SS. For Y>1, support one span in the beginning 3 symbols in each of the Y slots for group (1) SS. FFS group (2) SS.3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1 | [Per UE/band] |  | Optional with capability signalling |

 |
| Ericsson [10] | As can be seen above, Component #2 of basic FG 24-4 relates to multi-slot PDCCH monitoring for 960 kHz SCS. The following agreement was made in RAN1#107-e on multi-slot monitoring capability, and the highlighted text is relevant for 960 kHz SCS. Since this text has not been captured in 38.213, it needs to be captured in the appropriate places in the UE feature list with sufficient detail according to the agreement, considering both what is mandatory for the UE to support and what is optional. **Agreement*** For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS
	+ A SS is monitored within Y consecutive slots within a slot group of X slots
	+ The Y consecutive slots can be located anywhere within the slot group of X slots
		- Note: There is no requirement to align the Y consecutive slots across UEs or with slot n0
	+ The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups
	+ BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots
* For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS
	+ SS monitoring locations can be anywhere within a slot group of X slots, with the following exception
		- BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.
* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)
			* Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8
* A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slots
	+ For Y>1: FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)
	+ For 960 kHz SCS For Y=1: FG3-5b with *set1* = (7, 3)
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ The following supersedes FG3-5b and FG3-1 definition:
	+ Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD
	+ Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD

Proposal: Multi-slot PDCCH monitoring capability for 960 kHz SCS is captured for mandatory (Xs,Ys) = (8,1) by updating Component 2 of FG 24-5. Optional (Xs,Ys) = (8,4), (4,2) and (4,1) are captured by updating FG 24-5f.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with ~~X=8~~ (Xs,Ys) = (8,1) slots 3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with *set1* = (7, 3) symbols4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes Component 6 of FG 3-5b) FFS: 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1, 3-5b |  | Optional with capability signallingA UE that supports 960 kHz SCS must indicate this FG is supported |
| 24-5f | Enhanced multi-slot PDCCH monitoring for 960KHz | 1. Multiple-slot PDCCH monitoring for 960KHz with ~~X=4 slots~~ (Xs,Ys) = (8,4), (4,2), (4,1) slots2. Within each of the Ys = 1, 2, or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-13. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes the corresponding component of FG 3-1)4. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-1) | 24-5, 3-1 |  | Optional with capability signalling |

For the same reason explained in Section 2.2.4 for 480 kHz SCS, we propose that multi-PDSCH scheduling is a component within the basic FG 24-5 and that multi-PUSCH scheduling is a component of FG 24-5a.Proposal: Multi-PDSCH scheduling with single DCI is a component of the FG 24-5 (Basic DL support) for 960 kHz SCS. Multi-PUSCH scheduling with single DCI is a component of FG 25-5a (UL support). Support the following changes to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with X=8 slots~~FFS:~~ 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1 |  | Optional with capability signallingA UE that supports 960 kHz SCS must indicate this FG is supported |
| 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~[~~3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS~~]~~ | 24-5 |  | Optional with capability signalling |

 |
| Apple [11] | FG 24-5 component item 4 should be updated based on agreement in RAN1 #107-e as follows Components: Definition of X : Multi-slot PDCCH monitoring is based on slots within a slot group. Each slot group consists of X consecutive slots. Slot groups are consecutive and non-overlappingDefinition of Y: For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS, a SS is monitored within Y consecutive slots within a slot group of X slots. The Y consecutive slots can be located anywhere within the slot group of X slots. The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups. BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots.For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS: SS monitoring locations can be anywhere within a slot group of X slots, with the following exception. BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.Multiple-slot PDCCH monitoring for 960KHz with (X, Y)= (8,1) slotsFG3-5b with *set1* = (7, 3). Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDDProcessing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDDIn FG 24-5, remove brackets on item 5 “5. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements”.FG 24-5 should be a per-band feature. |
| MediaTek Inc. [12] | Similar to 480Hz, we propose to update the component description of FG 24-5 and FG24-5f accordingly based on the agreement made in RAN1 #107-e meeting. Proposal: Update FG24-5 and FG 24-5f as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | ~~1. 960KHz SCS for UL data and control channels and reference signal transmission in FR202~~2. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access~~3. 960KHz for SSB monitoring~~4. Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(8,1) ~~X=[8] slots~~ ~~[FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]~~~~5. PRACH with 960KHz and length 139~~~~FFS: 6. Support multi-RB PUCCH format 0/1/4 for 960 kHz~~~~FFS: 7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 960 kHz SCS~~[5. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements] |  |  |

We suggest to add separated FGs for the enhancements of both multi-PDSCH and multi-PUSCH scheduled by single DCI instead of including those FGs as basic FGs. We also suggest to add the notion of FR2-2 in this FG such that it can be differentiated from the existing multi-PUSCH feature introduced for Rel-16 NR-U and for FR2-1.Proposal: Remove multi-PDSCH scheduling from FG24-5 and add FGs for multi-PDSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-5d | Multiple PDSCH scheduling by single DCI for 960 kHz in FR2-2 | 1. Multi- PDSCH scheduling by single DCI for the operation with 960 kHz SCS
2. HARQ enhancements
 |  | Optional |

 |
| LG Electronics [13] |

|  |  |  |  |
| --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with X=8 slots3. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements |

 |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2[3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS] |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | “Component”: Considering the reduced monitoring occasion within X slot group, support of multi PUSCH scheduling with single DCI is essential to maintain the peak throughput. We support to remove bracket on the 3rd component.**Proposal: Support to have multi PUSCH scheduling by single DCI as component of FG24-5a.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS |  |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | We believe they should be defined in the same manner as for FG24-4, except for the aspects related to SA/DC support since no support of SA/DC with 960 kHz SCS was agreed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] | For FG 24-4/4a and FG 24-5/5a, they are associated with multi-PDSCH/PUSCH scheduling with 480 kHz and 960 kHz, respectively. Further, according to the approved UE feature list, we can observe that multi-PUSCH scheduling by single DCI is listed as a component for supporting “480 kHz SCS support for UL” in FG 24-4a. However, “multi-PDSCH/PUSCH scheduling by single DCI” is not a component for FG 24-4, 24-5 and 24-5a. During the discussion of PDSCH/PUSCH enhancement for above 52.6 GHz, we have no see any difference between 480kHz and 960 kHz in agreement/conclusion for multi-PDSCH/PUSCH scheduling by single DCI. Therefore, referring to FG 24-4a, multi-PDSCH scheduling by single DCI also should be a component for FG 24-4 and 24-5 and multi -PUSCH scheduling by single DCI also should be a component for FG 24-5a.From the signlling overhead point of view, it is recommended to support multi-PDSCH/PUSCH scheduling by single DCI. But this does not mean that multi-PDSCH/PUSCH scheduling by single DCI must be regarded as a basic function for supporting 480 kHz and 960 kHz SCS DL/UL. Only support single-PDSCH/PUSCH scheduling by single DCI can work for 480 kHz and 960 kHz SCS DL/UL. Therefore, we propose that multi-PDSCH/PUSCH scheduling by single DCI can be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a.**Proposal: Propose “multi-PDSCH/PUSCH scheduling by single DCI” to be a separate FG apart from FG 24-4, 24-4a, 24-5 and 24-5a, that is:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~[3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS]~~ |  |
| 24-5a\_x | Multiple PUSCH scheduling by single DCI for 960 kHz | Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS |  |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] | For the same reason explained in Section 2.2.4 for 480 kHz SCS, we propose that multi-PDSCH scheduling is a component within the basic FG 24-5 and that multi-PUSCH scheduling is a component of FG 24-5a.Proposal: Multi-PDSCH scheduling with single DCI is a component of the FG 24-5 (Basic DL support) for 960 kHz SCS. Multi-PUSCH scheduling with single DCI is a component of FG 25-5a (UL support). Support the following changes to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with X=8 slots~~FFS:~~ 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1 |  | Optional with capability signallingA UE that supports 960 kHz SCS must indicate this FG is supported |
| 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~[~~3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS~~]~~ | 24-5 |  | Optional with capability signalling |

 |
| Apple [11] | In FG 24-5a, the brackets should be removed on “[3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS]” |
| MediaTek Inc. [12] | Proposal: Remove multi-PUSCH scheduling from FG24-4a and FG24-5a and add FGs for multi-PUSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-5e | Multiple PUSCH scheduling by single DCI for 960 kHz in FR2-2 | 1. Multi- PUSCH scheduling by single DCI for the operation with 960 kHz SCS
2. HARQ enhancements
 |  | Optional |

 |
| LG Electronics [13] |

|  |  |  |  |
| --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS |

 |
| Nokia/Nokia Shanghai Bell [14] | Add 24-5 (960kHz DL SCS) as pre-requisite. |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz [with/without shared spectrum channel access] | Support multi-RB PUCCH format 0/1/4 for 960 kHz |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Feature group”: According to the WID, it is clearly stated that such feature is for unlicensed band only as copied below. From technical perspective, the introduction of multi RB is trying to make use of the total TX power under PSD limitation in unlicensed band.• “Type”: They should be per band and only be applied to band with shared spectrum channel access. • “Mandatory/Optional”: In NRU Rel-16, the support of PRB interlace mapping for PUCCH (FG10-3a) is “per band” and “Optional with capability signaling”. Considering the similar motivation to introducing such FG, FG24-1c should also be “per band” and “optional with capability signaling”. As there might be UE do not support uplink at all, the text of “[A UE that supports FR2-2 must indicate this FG is supported]” is not necessary.**Proposal: The FG24-1c, 24-4c and 24-5c should be per band and only be applied with shared spectrum channel access. They should be optional with capability signaling and not necessary to be supported for all UE claiming to support FR2-2.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz with shared spectrum channel access | Support multi-RB PUCCH format 0/1/4 for 960 kHz |  |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] | After RAN1#107-e, it is not decided yet applicable spectrum type of the following feature groups, i.e. with/without shared spectrum access. The motivation of wideband PRACH and multi-RB PUCCH is mainly from PSD limitation on unlicensed band. Therefore, there is no need to extend them to licensed band.**Proposal: FG 24-1b, 24-1c, 24-4b and 24-5c are only applicable to the scenarios without shared spectrum access.** |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | We believe they should be defined in the same manner as for FG24-4, except for the aspects related to SA/DC support since no support of SA/DC with 960 kHz SCS was agreed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz  | Support multi-RB PUCCH format 0/1/4 for 960 kHz |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] | According to the revised WID, enhancement for PUCCH format 0/1/4 is limited to operation with shared spectrum irrespective to SCS. The revised WID objective is as follows:

|  |
| --- |
| * Physical layer aspects including [RAN1]:
	+ Support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation
 |

Based on the above objective, we propose to remove “without shared spectrum channel access” related description and yellow highlight and brackets from FG 24-1c, FG 24-4c and FG 24-5c. Preferably, we recommend the following change to the title of FG 24-1c, FG 24-4c and FG 24-5c. Besides, FG 24-1a is a prerequisite of FG 24-1c, so remove brackets and yellow highlight of FG 24-1a.**Proposal: Modify FG 24-1c, FG 24-4c and FG 24-5c as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz for operation with~~/without~~ shared spectrum channel access~~]~~ | Support multi-RB PUCCH format 0/1/4 for 960 kHz |  |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | Similar to FG 24-1c, the wideband PRACH as well as PUCCH design were motivated by the power limitation issue due to PSD limitation. Technically speaking, this limitation is not related to shared channel access. Note that there might be the same that shared channel access is used but there is no PSD limication imposed. Thus, no need for wideband PRACH or PUCCH. **Proposal: For FG 24-4b, FG 24-4c, FG 24-5c, replacing [with/without shared spectrum channel access] with [for region where PSD limitation is imposed].** |
| Intel Corporation [9] |  |
| Ericsson [10] | For FGs 1b/1c/4b/4c/5 related to wideband PRACH multi-RB PUCCH, the FG names currently include the wording "with/without shared spectrum channel access". These are generic "tools in the toolbox" hence this wording should not be included in the FG name. After further discussion in RAN1, if there is some need to restrict to operation only with shared spectrum channel access, then the above note can be added to the FG. However, we observe that at least for wideband PRACH, the following WID objective [3] does not restrict to operation only with shared spectrum channel access; it applies for both with and without shared spectrum channel access.* Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum

Regarding multi-RB PUCCH, the WID objective is as follows* Support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation.

Which indeed refers to a PSD limitation for operation with shared spectrum channel access; however, there may be PSD limitations even for operation without shared spectrum channel access in FR2-2. Based on the above discussion we propose the following.**Proposal: In the FG name for wideband PRACH and multi-RB PUCCH-related FGs 1b/1c/4b/4c/5, remove the wording "with/without shared spectrum channel access" from the FG name. Later, if there is a need to introduce some restriction, it can be done with the same note as described for the channel access-related FGs. Support the following changes to the FG list:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz ~~[with/without shared spectrum channel access]~~ | Support multi-RB PUCCH format 0/1/4 for 960 kHz |  |  | Optional with capability signalling |

 |
| Apple [11] |  |
| MediaTek Inc. [12] | Similar to our comments on wideband PRACH, the multi-RB PUCCH FGs should be considered as optional FGs due to the different regulation requirements in different areas. Proposal: Update FG 24-1c, FG24-4c, and FG24-5c as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | Support multi-RB PUCCH format 0/1/4 for 960 kHz |  | Optional with capability signalling |

 |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] | Feature can be support with or without shared spectrum channel access. No need to separate the FG though, per band indication is sufficient. |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5f | Enhanced PDCCH monitoring for 960KHz | Multiple-slot PDCCH monitoring for 960KHz with X=4 slots |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | • “Component”: In RAN1#107e, multi-slot PDCCH monitoring capability with (X,Y)= (8,4), (4,2), (4,1) are supported as optional capabilities. So the components should be updated.**Proposal: The component of FG24-5f should be updated to support the optional capability with (X,Y)= (8,4), (4,2), (4,1).**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-5f | Enhanced PDCCH monitoring for 960KHz | Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(8,4), (4,2),(4,1) |  |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] |  |
| ZTE/Sanechips [6] | In RAN1#107 e-meeting, multi-slot PDCCH monitoring capability is agreed to be supported in FR 2-2. The following agreement was made:* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)

FG24-4, FG 24-4f, FG24-5 and FG24-5f should be modified accordingly. For FG24-2, It should be clearly clarified that only (X,Y) = (4,1) is mandatorily supported for SCS 480 kHz. Besides, optional capability (X,Y) = (4,2) for SCS 480 kHz can be added in FG24-4f while deleting X=[2] slots since there is no agreement on supporting this additional value. Similarly, we need to clarify that only (X,Y) = (8,1) is mandatorily supported for SCS 960 kHz in FG 24-5 while (X,Y) = (8,4), (4,2), (4,1) is optionally supported for SCS 960 kHz in FG 24-5f. **Proposal: According the agreement on multi-slot PDCCH monitoring capability made in RAN1 #107 e-meeting, modify FG24-4, FG 24-4f, FG24-5 and FG24-5f as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-5f | Enhanced PDCCH monitoring for 960KHz | Multiple-slot PDCCH monitoring for 960KHz with (X,Y) = (8,4), (4,2), (4,1) ~~X=4 slots~~ |  |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] | The agreed optional combination (X, Y), i.e., (8, 4), (4, 2), (4, 1) could be captured in 24-4f. **Proposal: Updated to reflect RAN1 agreements till now and include necessary FFS points*** Capture agreed combination (X, Y) = (8, 4), (4, 2), (4, 1)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-5f | Enhanced PDCCH monitoring for 960KHz | Multiple-slot PDCCH monitoring for 960KHz with combination (X, Y) = (8, 4), (4, 2), (4, 1)~~X=4 slots~~ | 24-5 |  |  | Optional with capability signalling |

 |
| Ericsson [10] | As can be seen above, Component #2 of basic FG 24-4 relates to multi-slot PDCCH monitoring for 960 kHz SCS. The following agreement was made in RAN1#107-e on multi-slot monitoring capability, and the highlighted text is relevant for 960 kHz SCS. Since this text has not been captured in 38.213, it needs to be captured in the appropriate places in the UE feature list with sufficient detail according to the agreement, considering both what is mandatory for the UE to support and what is optional. **Agreement*** For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS
	+ A SS is monitored within Y consecutive slots within a slot group of X slots
	+ The Y consecutive slots can be located anywhere within the slot group of X slots
		- Note: There is no requirement to align the Y consecutive slots across UEs or with slot n0
	+ The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups
	+ BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots
* For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS
	+ SS monitoring locations can be anywhere within a slot group of X slots, with the following exception
		- BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.
* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)
			* Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8
* A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slots
	+ For Y>1: FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)
	+ For 960 kHz SCS For Y=1: FG3-5b with *set1* = (7, 3)
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ The following supersedes FG3-5b and FG3-1 definition:
	+ Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD
	+ Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD

Proposal: Multi-slot PDCCH monitoring capability for 960 kHz SCS is captured for mandatory (Xs,Ys) = (8,1) by updating Component 2 of FG 24-5. Optional (Xs,Ys) = (8,4), (4,2) and (4,1) are captured by updating FG 24-5f.

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with ~~X=8~~ (Xs,Ys) = (8,1) slots 3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with *set1* = (7, 3) symbols4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes Component 6 of FG 3-5b) FFS: 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1, 3-5b |  | Optional with capability signallingA UE that supports 960 kHz SCS must indicate this FG is supported |
| 24-5f | Enhanced multi-slot PDCCH monitoring for 960KHz | 1. Multiple-slot PDCCH monitoring for 960KHz with ~~X=4 slots~~ (Xs,Ys) = (8,4), (4,2), (4,1) slots2. Within each of the Ys = 1, 2, or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-13. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes the corresponding component of FG 3-1)4. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-1) | 24-5, 3-1 |  | Optional with capability signalling |

 |
| Apple [11] | FG 24-4f should be modified based on agreement in RAN1 #107-e as follows FGEnhanced PDCCH monitoring for 960KHzComponents: Multiple-slot PDCCH monitoring for 960 KHz with X = 8 or 4 and Y = 4, 2 or 1.FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)Optional with capability signalingCandidate value set for (X, Y): {(8,4), (4,2), (4,1)}Prerequisite is FG 24-5For PDCCH monitoring the following behavior should be captured:The configurable values for multi-slot PDCCH monitoring operation should be same as the reported X value(s). The UE is not expected to handle a scenario in which they are different, and a UE might report its monitoring capability for more than one (X,Y) combination.For each SCS 960 kHz, the minimum configurable multi-slot PDCCH monitoring periodicity is the smallest value X that a UE supports when reporting its PDCCH monitoring capabilities for the corresponding SCS and are UE specific*.* |
| MediaTek Inc. [12] | Similar to 480Hz, we propose to update the component description of FG 24-5 and FG24-5f accordingly based on the agreement made in RAN1 #107-e meeting. Proposal: Update FG24-5 and FG 24-5f as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-5f | Enhanced PDCCH monitoring for 960KHz | Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(8,4)~~X=4 slots~~ |  | Optional |

 |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-6 | Support [Type 1] channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support [Type 1] channel access procedure
2. [Support LBT performed per carrier/BWP bandwidth]
 | 24-1 |  |  |  | per band |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

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| Company | Summary |
| Huawei/HiSilicon [2] |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-6 | Support [Type 1] channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support [Type 1] channel access procedure

[Support LBT performed per carrier/BWP bandwidth] | 24-1 |  |  |  | per band |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | * For the exact numbering of channel access type, we think the current draft is aligned with the text in 37.213. Therefore, their brackets can be removed.
* For the text with bracket in the last column, we are ok with having them as they are. Thus, their brackets can be removed.
* For the text “[Support LBT performed per carrier/BWP bandwidth]”, our understanding is that the word “carrier” can be removed now. Moreover, we do not see the reason why it is included only in FG24-6, not in FG24-7. To have an alignment on this point, we suggest adding the text in FG24-7 as well.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-6 | Support Type 1 channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support Type 1 channel access procedure
2. Support LBT performed per BWP bandwidth
 | 24-1 |  |  |  | per band |  |  |  |  | Optional with capability signallingA UE that supports FR2-2 must indicate this FG is supported when required by regulation |

 |
| ZTE/Sanechips [6] | In RAN1#106bis e-meeting, the following agreement on CWs adjustment was achieved, it means that Cat3 LBT is supported for above 52.6GHz, not Cat4 LBT. Further, the fixed CW size was also determined in RAN1 #107 e-meeting. Based on this, we can confirm that LBT supported in FR2-2 is a random back-off mechanism with fixed contention window and it is remarked as Type 1 channel access procedure as described in TS 37.213. Hence, we propose to remove yellow highlight and brackets for “Type 1”.

|  |
| --- |
| Conclusion(RAN1#106bis e-meeting):There is no consensus to introduce CWS Adjustment for unlicensed operation in FR2-2Conclusion(RAN1#106bis e-meeting):There is no consensus to introduce CAPC for unlicensed operation in FR2-2Agreement(RAN1 #107 e-meeting):For Type 1 channel access, $N\_{init}$ is a random number uniformly distributed between 0 and CW=3* By implementation, a node may choose a larger number for counter N than $N\_{init}$
 |

Regarding LBT bandwidth, from RAN1 point of view, it seems to correspond to BWP bandwidth due to RAN1 has no the term “channel/carrier bandwidth”. So, we think it is reasonable and obvious to perform LBT over the active BWP for UE side. In this regard, we propose to remove “carrier” for supporting LBT bandwidth and brackets in component 1.**Proposal:** **Modify FG24-6 as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-6 | Support ~~[~~Type 1~~]~~ channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support ~~[~~Type 1~~]~~ channel access procedure
2. ~~[~~Support LBT performed per ~~carrier/~~BWP bandwidth~~]~~
 | 24-1 |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | The terminology of either unlicensed operation or shared spectrum channel access should be unified. We suggest that we can unify them to shared spectrum channel access. **Proposal: For FG 24-6 and FG 24-7, replacing unlicensed operation with shared spectrum channel access to have a unified terminology.**Moreover, for FG 24-6, it is still not clear with LBT performed per carrier, which is not used in any of the RAN1 specification. In TS37.213, the definition of LBT bandwidth is ‘channel’, which from RAN1 definition and from UE perspective, it should be reflected by active BWP bandwidth. Thus, in this meeting, we hope this could be further clarified. From our knowledge, relevant discussion was arranged in the AI 8.2.6 in RAN1#107-e meeting and we can wait for the discussion outcome from AI 8.2.6 from RAN1#107bis-e to decide whether updates are needed. **Proposal: for FG 24-6, the component 2 should keep per BWP bandwidth and remove per carrier, which is not clear from UE perspective or further clarification on channel bandwidth can be discussed in this meeting.**  |
| Intel Corporation [9] |  |
| Ericsson [10] | In Rel-16 NR-U, some features were supported only for operation with shared spectrum channel access, while others were supported also for licensed operation (operation without shared spectrum channel access). For Rel-16, the way that this was handled was that the default FG definition was for both with/without shared spectrum channel access, but if a FG was to be restricted for operation only with shared spectrum channel access, then the following was added to the "Note" column in the UE feature list (see for example, FG 10-3a in 38.822 [2] corresponding to interlace mapping for PUCCH).

|  |
| --- |
| **Note** |
| The signaling is per band but is only expected for a band where shared spectrum channel access must be used |

We observe that the same practice is being used in Rel-17 for the NR\_IIOT\_URLLC\_enh WI (see for example, FG 25-12 and 25-13 in the Rel-17 UE feature list [1]).For consistency, we think the same practice should be used for this WI if there are features to be restricted to operation only with shared spectrum channel access. This implies that for the channel access-related FGs 24-6 and 24-7, the above Note should be added. In addition, FGs 24-6 and 24-7 are for uplink channel access procedures, hence the pre-requisite FGs should be 24-1a (UL support), not FG 24-1 which applies to DL.Proposal: For FGs applicable to operation only with shared spectrum channel access, follow the same practice as in Rel-16 NR-U and Rel-17 URLLC enhancements and add the note "The signaling is per band but is only expected for a band where shared spectrum channel access must be used." Support the following changes to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-6 | Support [Type 1] channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support [Type 1] channel access procedure
2. [Support LBT performed per carrier/BWP bandwidth]
 | 24-1a | The signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

 |
| Apple [11] | In FG 24-6, we are fine with removing the brackets around Type 1In the FG 24-6 components, we can remove the brackets around “[Support LBT performed per carrier/BWP bandwidth]” based on the following agreement:*Agreement:**For LBT for single carrier transmission, gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth)*Note that to make it match the agreement, we could modify the text as follows: “[Support LBT performed per carrier [ ~~/~~ ] or BWP bandwidth]” |
| MediaTek Inc. [12] |  |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-7 | Support [Type 2] channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support [Type 2] channel access procedure | 24-1, 24-6 |  |  |  | per band |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-7 | Support [Type 2] channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support [Type 2] channel access procedure | 24-1, 24-6 |  |  |  | per band |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | * For the exact numbering of channel access type, we think the current draft is aligned with the text in 37.213. Therefore, their brackets can be removed.
* For the text with bracket in the last column, we are ok with having them as they are. Thus, their brackets can be removed.
* For the text “[Support LBT performed per carrier/BWP bandwidth]”, our understanding is that the word “carrier” can be removed now. Moreover, we do not see the reason why it is included only in FG24-6, not in FG24-7. To have an alignment on this point, we suggest adding the text in FG24-7 as well.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-7 | Support Type 2 channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support Type 2 channel access procedure
2. Support LBT performed per BWP bandwidth
 | 24-1, 24-6 |  |  |  | per band |  |  |  |  | Optional with capability signallingA UE that supports FR2-2 must indicate this FG is supported when required by regulation |

 |
| ZTE/Sanechips [6] | So far, it was only agreed that Cat2 LBT can be supported for the responding device of COT sharing. But there is still no conclusion on whether other use cases can use Cat2 LBT. Wherein, Cat 2 LBT is also known as Type 2 channel access procedure as described in TS 37.213. Hence, for COT sharing case, we propose to remove yellow highlight and brackets for “Type 2 in FG 24-7.**Proposal: Modify FG24-7 as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-7 | Support ~~[~~Type 2~~]~~ channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support ~~[~~Type 2~~]~~ channel access procedure | 24-1, 24-6 |

 |
| Qualcomm Incorporated [7] |  |
| OPPO [8] | The terminology of either unlicensed operation or shared spectrum channel access should be unified. We suggest that we can unify them to shared spectrum channel access. **Proposal: For FG 24-6 and FG 24-7, replacing unlicensed operation with shared spectrum channel access to have a unified terminology.**  |
| Intel Corporation [9] |  |
| Ericsson [10] | In Rel-16 NR-U, some features were supported only for operation with shared spectrum channel access, while others were supported also for licensed operation (operation without shared spectrum channel access). For Rel-16, the way that this was handled was that the default FG definition was for both with/without shared spectrum channel access, but if a FG was to be restricted for operation only with shared spectrum channel access, then the following was added to the "Note" column in the UE feature list (see for example, FG 10-3a in 38.822 [2] corresponding to interlace mapping for PUCCH).

|  |
| --- |
| **Note** |
| The signaling is per band but is only expected for a band where shared spectrum channel access must be used |

We observe that the same practice is being used in Rel-17 for the NR\_IIOT\_URLLC\_enh WI (see for example, FG 25-12 and 25-13 in the Rel-17 UE feature list [1]).For consistency, we think the same practice should be used for this WI if there are features to be restricted to operation only with shared spectrum channel access. This implies that for the channel access-related FGs 24-6 and 24-7, the above Note should be added. In addition, FGs 24-6 and 24-7 are for uplink channel access procedures, hence the pre-requisite FGs should be 24-1a (UL support), not FG 24-1 which applies to DL.Proposal: For FGs applicable to operation only with shared spectrum channel access, follow the same practice as in Rel-16 NR-U and Rel-17 URLLC enhancements and add the note "The signaling is per band but is only expected for a band where shared spectrum channel access must be used." Support the following changes to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-7 | Support [Type 2] channel access procedure in uplink for FR2-2 unlicensed operation | 1. Support [Type 2] channel access procedure | 24-1a, 24-6 | The signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

 |
| Apple [11] | In FG 24-7, we are fine with removing the brackets around Type 2 in the |
| MediaTek Inc. [12] |  |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 480/960 kHz |  |  |  |  | [Per UE/per FSPC/per band] |  |  |  | FFS: 120 kHz | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107e, whether 32 HARQ processes are supported for 120 kHz has been discussed in the email thread of [107-e-NR-52-71GHz-06]. Based on the feedback, 7 companies supported the proposal 3.6 while 4 companies did not see the necessity. The reason from opposing companies is that the additional 16 HARQ processes is not necessary for 120 kHz SCS because the existing design for FR2-1 works well. In Rel-17, the multi PDSCH/PUSCH scheduling by single DCI is introduced for 120 kHz SCS as well and the timeline for HARQ-ACK feedback is based on the last scheduled PDSCH/PUSCH. The starvation of HARQ processes occurring in 480 kHz and 960 kHz SCS also applies to 120 kHz SCS. Moreover, as mentioned by some companies in the email discussion, if there are different number of HARQ processes for different SCS, the solution to soft combining during switching of BWP with different SCS is not clear. So we support to extend the capability of 32 HARQ processes to 120 kHz SCS. The support of 32 HARQ processes was also introduced in NTN WI (FG26-5) for NTN cell in FR1 and FR2-1. It is under discussion under NTN UE feature whether such capability can be extended to other non-NTN cell. The answer should obviously be yes since it was also agreed to support 32 HARQ processes for FR2-2 as part of this WI. Moreover, if the support of multiple PDSCH/PUSCH scheduling by single DCI is extended to bands outside of FR2-2, as in NRU Rel-16, the support of 32 HARQ processes should be extended together to avoid HARQ processing starvation. So we think the FG26-5 discussed in NTN WI can be applied to all numerologies in both FR1 and FR2. The FG24-8 and FG24-9 are overlapping with FG26-5. Observation: FG24-8 and FG24-9 are overlapping with FG26-5 (Increasing the number of HARQ processes) discussed in NTN WI. The FG26-5 could be reported “per band” and defined independently of the numerologies and the feature (i.e. not limited to NTN or 60 GHz, etc.).

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-8 | 32 DL HARQ processes for FR 2-2 | 1. Support 32 HARQ processes in DL for 480/960 kHz1. Support 32 HARQ processes in DL for 120kHz
 |  |  |  |  | per band |  |  |  | FFS: 120 kHz | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] | It was agreed to support 32 DL and UL HARQ processes, using same solution as in NTN, but for UE features, the FGs of supporting 32 DL and UL HARQ processes should be separate from the corresponding FGs for NTN, since the type of UE to support those FGs can be different. Also, when the agreement was made, the motivation is clearly for 480 and 960 kHz SCSs only, to address the enlarged number of transmissions due to shorter slot duration, so the discussion should not be repeated for 120 kHz in the UE feature discussion. Lastly, the supporting of FG 24-8 and 24-9 should be per FSPC. **Proposal: For FG 24-8 and FG 24-9:****• Keep the FGs separately from supporting 32 HARQ processes in NTN;****• Remove “FFS: 120 kHz” in the two FGs;****• “Type” of the FGs are per FSPC.** |
| NTT DOCOMO, INC. [5] | * For Type, we think it should be per UE or per band, and do not see why it needs to be per FSPC. Our preference is per UE.
* For FFSs in the second last column, we think it could be removed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 480/960 kHz |  |  |  |  | Per UE |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] |  |
| Apple [11] | FG 24-8: the signaling is per band but is only expected for a band where shared spectrum channel access must be used (similar to FG 10-1 for NR-U in 38.822). |
| MediaTek Inc. [12] |  |
| LG Electronics [13] | For FGs 24-8 and 24-9, there is one FFS point regarding whether to support 32 DL/UL HARQ processes for 120 kHz SCS based on the following agreement.

|  |
| --- |
| Agreement:For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.* Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.
* Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.
 |

As discussed in our companion paper [2], in order to avoid additional potential issues (e.g., type-3 HARQ-ACK codebook generation or DCI field for HARQ process index indication), we suggest to allow 32 maximum HARQ processes also for 120 kHz SCS in FR2-2, which seems to be a simple extension and UE capable of 32 HARQ processes for 480/960 kHz SCS would be capable of 32 HARQ processes for 120 kHz SCS as well.**Proposal: For 120 kHz SCS (in addition to 480/960 kHz), support 32 as the maximum number of HARQ processes for DL and UL, and update FGs 24-8 and 24-9 as follows.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Note** |
| 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 |  |

 |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 480/960 kHz |  |  |  |  | [Per UE/per FSPC/per band] |  |  |  | FFS: 120 kHz | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] | In RAN1#107e, whether 32 HARQ processes are supported for 120 kHz has been discussed in the email thread of [107-e-NR-52-71GHz-06]. Based on the feedback, 7 companies supported the proposal 3.6 while 4 companies did not see the necessity. The reason from opposing companies is that the additional 16 HARQ processes is not necessary for 120 kHz SCS because the existing design for FR2-1 works well. In Rel-17, the multi PDSCH/PUSCH scheduling by single DCI is introduced for 120 kHz SCS as well and the timeline for HARQ-ACK feedback is based on the last scheduled PDSCH/PUSCH. The starvation of HARQ processes occurring in 480 kHz and 960 kHz SCS also applies to 120 kHz SCS. Moreover, as mentioned by some companies in the email discussion, if there are different number of HARQ processes for different SCS, the solution to soft combining during switching of BWP with different SCS is not clear. So we support to extend the capability of 32 HARQ processes to 120 kHz SCS. The support of 32 HARQ processes was also introduced in NTN WI (FG26-5) for NTN cell in FR1 and FR2-1. It is under discussion under NTN UE feature whether such capability can be extended to other non-NTN cell. The answer should obviously be yes since it was also agreed to support 32 HARQ processes for FR2-2 as part of this WI. Moreover, if the support of multiple PDSCH/PUSCH scheduling by single DCI is extended to bands outside of FR2-2, as in NRU Rel-16, the support of 32 HARQ processes should be extended together to avoid HARQ processing starvation. So we think the FG26-5 discussed in NTN WI can be applied to all numerologies in both FR1 and FR2. The FG24-8 and FG24-9 are overlapping with FG26-5. Observation: FG24-8 and FG24-9 are overlapping with FG26-5 (Increasing the number of HARQ processes) discussed in NTN WI. The FG26-5 could be reported “per band” and defined independently of the numerologies and the feature (i.e. not limited to NTN or 60 GHz, etc.).

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-9 | 32 UL HARQ processes for FR 2-2 | 1． Support 32 HARQ processes in UL for 480/960 kHz2. Support 32 HARQ processes in UL for120 kHz |  |  |  |  | per band |  |  |  | FFS: 120 kHz | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] | It was agreed to support 32 DL and UL HARQ processes, using same solution as in NTN, but for UE features, the FGs of supporting 32 DL and UL HARQ processes should be separate from the corresponding FGs for NTN, since the type of UE to support those FGs can be different. Also, when the agreement was made, the motivation is clearly for 480 and 960 kHz SCSs only, to address the enlarged number of transmissions due to shorter slot duration, so the discussion should not be repeated for 120 kHz in the UE feature discussion. Lastly, the supporting of FG 24-8 and 24-9 should be per FSPC. **Proposal: For FG 24-8 and FG 24-9:****• Keep the FGs separately from supporting 32 HARQ processes in NTN;****• Remove “FFS: 120 kHz” in the two FGs;****• “Type” of the FGs are per FSPC.** |
| NTT DOCOMO, INC. [5] | * For Type, we think it should be per UE or per band, and do not see why it needs to be per FSPC. Our preference is per UE.
* For FFSs in the second last column, we think it could be removed.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 480/960 kHz |  |  |  |  | Per UE |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] |  |
| Apple [11] | FG 24-9: the signaling is per band but is only expected for a band where shared spectrum channel access must be used (similar to FG 10-1 for NR-U in 38.822) |
| MediaTek Inc. [12] |  |
| LG Electronics [13] | For FGs 24-8 and 24-9, there is one FFS point regarding whether to support 32 DL/UL HARQ processes for 120 kHz SCS based on the following agreement.

|  |
| --- |
| Agreement:For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.* Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.
* Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.
 |

As discussed in our companion paper [2], in order to avoid additional potential issues (e.g., type-3 HARQ-ACK codebook generation or DCI field for HARQ process index indication), we suggest to allow 32 maximum HARQ processes also for 120 kHz SCS in FR2-2, which seems to be a simple extension and UE capable of 32 HARQ processes for 480/960 kHz SCS would be capable of 32 HARQ processes for 120 kHz SCS as well.**Proposal: For 120 kHz SCS (in addition to 480/960 kHz), support 32 as the maximum number of HARQ processes for DL and UL, and update FGs 24-8 and 24-9 as follows.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Note** |
| 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 |  |

 |
| Nokia/Nokia Shanghai Bell [14] |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS |  |  |  |  |  |  |  |  | Candidate value set: 56 or 112 symbols | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS |  |  |  |  | Per UE |  |  |  | Candidate value set: 56 or 112 symbols | Optional with capability signalling |

 |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] |  |
| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] |  |
| Ericsson [10] |  |
| Apple [11] |  |
| MediaTek Inc. [12] |  |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

**New FGs**

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | Moreover, we believe additional FG(s) need to be defined for HARQ-ACK bundling. We believe it should be associated with the support of multi-PDSCH scheduling. Since separate FG is defined multi-PDSCH scheduling per SCS, the FG for HARQ-ACK bundling may also have to be defined per SCS. Another issue is whether to have a unified FG for both Type 1 and Type 2 HARQ-ACK codebook. We are open for this issue. Based on that, we suggest adding the following. Note that we are also fine with merging FG24-11 and FG24-11a, FG24-12 and FG24-12a, and FG24-13 and FG24-13a (i.e., having single capability for each SCS on HARQ-ACK bundling). **Proposal: Add new FGs for HARQ-ACK bundling, e.g., as in Table 2.2-2*** **It should be per SCS**
* **It can be per type of HARQ-ACK codebook**

Table 2.2-2: The proposed additional FGs

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11 | HARQ-ACK bundling for Type 1 HARQ codebook multi-PDSCH scheduling for 120 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-1d |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-11a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-1d |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12 | HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | 24-4 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | 24-4 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13 | HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 960 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 960 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| ZTE/Sanechips [6] |  |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] | During the discussions in previous RAN1 meeting, it was acknowledged that some UEs may need certain time to switch their beam especially for SCS 480 kHz/960 kHz as the corresponding CP duration may not be enough for absorbing uncertainties during transient time of the beam switching. For this purpose, an optional UE capability signalling is proposed in order to indicate a gap of 1 OFDM symbol (at least) for UE beam switching.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-11 | Time gap for UE beam switching | A time gap of 1 OFDM symbol for UE beam switching for 480 kHz/960 kHz |  |  |  | Optional with capability signalling |

**Proposal:*** Add new optional with capability signaling feature “time gap for UE beam switching” with following description
	+ A time gap of 1 OFDM symbol for UE beam switching for 480 kHz/960 kHz
 |
| Ericsson [10] |  |
| Apple [11] |  |
| MediaTek Inc. [12] | In RAN1 #106bis e meeting, the following agreement regarding m-TRP multi-PDSCH scheduling reception is achieved.Agreement:The working assumption in RAN1#106-e is confirmed with the following update:For multi-PDSCH scheduling for multi-TRPs, support a single DCI field ‘Transmission Configuration Indication’ as in Rel-16 TCI state indication mechanism for multi-TRPs* The single DCI field ‘Transmission Configuration Indication’ indicates one or two TCI states associated with a code point for single DCI based multi-TRP mechanism
	+ When two TCI states are indicated, reuse Rel-16 association rules to apply the two TCI states for each PDSCH scheduled by a multi-PDSCH scheduling DCI
* The single DCI field ‘Transmission Configuration Indication’ indicates only one TCI state associated with a code point for multi-DCI based multi-TRP mechanism
* Reuse Rel-16 RRC configuration and MAC CE activation/deactivation methods for the one or two TCI states
* ~~FFS: Details of multiple TCI state association with multiple PDSCHs~~
* Within the TDRA table for multi-PDSCH scheduling, the UE does not expect to be configured with the higher layer parameter repetitionNumber

To allow UE to support m-TRP single-PDSCH scheduling and only s-TRP multi-PDSCH scheduling, we suggest to introduce additional FGs for m-TRP multi-PDSCH scheduling.Proposal: Add FGs for m-TRP multi-PDSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-1g | Single-DCI based SDM scheme multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-4g | Single-DCI based SDM scheme multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-5g | Single-DCI based SDM scheme multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-1h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-4h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-5h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-1i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-4i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-5i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-1j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-4j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-5j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2
 |  | Optional |

 |
| LG Electronics [13] |  |
| Nokia/Nokia Shanghai Bell [14] |  |

**Other incl. basic features**

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon [2] |  |
| vivo [3] |  |
| Samsung [4] |  |
| NTT DOCOMO, INC. [5] | A general issue would be how to consider FR-related differentiation. In this WI, companies discuss on various types of new features and enhancements of the existing NR functionalities to extend NR to 52.6 – 71 GHz frequency range. Any UE feature to be supported in this WI will then be applicable at least for 52.6 – 71 GHz. However, companies may or may not argue that some of the UE features to be specified in this WI could be technically beneficial even in another frequency range, and then desire to discuss whether/how to expand the applicability of such UE features to other frequency ranges. It may consume quite a lot of time in RAN1 to discuss the range of applicability one by one. Note that 52.6 – 71 GHz frequency range at least include unlicensed bands, while licensed bands may also be identified in the future. The WI also target the support for both licensed and unlicensed band in this frequency range. This fact may also make the discussion more complex. Also, frequency range notation itself should be carefully considered. In the latest WID for supporting NR from 52.6 GHz to 71 GHz [2], two important aspects on frequency range definition regarding beyond 24 GHz are captured; one is to extend the definition of FR2 up to 71GHz, and the other is to introduce new FR sub-labels, FR2-1 and FR2-2, to be used for differentiating 24.25 – 52.6 GHz and 52.6 – 71 GHz if needed. Therefore, as well as FR1/2 differentiation, FR2-1/2-2 differentiation may also need to be considered. With the consideration above, how to have FR-related differentiation would depend on each UE feature in our view. We see the following alternatives at this stage.* One potential approach to easily solve this issue could be to define all the UE features to be specified in this WI per-band (or per BC). With this, UE can report its capability regarding functionalities for 52.6 – 71 GHz operation per band that the UE supports, which means vendors have a freedom for its own implementation. However, it may increase the overhead for UE capability signalling depending on the number of bands/band combinations to be specified.
* For UE features which can be applied regardless of licensed or unlicensed band, extending per-FR capability signalling may be another possibility. For example, by enabling per-FR capability signalling to differentiate FR2-1 and FR2-2, it would be possible to indicate a certain UE feature is applicable for FR2-2 only if needed. Or, if a UE feature is applicable to both FR2-1 and FR2-2 without any difference, just to use the existing per-FR capability signalling would also be possible. By defining in this manner, vendors still have a freedom to implement a certain feature for a certain frequency range, while overhead for capability signalling can be suppressed.
* To decrease signalling overhead more, per-UE signalling with some Notes can also be considered. This approach, however, may be applicable to particular UE features only, for which the targeted FR is crystal clear. For example, if a UE feature is clearly applicable for FR2-2 unlicensed band only, it could be possible to define it as a UE feature with per-UE capability signalling with a Note saying i.e., “this is applicable only for unlicensed band in FR2-2”. While this approach achieves much less overhead on UE capability signalling, an issue may be less implementation flexibility.

Table 1. Comparison of FR differentiation approaches

|  |  |  |
| --- | --- | --- |
| FR differentiation | Flexibility for implementation  | UE capability signalling overhead |
| Per-band  | Very flexible | Heavy  |
| Per FR | Less flexible  | Relatively light |
| Per UE | Much less flexible | Light  |

**Proposal: For the discussion on Rel-17 UE features at least regarding 52.6 – 71 GHz WI, the following alternatives can be considered in case-by-case manner, in terms of FR differentiation.** * **Alt 1: define as per-band**
* **Alt 2: define as per-FR**
	+ **Differentiation of FR2-1/2-2 may or may not be needed**
* **Alt 3: define as per-UE**
	+ **A fixed limitation (e.g., as a Note) on applicable frequency range may be needed**

 Views on applicability of Rel-15/16 NR UE features to FR2-2In Appendix, we show a brief set of analysis regarding Rel-15/16 UE features in terms of applicability to 52.6 – 71 GHz frequency range, based on the UE features specified in 38.822 [2], where we have focused with the principles below: * Check mandatory UE features in Rel-15/16 if it is applicable to 52.6 – 71 GHz frequency range
* Check UE features with per-UE signalling if it is applicable to 52.6 – 71 GHz frequency range when it is reported applicable to FR2
* For UE features with per-FR capability signalling, we have not analysed yet since it may be straightforward that per-FR signalling will indicate sub-FR level applicability, although it needs further discussions
* For UE features with per-band or per-BC capability signalling, we have checked only for the ones supported in Rel-16 NR-U

Below are some particular aspects that may require discussionsOn mandatory UE featuresSome UE features are defined as mandatory for NR in Rel-15. It has to be supported even for UEs supporting Rel-17 functionalities. However, they didn’t consider the operation in 52.6 – 71 GHz when specified, especially with larger SCSs. Therefore, some UE features, even the ones defined as mandatory in Rel-15/16, may or may not be feasible in case of the operation in 52.6 – 71 GHz frequency range. One potential issue among the mandatory features is related to FG3-1 on basic DL control channel, with the following components:

|  |
| --- |
| 1) One configured CORESET per BWP per cell in addition to CORESET0* CORESET resource allocation of 6RB bit-map and duration of 1 – 3 OFDM symbols for FR1
* For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSSs, CORESET resource allocation of 6RB bit-map and duration 1-3 OFDM symbols for FR2
* For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 1-2 OFDM symbols for FR2
* REG-bundle sizes of 2/3 RBs or 6 RBs
* Interleaved and non-interleaved CCE-to-REG mapping
* Precoder-granularity of REG-bundle size
* PDCCH DMRS scrambling determination
* TCI state(s) for a CORESET configuration

2) CSS and UE-SS configurations for unicast PDCCH transmission per BWP per cell* PDCCH aggregation levels 1, 2, 4, 8, 16
* UP to 3 search space sets in a slot for a scheduled SCell per BWP
* This search space limit is before applying all dropping rules.
* For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot
* For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of a slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot

3) Monitoring DCI formats 0\_0, 1\_0, 0\_1, 1\_14) Number of PDCCH blind decodes per slot with a given SCS follows Case 1-1 table5) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot per scheduled CC for FDD6) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot per scheduled CC for TDD |

For UEs supporting NR from 52.6 GHz to 71 GHz, at least the operation with 120 kHz SCS is to be supported. As 120 kHz SCS is the one which was supported in Rel-15/16 NR already, it does not cause any issue to support the existing UE features, including the ones specified as mandatory, e.g., FR3-1. However, the UEs supporting NR in 52.6 – 71 GHz may support larger SCS(s), i.e., 480 and/or 960 kHz SCS, as well in order to achieve the operation with larger absolute bandwidth per CBW. Since symbol duration is scaled based on SCS in the same manner as in FR1 and FR2, and definition of slot is same as in Rel-15/16 NR, the operation with 480/960 kHz SCS automatically means the one with shortened duration of a slot. When operating with shortened duration of a slot by supporting 480 and/or 960 kHz SCS, some components supported as mandatory in FG3-1 may not be feasible. For example, in the second component, up to 3 search space sets in a slot for a scheduled SCell per BWP is supported. Since NR in 52.6 – 71 GHz will be operated with SCS of 120 kHz or larger, whether up to 3 SS sets in a slot is always possible may not be clear. Moreover, in the sixth component, per-slot and per-CC maximum limitation of DCI processing is described, where one unicast DCI scheduling DL and 2 unicast DCI scheduling UL are supported. The feasibility of this may also be affected by shortened duration of a slot, e.g., only smaller number of DCIs may be possible for UE to process per slot with shortened time duration. Given above, we propose to discuss on how to interpret FG3-1 for the operation with SCS of 480 and/or 960 kHz. We see some alternatives to deal with the situation can be considered; one is to add a Note in a new UE feature to support 480 and 960 kHz SCS in 52.6 – 71 GHz frequency range such as “[a certain components of] FG 3-1 is not applicable to the SCS supported by this FG”. **Proposal: For UEs supporting NR in 52.6 – 71 GHz frequency range, how to treat a mandatory UE feature, FG 3-1, should be discussed at least when the UE supports the operation with 480 and/or 960 kHz SCS** On UE features with per-UE capability signallingAs well as mandatory UE features, UE features with per-UE capability signalling also need to be checked in terms of their applicability to the operation in 52.6 – 71 GHz. When UEs report their support of a certain UE feature with per-UE capability signalling, NW will understand that the UE supports the feature regardless of the operating band, frequency range (or even duplex). However, it may not always the case that UE features with per-UE capability signalling are applicable to 52.6 – 71 GHz when it is applicable to the existing frequency ranges. Our brief analysis is shown on the 6th column on the tables in Appendix. We generally believe most of the UE features with per-UE capability signalling are also applicable to FR2-2 as well. On the other hand, to support such UE features in practice in 52.6 – 71 GHz frequency range, some maintenances in the specifications will be needed, especially in terms of SCS. For example, FG 12-6 is a UE feature with per-UE capability signalling to report whether the UE supports DL SPS with the periodicity shorter than 10 ms. In Rel-16, an RRC parameter *periodicityExt-r16* is supported for configuring DL SPS periodicity shorter than 10 ms. However, how to use the value configured via *periodicityExt-r16* has not been defined in case that larger SCS than 120 kHz is configured. In other words, even if the UE feature reporting is supported for NR in 52.6 – 71 GHz as it is, when larger SCS than 120 kHz is used, this functionality (i.e., DL SPS with shorter than 10 ms periodicity) cannot be configured in practice. **Observation: While most of Rel-15/16 UE features with per-UE capability signalling can be reused as they are for UE to report their support for NR in 52.6 – 71 GHz, some maintenances will be required in the specifications to support the functionalities in practice.** **Proposal: For Rel-15/16 UE features with per-UE capability signalling, whether to be applicable to FR2-2 when they are reported as applicable should be analysed a case-by-case manner**On UE features with per-FR/band/BC capability signallingThere would be other types of UE features in NR in terms of FR differentiation, that is, UE features with per-FR/band/BC capability signalling. For the ones with per band/BC capability signalling, we do not see the need to check their validity since per-band/BC signalling naturally differentiate FR2-2 as well as the other FRs. Thus we do not incorporate them with the table in Appendix. On the other hand, some UE features with per-band/BC signalling include a Note associated with FR and/or whether it is licensed or unlicensed. For example, FG22-6/7 on PUCCH grouping, there are the descriptions on carrier type, which differentiate between the existing FRs and licensed/unlicensed band for FR1. Here, whether “FR2” can include 52.6 – 71 GHz or not is unclear at this stage. Moreover, as 52.6 – 71 GHz includes unlicensed bands, differentiation between licensed/unlicensed band may be required even if the wording “FR2” is kept as it is. **Proposal: For Rel-15/16 UE features with per-FR capability signalling,** * **If FR-related description is included in e.g., component, whether/how to consider 52.6 – 71 GHz may need to be discussed.**
* **Otherwise, as it can naturally differentiate FR2-2 from other FRs, there is no need to discuss in terms on FR2-2**

The ones with per-FR capability signalling may not have any issue either since Rel-15/16 defines FR2 as a frequency range between 24.25 – 52.6 GHz. Also, even if FR2-2 is additionally considered, as well as FR1/2-1 differentiation which has already been done via per-FR capability signalling, FR2-2 will need to be differentiated from the other FRs in many cases. Given that, we have not analysed yet on the ones with per-FR capability signalling on the tables in Appendix.An issue which may be lying on the ones with per-FR capability signalling would be whether to be applicable when they are reported as applicable to FR2 if no differentiation between FR2-1 and FR2-2 is considered. Some could be applicable to FR2-2 in the same manner as to FR2-1, while some others may not. This issue may also need to be checked in a case-by-case basis. We think it should also be discussed in RAN1 in the future. **Proposal: For Rel-15/16 UE features with per-FR capability signalling, how to treat when it is reported as applicable to FR2 should be discussed*** **Option 1: Differentiation between FR2-1 and FR2-2 is introduced**
* **Option 2: All the UE features are treated as applicable or inapplicable to FR2-2 as well as FR2-1 when it is reported for FR2, while the ones for which such treatment cannot be appropriate are defined as exceptional cases via e.g., adding Note**

For the ones with per-band signalling, at least how to treat the ones related to Rel-16 NR-U is worth more clarification in our view. For example, FG10-2 is defined for “SSB-based RRM with Q with dynamic channel access mode”, which is the same functionality as DBTW to be supported for FR2-2. Thus, it can be reused to report that a UE supports RRM with DBTW in FR2-2 by reporting FG10-2 with a band in FR2-2. On the other hand, there has already been some new FGs agreed for FR2-2, which is the same as (or similar to) the existing one for Rel-16 NR-U, e.g., multi-PUSCH scheduling. To align with how to treat Rel-16 NR-U FGs, all the functionalities supported for FR2-2 unlicensed band need to be re-defined, even if the same (or similar) FG has been defined in Rel-16 NR-U already. We believe this aspect should be clarified more. **Proposal: How to treat Rel-15/-16 UE features with per-band (at least the ones defined for Rel-16 NR-U) should be clarified.** * **Alt-1: The existing FG (e.g., FG10-2 for RRM with DBTW) is reused to report that the UE supports it in FR2-2 by indicating for a band in FR2-2.**
* **Alt-2: A dedicated FG is newly defined for any functionality supported in FR2-2, even if the same functionality has already been defined for Rel-15/-16**
 |
| ZTE/Sanechips [6] | The revised WID notes the applicability of the UE features introduced for FR 2-2 should be discussed case by case. Note 5: FR2 is extended to cover 24.25GHz to 71GHz with FR2-1 for 24.25-52.6GHz and FR2-2 for 52.6-71GHz. o The related UE capabilities and their applicability to the frequency range 52.6 to 71 GHz will have to be analysed on a case by case basiso The application of any of the UE feature introduced for 52.6-71 GHz to existing FR1/FR2 should be discussed case by case.Firstly, as described in second bullet in Note 5, we should consider application band range (i.e. FR2-2 only, FR2, both FR2 and FR1) of any of the UE feature. In our opinion, at least we need to consider the possibility of extending the UE features newly introduced for 120KHz or all SCSs to FR2-1 even FR1, e.g. multi-PDSCH scheduling by a single DCI. In addition, since FR2-2 involve both licensed and unlicensed spectrum operation, the application band type (i.e. licensed band only, unlicensed band only or both licensed and unlicensed band) for each FG should be discussed case by case.**Proposal: The application band range (i.e. FR2-2 only, FR2, both FR2 and FR1) and application band type (i.e. licensed band only, unlicensed band only or both licensed and unlicensed band) for each FG introduced for FR2-2 should be discussed case by case.**In RAN1 #107 e-meeting, which FG can be regarded as a basic feature group has been discussed, but there is no basic consensus. Wherein, a potential method to define basic FG is related to a certain deploy scenario as shown in Table 1. The deployment scenarios for operation in FR2-2 are as following:1. Scenario A: CA with PCell in FR1 (or FR2-1) + SCell (DL-only) in FR2-2
2. Scenario B-1: CA with PCell in FR1 (or FR2-1) + SCell (DL+UL) in FR2-2
3. Scenario B-2: DC with PCell in FR1 (or FR2-1) + PSCell (DL+UL) in FR2-2
4. Scenario C: Standalone operation in FR2-2, i.e., PCell in FR2-2

Table 1: The relationship between basic FGs and deployment scenarios

|  |  |
| --- | --- |
| Basic FGs | deployment scenarios |
| ASCell (DL-only) | B-1SCell (DL+UL) | B-2 (DC)PSCell (DL+UL) | C (Standalone) |
| 24-1: Basic FR2-2 DL support | √ | √ | √ | √ |
| 24-1a: Basic FR2-2 UL support (including Wideband PRACH) |  | √ | √ | √ |
| 24-1c: Multi-RB supportPUCCH format 0/1/4 for 120 kHz [with~~/without~~ shared spectrum channel access] |  | √(for unlicensed band) | √(for unlicensed band) | √(for unlicensed band) |
| 24-1d: Multiple PDSCH scheduling by single DCI for 120kHz |  |  |  |  |
| 24-1e: Multiple PUSCH scheduling by single DCI for 120kHz |  |  |  |  |
| 24-2: 120KHz SSB support for SA/DC in FR2-2 |  |  | √ | √ |

**Proposal: The Table 1 is defined to determine the basic FGs and its associated deployment scenario.**In this section, we will discuss on the application range of some enhanced features specified in FR 2-2, that is, whether some enhancements can be extended to FR 2-1 and/or FR 1.For the existing FGs discussed for NR above 52.5GHz, we think that it will be limited to FR2-2 by default. In this regard, we need to further discuss whether some of FGs can be applied to FR 2-1 and/or FR 1. Wherein, the principles for judging whether can be extended to FR 2-2 and/or FR 1 are as follows:1. Whether it is beneficial to FR1 and/or FR 2-1;
2. Whether it is compatible with the existing FR1 and/or FR 2-1 features;
3. Whether it is only applicable to unlicensed band or licensed band or both;

For the following enhanced FGs in FR 2-2, we will share our preference on whether it can be applied to FR1 and/or FR2-1:* Multiple PDSCH scheduling by single DCI (e.g., FG 24-1d)

In FR 2-2, multiple PDSCH scheduling by single DCI is applied to the licensed and unlicensed spectrum operation to unify design requirement. Besides, this enhancement is beneficial to degrade the overhead of DCI signalling. So considering signalling overhead, we think it can be considered as a feature to be applied to FR 2-1 and FR 1 and no differentiation licensed and unlicensed spectrum.* Multiple PUSCH scheduling by single DCI(e.g., FG 24-1e)

In FR1, multiple PUSCH scheduling by single DCI has been supported but only continuous PUSCH scheduling by single DCI is introduced. And such enhancement has not been introduced in FR 2-1. However, FR 2-2 supports non-continuous and continuous PUSCHs in time-domain scheduled by single DCI, which is different with that of FR1. In order to reduce signalling overhead, it is beneficial to extend this feature for FR 1 and even for FR 2-1.**Proposal: Enhancements on multiple PUSCH/PDSCH scheduling by single DCI can be considered to be applied to FR1 and FR2-1 as optional features.** |
| Qualcomm Incorporated [7] |  |
| OPPO [8] |  |
| Intel Corporation [9] | For UE operating with unlicensed SA mode, it needs to also support wideband PUCCH and wideband PRACH together. The main reason is that the wideband PUCCH and wideband PRACH were specifically targeted to improve the coverage issues due to power spectral density in unlicensed bands. However, if the UE optionally do not support this feature, this would shrink the potentially coverage for unlicensed cell deployments. Therefore, all UEs that is able to operate uplink transmission should support wideband PUCCH and wideband PRACH. Otherwise, the main motivation to introduce the feature is lost.**Proposal:****• 24-1b and 24-1c should be supported along with 24-1a when UE supports unlicensed SA operation with 120 kHz SCS.****• 24-4b and 24-4c should be supported along with 24-4a when UE supports unlicensed SA operation with 480 kHz SCS.****• 24-5c should be supported along with 24-5a when UE supports unlicensed SA operation with 960 kHz SCS.**Furthermore, while we acknowledge the potential use cases where the UE only supports downlink and not uplink in the 60 GHz band, we think such UE types (DL only UEs and DL and UL supporting UEs) may result in market fragmentation. While we can accept the feature distinction between DL and UL, our 1st preference is to combine basic feature 24-1 and 24-1a for 120kHz, and similarly for 480 and 960 kHz combine basic feature 24-4 and 24-4a, and combine basic feature 24-5 and 24-5a, respectively.**Proposal:****• Merge basic feature 24-1 and 24-1a into a single feature.****• Merge basic feature 24-4 and 24-4a into a single feature.****• Merge basic feature 24-5 and 24-5a into a single feature.** |
| Ericsson [10] | In RAN1 #107-e, it was discussed which FGs should be defined for basic operation in FR2-2 for 120 kHz. So far it has been agreed only that FG 24-1 is defined for basic operation; it is still FFS whether FGs 24-1a/1b/c/2 are defined this way. In our view, the definition of FGs for basic operation should account for three fundamental deployment scenarios as follows:1. Scenario A (DL-only)
	* CA with PCell in FR1 (or FR2-1) + SCell (DL-only) in FR2-2
2. Scenario B (DL + UL)
	* CA/DC with PCell in FR1 (or FR2-1) + (P)SCell (DL+UL) in FR2-2
3. Scenario C (Standalone)
	* Standalone operation in FR2-2, i.e., PCell in FR2-2

To lower the bar for development of a device ecosystem, only FG 24-1 should be defined for basic operation with 120 kHz which would support the most basic deployment scenario of DL-only SCells in FR2-2, i.e., Scenario A. Then, for devices that support Scenario B, FG 24-1 can be made as a pre-requisite for FG 24-1a which defines components for UL operation. Finally, for devices that support Scenario C, FGs 24-1 and 24-1a can be made as pre-requisites for FG 24-2 which defines components for standalone operation. This results in the following structure for 120 kHz SCS:* Scenario A supported with FG 24-1
* Scenario B supported with FG 24-1a with pre-requisite FG 24-1
* Scenario C supported with FG 24-2 with pre-requisite FGs 24-1 and 24-1a

Proposal: For 120 kHz SCS, only FG 24-1 is defined for basic operation; FGs 24-1a/b/c/2 are not defined for basic operation. Support the following change to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-1 | Basic FR2-2 DL support |  1. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2 for non-initial access |  |  | Optional with capability signallingA UE that supports FR2-2 must indicate this FG is supported |
| 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 1392. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | ~~[~~24-1~~]~~ |  | Optional with capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |
| 24-1b | Wideband PRACH [with/without shared spectrum channel access] | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | ~~[~~24-1a~~]~~ | FFS: whether to split this FG for SA and DC | Optional [with/without]capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |
| 24-1c | Multi-RB supportPUCCH format 0/1/4 for 120 kHz [with/without shared spectrum channel access] | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | ~~[~~24-1a~~]~~ |  | Optional with capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |
| 24-2 | 120KHz SSB support for SA/DC in FR2-2 | 1. Support 120KHz SSB for SA/DC in FR2-2 | ~~[~~24-1, 24-1a~~]~~ | per bandFFS: whether to split this FG for SA and DC | Optional [with/without] capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |

Following the same logic for supporting Scenarios A, B, and C in an incremental manner (see Section 2.1.1), we propose that only FG 24-4 is defined for basic operation with 480 kHz which enables Scenario A. Scenarios B and C are then enabled by appropriately defining the pre-requisite FGs.This results in the following structure for 480 kHz SCS:* Scenario A supported with FG 24-4
* Scenario B supported with FG 24-4a with pre-requisite FG 24-4
* Scenario C supported with FG 24-3 with pre-requisite FGs 24-4 and 24-4a

Proposal: For 480 kHz SCS, only FG 24-4 is defined for basic operation; FGs 24-4a/b/c/3 are not defined for basic operation. Support the following change to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-3 | 480KHz SSB support for SA/DC in FR2-2 | 1. Support 480KHz SSB for SA/DC in FR2-2 | ~~24-1[, 24-2,~~ 24-4~~]~~, 24-4a | 1. FFS: whether to split this FG for SA and DC
 | Optional [with/without] capability signalling |
| 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with X=4 slots FFS: 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements | 24-1 |  | Optional with capability signallingA UE that supports 480 kHz SCS must indicate this FG is supported |
| 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-4 |  | Optional with capability signalling |
| 24-4b | Wideband PRACH for 480 kHz [with/without shared spectrum channel access] | PRACH with 480KHz and length 571  | 24-4a | FFS: whether to split this FG for SA and DC[Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH] | Optional with capability signalling |
| 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz [with/without shared spectrum channel access] | Support multi-RB PUCCH format 0/1/4 for 480 kHz | 24-4a |  | Optional with capability signalling |

Following the same logic for supporting Scenarios A, and B in an incremental manner (see Section 2.1.1), we propose that only FG 24-5 is defined for basic operation with 960 kHz which enables Scenario A. Scenarios B is then enabled by appropriately defining the pre-requisite FGs. Note: standalone is not supported for 960 kHz SCS.This results in the following structure for 960 kHz SCS:* Scenario A supported with FG 24-5
* Scenario B supported with FG 24-5a with pre-requisite FG 24-5

Proposal: For 960 kHz SCS, only FG 24-5 is defined for basic operation; FGs 24-5a and 24-4c are not defined for basic operation. Support the following change to the FG list:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Note** | **Mandatory/Optional** |
| 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with X=8 slotsFFS: 3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1 |  | Optional with capability signallingA UE that supports 960 kHz SCS must indicate this FG is supported |
| 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2[3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS] | 24-5 |  | Optional with capability signalling |
| 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz [with/without shared spectrum channel access] | Support multi-RB PUCCH format 0/1/4 for 960 kHz | 24-5a |  | Optional with capability signalling |

 |
| Apple [11] |  |
| MediaTek Inc. [12] | Based on the conclusion made in RAN #92, indication of the UE features for FR2-2 only should be included in UE capability reporting, which is not allowed based on the current UE feature list structure. One way to address the issue could be to include the notion of “FR2-2” in the naming or components of the FG applied for FR2-2 only. Another way could be to include a column in the UE feature list table to indicate “FR1-FR2-1-FR2-2 differentiation” for FGs to allow UE to support different functionalities between FR1, FR2-1, and FR2-2. Up to RAN1 #107-e meeting, only some FGs adopt the approach of adding the notion of “FR2-2”, e.g., FG 24-1 Basic FR2-2 DL support, but many FGs still lack of the applied frequency range information. Proposal: How to report UE features applied to only FR2-1 or FR2-2 should be further discussed.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Introduce FR2-1 for 24.25 – 52.6 GHz, and FR2-2 for 52.6 – 71 GHz,* The above two ranges to be introduced under the FR2 common range.

|  |  |
| --- | --- |
|  | Option A |
| Frequency range designation | Corresponding frequency range  |
| FR1 | 410 MHz – 7125 MHz |
| FR2 |  FR2-1: 24250 MHz – 52600 MHz |
| FR2-2: 52600 MHz – 71000 MHz |
| NOTE: Whenever the FR2 is referred, both FR2-1 and FR2-2 frequency sub-ranges shall be considered in this release, unless otherwise stated.NOTE: The designations FR2-1 and FR2-2 should only be used when needed. |

* The related UE capabilities and their applicability to the frequency range 52.6 to 71 GHz will have to be analysed on a case by case basis
* The application of any of the UE feature introduced for 52.6-71 GHz to existing FR1/FR2 should be discussed case by case.

TSG RAN specifications shall make it very clear (to readers) that frequency bands in the 52.6-71GHz range are only Release-independent from Rel-17 onwards, to ensure that there is clear industry understanding about which FR2 features are applicable for operation in 52.6-71GHz range. |

  |
| LG Electronics [13] | In [1], UE capability to support multi-PXSCH scheduling DCI is captured as a separate FG for 120 kHz and as a component of basic DL/UL FGs for 480 or 960 kHz SCS (with FFS for DL and square bracket for UL). 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 frequency ranges other than FR2-2 (i.e., also for 15/30/60 kHz SCS). For 480 and 960 kHz SCS, it is preferred to confirm that multi-PXSCH scheduling DCI is defined as a component of corresponding basic DL/UL FGs.**Proposal: Extend the applicability of multi-PDSCH scheduling DCI and multi-PUSCH scheduling DCI to frequency ranges 1 and 2-1 in addition to FR2-2.**In RAN1#107-e meeting [3], it was discussed how to define UE feature groups depending on several deployment scenarios, similar to what we discussed for Rel-16 NR-U. To be specific, deployment scenarios for basic UE feature group definition can be classified as follows:* Scenario A: CA with PCell in FR1 (or FR2-1) + SCell (DL-only) in FR2-2
* Scenario B1: CA with PCell in FR1 (or FR2-1) + SCell (DL+UL) in FR2-2
* Scenario B2: DC with PCell in FR1 (or FR2-1) + PSCell (DL+UL) in FR2-2
* Scenario C: Standalone operation in FR2-2, i.e., PCell in FR2-2

With the above identified deployment scenarios, we suggest to define basic UE feature groups as follows:* 24-1a (Basic UL): Basic UE feature group for Scenarios B1, B2, and C
* 24-1b (PRACH): Basic UE feature group for Scenarios B2 and C for unlicensed band
* 24-1c (PUCCH): Multi-RB PF0/1 is basic feature for Scenarios B2 and C for unlicensed band, while multi-RB PF0/1 for licensed band and multi-RB PF4 are not basic features
* 24-2 (SSB for SA/DC): Basic UE feature group for Scenario B2 or C

**Proposal: With the deployment scenarios A/B1/B2/C below, define basic UE feature groups as follows:**

|  |
| --- |
| **Scenario A: CA with PCell in FR1 (or FR2-1) + SCell (DL-only) in FR2-2****Scenario B1: CA with PCell in FR1 (or FR2-1) + SCell (DL+UL) in FR2-2****Scenario B2: DC with PCell in FR1 (or FR2-1) + PSCell (DL+UL) in FR2-2****Scenario C: Standalone operation in FR2-2, i.e., PCell in FR2-2** |

* **24-1a (Basic UL): Basic UE feature group for Scenarios B1, B2, and C**
* **24-1b (PRACH): Basic UE feature group for Scenarios B2 and C for unlicensed band**
* **24-1c (PUCCH): Multi-RB PF0/1 is basic feature for Scenarios B2 and C for unlicensed band, while multi-RB PF0/1 for licensed band and multi-RB PF4 are not basic features**
* **24-2 (SSB for SA/DC): Basic UE feature group for Scenario B2 or C**
 |
| Nokia/Nokia Shanghai Bell [14] | In general, per Band indication is sufficient for the FGs in this WI, given they apply to a limited set of bands, and further savings on complexity and/or overhead when choosing between per UE/per Band are not significant.Basic feature groups:* + Given the characteristics of high frequency band and practical operation considerations, we do not see much value in defining a mapping between FGs and scenarios where they are basic. This was a valid exercise for NR-U, but we are not convinced the same applies here. Hence, our preference is as follows:
		- 24-1: Basic FG
		- 24-1a: Basic FG
		- 24-1b: Optional with capability signaling
		- 24-1c: Optional with capability signaling
		- 24-1d: Optional with capability signaling
		- 24-1e: Optional with capability signaling
		- 24-2: Basic FG
 |

# Discussion/Approval Items during RAN1 #107bis-e — First Checkpoint

After review of contributions submitted to RAN1 #107bis-e in this agenda item, the following topics were identified by the moderator for discussion/approval during RAN1 #107bis-e.

**General comments**

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
|  |  |

Note: The following FGs will not be discussed during RAN1 #107bis-e per the RAN1 Chair’s guidance on the RAN1 email reflector.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 480/960 kHz |  |  |  |  | [Per UE/per FSPC/per band] |  |  |  | FFS: 120 kHz | 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 480/960 kHz |  |  |  |  | [Per UE/per FSPC/per band] |  |  |  | FFS: 120 kHz | Optional with capability signalling |

# Issue 1: FG 24-1

The following was agreed by GTW on Monday, Jan 17, 2022.

**Agreement: 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 | 24-1 | Basic FR2-2 DL support |  1. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2 for non-initial access |  | Yes | N/A | FR2-2 is not supported | ~~[per UE][~~per band~~]~~ | N/A | N/A | N/A |  | Optional with capability signallingA UE that supports FR2-2 must indicate this FG is supported |

# Issue 2: FG 24-1a

The following was agreed by GTW on Monday, Jan 17, 2022.

**Agreement: 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 | 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 1392. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | ~~[~~24-1~~]~~ | Yes | N/A | UL in FR2-2 is not supported | ~~[per UE][~~per band~~]~~ | N/A | N/A | N/A |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Since the agreement for this FG still has some yellow (FFS), we will comment further.In our view, only FG 24-1 should be mandatory for a UE that supports FR2-2. This allows for a basic deployment with a DL only SCell. To enable a deployment with a DL+UL SCell/PSCell in FR2-2, FG24-1a is of course needed; but this should not be mandatory. Hence we propose the following:~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |
| NTT DOCOMO | Agree with Ericsson. On the other hand, we would be ok to make it mandatory for a certain case, if companies desire to do so.  |
| Futurewei | On FG 24-1: If this feature must be indicated if FR2-2 is supported it means that FR2-2 support implies 24-1 support, therefore it is no need to be indicated separately. Agree with suggestion to delete the note:[~~A UE that supports FR2-2 must indicate this FG is supported~~]  |
| LG Electronics | For yellow highlighted part, we can replace it with the following text (as in Rel-16 NR-U), since we think this FG should be a basic feature for DL+UL SCell, PScell, and PCell.This FG is a part of basic operation for following scenarios defined in TS38.300* Scenario A2, B, C, D and E
 |
| ZTE, Sanechips | we prefer to determine basic FG based on the deployment scenario. But if majority companies support that only a basic feature is supported for all deployment scenarios, we can also live with it. For the each required deployment scenario, we can achieve it by combination a basic feature with other features. |
| Apple | Agree with Ericsson and others this FG should not be made mandatory and that the note should be deleted. |
| Samsung | Agree to remove the FFS part.  |
| Intel | We prefer merging of DL and UL, but if companies think there is sufficient use case for separation, we would be ok (i.e. ok to accept removal of yellow highlight). |

# Issue 3: FG 24-1b

After review of contributions submitted to RAN1 #107bis-e 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 | 24-1b | Wideband PRACH for 120 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | ~~[~~24-1a~~]~~ | Yes | N/A | Wideband PRACH for 120 kHz in FR2-2 is not supported | [Per band] | N/A | N/A | N/A | ~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~capability signalling[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported] |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Regarding the yellow (FFS) items, we don't think wideband PRACH should be mandatory. Of course it is beneficial for coverage, but not all deployment scenarios are coverage limited. Even for standalone, it does not need to be mandatory. If the system uses wideband PRACH, and the UE doesn't support it; the UE simply cannot join the system. It is still beneficial for UEs able to join the system to report UE capability after initial access for the network to collect statistics on the support of the feature in case the operator decides to deploy this feature at a later date. Furthermore, network knowledge of UE capability can be useful for handover. Hence, we propose the following:~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]~~We are fine with "Per band" capability signaling |
| NTT DOCOMO | Although wideband PRACH is optional even in 5/6GHz NR-U bands, we prefer wideband PRACH as mandatory for UE supporting SA in FR2-2 band so that NW can utilize wideband PRACH for initial access to improve the coverage in some region. Otherwise, NW might not be able to configure wideband PRACH per SIB1 even in case it is beneficial and there are actually some UEs supporting this.  |
| Futurewei | We agree that wideband PRACH should not be mandatory for UL FR2-2 (more precisely not be mandatory for all bands in FR2-2). Agree to remove the note. Fine with per band signaling. |
| Huawei/HiSilicon | * “Mandatory/Optional”: Suggest to make the following two changes:
* 1- Add “This FG is only supported in bands for shared spectrum operation”.

We have the following bullet from WID to support the above addition:

|  |
| --- |
| * + Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum
 |

To our understanding, the highlighted text “for operation in shared spectrum” is applied for both PRACH sequence of L=571 and 1151 and non-consecutive RO. In addition, according to RAN1 discussion, the main motivation to introduce longer PRACH sequence is to make full use of UE TX power under the restriction of power spectrum density required by regional unlicensed band regulations. On the other hand, concentrating the transmit power in narrower bandwidth by power control mechanism is more efficient than introducing long PRACH sequence in licensed band. So the support of wideband PRACH should only be applied for shared spectrum operation, which is identical in NRU Rel-16. Note: Alternatively, above issue may be captured in “Feature Group” column by changing the component name to “Wideband PRACH for 120 kHz in FR2-2 with shared spectrum channel access”.* 2- Remove the yellow text: [A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]
* Due to the following reasons:
* A) In NRU Rel-16, the support of wideband PRACH (FG10-27) is “Optional with capability signaling” without any additional note that requires UE to indicate this FG is supported for any scenario. Considering the similar motivation as in NRU Rel-16 to introduce such FG, UE should not be required to indicate this FG is supported for any scenario.
* B) 120 kHz Wideband RACH is only an enhancement and not a basic feature/requirement to support UL transmission in 120 kHz in FR2-2 (FG 24-1a) or initial access in 120 kHz in FR2-2 (FG 24-2). Further, it is not a feature/requirement to support FR2-2 in general. This is only an enhancement intended to facilitate a better RACH coverage under PSD restriction of regional unlicensed band regulations.
* C) In licensed band, concentrating the transmit power in narrower bandwidth by power control mechanism is more efficient than introducing long PRACH sequence.
 |
| LG Electronics | Similar to multi-RB PUCCH, wideband PRACH should be limited for operation in shared spectrum, as Huawei pointed out.For yellow highlighted part in the note column, we can replace it with the following text, since we think this FG should be a basic feature for PScell and PCell.This FG is a part of basic operation for following scenarios defined in TS38.300* Scenario B, C, D and E

We are OK with “Per band” signaling. |
| ZTE, Sanechips | From coverage performance point of view, we think wideband PRACH is necessary to be supported as mandatory FG. |
| Apple | Agree with Huawei’s interpretation on the WID. We are okay with per band signaling.  |
| Samsung | We share the same view that wideband PRACH should not be mandatory in all the develop scenarios. Supporting wideband PRACH is beneficial for coverage improvement, but not an essential feature to support for all the scenarios. We are ok to remove “with/without shared spectrum channel access” for this FG.  |
| Intel | We think it is critical that wideband PRACH and PUCCH is mandatory supported for SA if the UE support UL. Otherwise, for deployments where NW wishes to leverage wider coverage, there is no method to support a wider coverage. The whole motivation to even introduce wideband PRACH and PUCCH is gone in this case.If companies do not prefer to have 24-1a also support 24-1b together, we think this should only be the case for NSA. Therefore, we suggest changing the [per band] to “per BC” and add a note “in case FG 24-1a is supported in SA deployment, UE is required to also indicate support for FG24-1b” |

# Issue 4: FG 24-1c

The following was agreed by GTW on Monday, Jan 17, 2022.

**Agreement: 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 | 24-1c | Multi-RB support PUCCH format 0/1/4 for 120 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | ~~[~~24-1a~~]~~ | Yes | N/A | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]This FG is only supported in bands under PSD limitation in shared spectrum operation  |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | Since the agreement for this FG still has some yellow (FFS), we will comment further.Regarding the yellow (FFS) items, we don’t think multi-RB PUCCH should be mandatory. Of course it is beneficial for coverage, but not all deployment scenarios are coverage limited. Even for standalone, it does not need to be mandatory. If the system uses multi-RB PUCCH, and the UE doesn’t support it; the UE simply cannot join the system. It is still beneficial for UEs able to join the system to report UE capability after initial access for the network to collect statistics on the support of the feature in case the operator decides to deploy this feature at a later date. Furthermore, network knowledge of UE capability can be useful for handover. Hence, we propose the following:~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported~~ |
| NTT DOCOMO | Same view as in FG24-1b. We prefer to define this as mandatory for UE supporting SA in FR2-2 band.  |
| Futurewei | Multi-RB is an enhancement therefore it does not need to be mandatory for FR2-2. Agree to remove the first note. For the second note remove the world “only” , otherwise it would imply that the feature cannot be supported in bands w/o PSD restriction for instance. There is no explicit mention of “only” in the WID or the Rel-17 agreements. |
| Huawei, HiSilicon | Remove the yellow note. This is just an enhancement and 24-1a/24-2/FR2-2 can function without such an enhancement.  |
| LG Electronics | For yellow highlighted part in the note column, we can replace it with the following text, since we think Multi-RB PUCCH format 0/1 for 120 kHz should be a basic feature for Pscell, and Pcell.Multi-RB PUCCH format 0/1 is a part of basic operation for following scenarios defined in TS38.300* Scenario B, C, D and E
 |
| Apple | Same view as FG 24-1b. |
| Samsung | Similar view that multi-RB PUCCH should not be mandatory.  |
| Intel | We think it is critical that wideband PRACH and PUCCH is mandatory supported for SA if the UE support UL. Otherwise, for deployments where NW wishes to leverage wider coverage, there is no method to support a wider coverage. The whole motivation to even introduce wideband PRACH and PUCCH is gone in this case.If companies do not prefer to have 24-1a also support 24-1c together, we think this should only be the case for NSA. Therefore, we suggest changing the [per band] to “per BC” and add a note “in case FG 24-1a is supported in SA deployment, UE is required to also indicate support for FG24-1c” |

# Issue 5: FG 24-1d

After review of contributions submitted to RAN1 #107bis-e 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 | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | ~~[~~24-1~~]~~ | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | We support the proposal for FG 24-1d |
| DOCOMO | Support  |
| Futurewei | We are fine with the proposal for FG 24-1d |
| Huawei/HiSilicon | OK |
| LG Electronics | As in our Tdoc [13], we propose to extend this FG to other frequency ranges such as FR1 and FR2-1, since it is designed with SCS-agnostic manner and would be beneficial also for FR1 and FR2-1. |
| ZTE, Sanechips | Support this FG and share same view with LG, that is, extend it to other FR. |
| Apple | Support this FG. |
| Samsung | We are ok with this proposal.  |
| Intel | Ok with the suggestions. |

# Issue 6: FG 24-1e

After review of contributions submitted to RAN1 #107bis-e 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 | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 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 | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | We support the proposal for FG 24-1e |
| NTT DOCOMO | Support  |
| Futurewei | We are fine with the proposal for FG 24-1e |
| Huawei/HiSilicon | OK |
| LG Electronics | As in our Tdoc [13], we propose to extend this FG to other frequency ranges such as FR1 and FR2-1, since it is designed with SCS-agnostic manner and would be beneficial also for FR1 and FR2-1. |
| ZTE, Sanechips | Support this FG and share same view with LG, that is, extend it to other FR. |
| Apple | Support |
| Samsung | We are ok with this proposal.  |
| Intel | Ok with the suggestions. |

# Issue 7: FG 24-2

After review of contributions submitted to RAN1 #107bis-e 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 | 24-2 | 120KHz SSB support for ~~SA/DC~~ initial access in FR2-2 | 1. Support 120KHz SSB for SA/DC in FR2-2 | ~~[~~24-1, 24-1a~~]~~ | N/A | N/A | 120KHz SSB based ~~stand-alone~~ intial access in FR2-2 is not supported | ~~N/A~~ Per band | N/A | N/A | N/A | ~~per band~~~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~ capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | We support the proposal for FG 24-2We agree that there is no need to split this FG for SA/DC, and even for standalone, there is a benefit of capability signaling (see analogous comments for FG 24-1b). |
| NTT DOCOMO | We are fine with the proposal. We agree not to split for SA and DC.  |
| Futurewei | We are fine with the proposal for FG 24-2 |
| Huawei/HiSilicon | OK. We are supportive of changing “SA/DC” to “initial access” as the basic support for DC is already provided in 24-1 for DL only and in 24-1+24-1a for DL+UL |
| LG Electronics | We are OK to replace SA/DC with initial access, but there is one more “SA/DC” in the fourth column which needs to be changed as well.We can also add the following note:This FG is a part of basic operation for following scenarios defined in TS38.300* Scenario C and D
 |
| ZTE, Sanechips | Considering “SA/DC” has been changed to “initial access” in the title of this FG, the corresponded modification should be also reflected in Component 1.Besides, according to the interpretation on “Optional with/without capability signalling” from moderator, UE capability can be reported only after RRC connection state is established. Fro the initial access stage(idle state), there is no UE capability, so “Optional ~~[~~with~~/without]~~ capability signalling” should be changed to “Optional ~~[with/~~**without~~]~~**capability signalling.” |
| Apple | We are fine with this. |
| Samsung | We are ok with this proposal. One typo “intial access” should be fixed.  |
| Intel | In SA, for UEs that support 120 kHz SSB for initial access will conduct initial access. So while gNB doesn’t need explicitly signaling to know this FG is supported, the signaling could be useful for NSA, and therefore we are ok with the changes. Please note this is different from requiring 24-1a to also support 24-1b and 24-1c in SA. For SA, nothing would work if the UE does not support 24-2, so there is really not a choice, and therefore it might be ok to not mandate support explicitly. |

# Issue 8: FG 24-3

After review of contributions submitted to RAN1 #107bis-e 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 | 24-3 | 480KHz SSB support for ~~SA/DC~~ initial access in FR2-2 | 1. Support 480KHz SSB for SA/DC in FR2-2 | 24-1~~[~~, 24-~~2~~4, 24-4a~~]~~ | ~~FFS~~ N/A | N/A | 480KHz SSB for initial access in FR2-2 is not supported | ~~[per UE][~~per band~~]~~ | N/A | N/A | N/A | ~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~ capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | We support the proposal for FG 24-3.We agree that there is no need to split this FG for SA/DC, and even for standalone, there is a benefit of capability signaling (see analogous comments for FG 24-1b). |
| NTT DOCOMO | We are fine with the proposal. We agree not to split for SA and DC.  |
| Futurewei | We are fine with the proposal for FG 24-3 |
| Huawei, HiSilicon | Prerequisite: Add (back) 24-2 as a prerequisite.According to the WID, A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access):

|  |
| --- |
| * Note: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)
 |

Support of 480 kHz SSB for initial access while not supporting 120 kHz SSB for initial access (not supporting 24-2) would be a violation of above Note from the WID. Assuming 24-2 is added as a prerequisite, 24-1 can be removed as a prerequisite as 24-1 is a prerequisite for 24-2. OK to include 24-4 and 24-4a as prerequisite.  |
| LG Electronics | We are fine with adding 24-2 as a prerequisite and replacing “SA/DC” with “initial access” also for the fourth column. |
| ZTE, Sanechips | Considering “SA/DC” has been changed to “initial access” in the title of this FG, the corresponded modification should be also reflected in Component 1.Besides, according to the interpretation on “Optional with/without capability signalling” from moderator, UE capability can be reported only after RRC connection state is established. Fro the initial access stage(idle state), there is no UE capability, so “Optional ~~[~~with~~/without]~~ capability signalling” should be changed to “Optional ~~[with/~~**without~~]~~**capability signalling.” |
| Apple | We are fine with this |
| Samsung | We are ok with this proposal.  |
| Intel | Similar with 120kHz, we ok with the changes. |

# Issue 9: FG 24-4

After review of contributions submitted to RAN1 #107bis-e 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 | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with ~~X=4 slots~~ (X,Y) = (4,1)~~FFS:~~ 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements | 24-1, 3-5b | Yes | N/A | 480KHz SCS for DL is not supported | ~~[~~Per ~~UE/~~band~~]~~ | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | According to the agreement on multi-slot monitoring capability from RAN1#107-e, there are components missing from the description of FG 24-4 that are related to the intra-slot monitoring capability that was part of the agreement (see highlighted text below). During the spec review discussions after RAN1#107-e, the 38.213 spec editor preferred not to add the intra-slot monitoring capability description to 38.213; rather, he said that the highlighted part of the agreement should be captured in the UE capability spreadsheet. Hence, we propose to capture the intra-slot monitoring capability aspect as additional components to this FG description. Note that it is not sufficient to simply add FG 3-5b as a pre-requisite FG, since in the RAN1#107-e agreement we made modifications to FG 3-5b for the multi-slot scenario. Hence, we propose to add the following components:3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with *set2* = (4, 3) and (7, 3) symbols4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes Component 6 of FG 3-5b) Note that in 38.213, the notation (Xs,Ys) is used for per-slot group monitoring to avoid confusion with (X,Y) defined for per-span monitoring. Hence (X,Y) should be changed to (Xs,Ys).**Agreement*** For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS
	+ A SS is monitored within Y consecutive slots within a slot group of X slots
	+ The Y consecutive slots can be located anywhere within the slot group of X slots
		- Note: There is no requirement to align the Y consecutive slots across UEs or with slot n0
	+ The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups
	+ BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots
* For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS
	+ SS monitoring locations can be anywhere within a slot group of X slots, with the following exception
		- BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.
* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)
			* Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8
* A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slots
	+ For Y>1: FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)
	+ For 960 kHz SCS For Y=1: FG3-5b with *set1* = (7, 3)
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ The following supersedes FG3-5b and FG3-1 definition:
	+ Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD
	+ Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD
 |
| NTT DOCOMO | We agree Ericsson’s suggested additional components. For component 2, we believe the exact value of (X, Y) can be a part of component signalling, i.e. component 2 can indicate which combination of (X, Y) the UE supports. Therefore, we do not see the need to explicitly capture any certain combination of (X, Y). |
| Futurewei | Multi-PDSCH scheduling and corresponding HARQ are enhancements (per WID), therefore should not be mandatory for the support of DL 480 kHz SCS.  |
| Huawei, HiSilicon | Prerequisite: Our understanding is that 3-5b should be removed. We have made multiple changes in 3-5b in the agreement for Multiple-slot PDCCH monitoring including: 1) Supported spans in 3-5b can be in any configured slots while the supported set1 and set2 spans from 3-5b in multiple-slot PDCCH monitoring can only be within configured Y consecutive slots of X slots. 2) only set2 with maximum 2 spans for 480 kHz for Y=1 are supported. Set3 is not supported. 3) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD (instead of per span as in 3-5b); 4) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD (instead of per span as in 3-5b)Keeping 3-5b as a prerequisite implies that 3-5b in its original form and without any of the above changes should be supported.  |
| ZTE, Sanechips | For component 2, we agree the update from Ericsson.For component 3, we do not see a strongly motivation to support multi-PUDSCH scheduling by a single DCI when multi-slot PDCCH monitoring is used for 480kHz since single PDSCH scheduling by a single DCI can also work. |
| Apple | Similar to the component descriptions in FG 3-1 and FG -5b, there is a need to add more detail to the component descriptions for this FG based on the agreements in addition to the updates suggested by Ericsson e.g. definition of X, Y etc. |
| Samsung | We in genera agree with Ericsson’s comment, and the UE capability agreed for slot within the Ys slot should be captured in the UE capability spread sheet, as suggested by TS 38.213 editor, for the consistency with Rel-15 and Rel-16 UE capability. Also, we agree that it may be not proper to use FG3-5b as the prerequisite FG, since there are changes made on top of FG3-5b.Better update (X,Y) to (Xs,Ys) to be consistent with the specification, since (X,Y) is used in TS 38.213 for other purpose.  |

# Issue 10: FG 24-4a

After review of contributions submitted to RAN1 #107bis-e 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 | 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-4 | Yes | N/A | 480KHz SCS support for UL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | We support the proposal for FG 24-4a |
| NTT DOCOMO | We are ok with the proposal.  |
| Futurewei | Multi-PUSCH scheduling is an enhancement (per WID), therefore should not be mandatory for the support of UL 480 kHz SCS. |
| Huawei, HiSilicon | Prerequisite: Add 24-1a (Basic FR2-2 UL support) as a prerequisite. According to the WID, A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access):

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| * Note: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)
 |

Support of 480 kHz for UL while not supporting 120 kHz for UL would be a violation of above Note from the WID.  |
| LG Electronics | We are fine with adding 24-1a as a prerequisite. |
| ZTE, Sanechips | For component 3, we don’t think it must be supported here since not all UEs have the need for reducing signalling overhead and saving power and so on.  |
| Apple | We are fine with this. |
| Samsung | We are ok with this proposal. |
| Intel | Ok with changes. |

# Issue 11: FG 24-4b

After review of contributions submitted to RAN1 #107bis-e 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 | 24-4b | Wideband PRACH for 480 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | PRACH with 480KHz and length 571  | 24-4a | Yes | N/A | Wideband PRACH for 480 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~FFS: whether to split this FG for SA and DC~~~~[Agreement:~~~~Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH]~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | We support the proposal for FG 24-4bWe agree that there is no need to split this FG for SA/DC, and even for standalone, there is a benefit of capability signaling (see analogous comments for FG 24-1b). |
| NTT DOCOMO | We are fine with the proposal.  |
| Futurewei | We are fine with the Proposal 24-4b |
|  | * “Mandatory/Optional”: Suggest to add “This FG is only supported in bands for shared spectrum operation”.

We have the following bullet from WID to support the above addition:

|  |
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| * + Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum
 |

To our understanding, the highlighted text “for operation in shared spectrum” is applied for both PRACH sequence of L=571 and 1151 and non-consecutive RO. In addition, according to RAN1 discussion, the main motivation to introduce longer PRACH sequence is to make full use of UE TX power under the restriction of power spectrum density required by regional unlicensed band regulations. On the other hand, concentrating the transmit power in narrower bandwidth by power control mechanism is more efficient than introducing long PRACH sequence in licensed band. So the support of wideband PRACH should only be applied for shared spectrum operation, which is identical in NRU Rel-16. Note: Alternatively, above issue may be captured in “Feature Group” column by changing the component name to “Wideband PRACH for 480 kHz in FR2-2 with shared spectrum channel access”. |
| LG Electronics | As commented for FG 24-1b, wideband PRACH should be limited for operation in shared spectrum. |
| ZTE, Sanechips | We do not see a strongly need to separate wideband PRACH with FG 24-4a. |
| Apple | We are fine with this |
| Samsung | We are ok with this proposal. |
| Intel | Similarly with 120kHz FG24-1b, we think this should be supported in case 24-4a is supported and in SA. We think it is critical that wideband PRACH and PUCCH is mandatory supported for SA if the UE support UL. Otherwise, for deployments where NW wishes to leverage wider coverage, there is no method to support a wider coverage. The whole motivation to even introduce wideband PRACH and PUCCH is gone in this case.If companies do not prefer to have 24-4a also support 24-4b together, we think this should only be the case for NSA. Therefore, we suggest changing the [per band] to “per BC” and add a note “in case FG 24-4a is supported in SA deployment, UE is required to also indicate support for FG24-4b” |

# Issue 12: FG 24-4c

The following was agreed by GTW on Monday, Jan 17, 2022.

**Agreement: 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 | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | Support multi-RB PUCCH format 0/1/4 for 480 kHz | 24-4a | Yes | N/A | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signallingThis FG is only supported in bands under PSD limitation in shared spectrum operation |

# Issue 13: FG 24-4f

After review of contributions submitted to RAN1 #107bis-e 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 | 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | 1.) Multiple-slot PDCCH monitoring for 480KHz with (X,Y)=(2,1)2.) Multiple-slot PDCCH monitoring for 480KHz with (X,Y)=~~[~~(4,2)~~] slots~~ | 24-4, 3-1 | Yes | N/A | Enhanced PDCCH monitoring for 480KHz in FR2-2 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | According to the agreement on multi-slot monitoring capability from RAN1#107-e, there is a component missing from the description of FG 24-4f that is related to the intra-slot monitoring capability that was part of the agreement (see highlighted text below). During the spec review discussions after RAN1#107-e, the 38.213 spec editor preferred not to add the intra-slot monitoring capability description to 38.213; rather, he said that the highlighted part of the agreement should be captured in the UE capability spreadsheet. Hence, we propose to capture the intra-slot monitoring capability aspect as additional components to this FG description. Note that it is not sufficient to simply add FG 3-1 as a pre-requisite FG, since in the RAN1#107-e agreement the reference to FG 3-1 only applies to the so-called Group (1) search spaces in the Ys slots. It is still being discussed in AI 8.2.2 the behavior for the so-called Group (2) search spaces. Hence, we propose to add the following component for now (applicable to Group (1) SSs), and then come back later and potentially add an additional component for Group (2) once an agreement has been made.3. Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-1Note that in 38.213, the notation (Xs,Ys) is used for per-slot group monitoring to avoid confusion with (X,Y) defined for per-span monitoring. Hence (X,Y) should be changed to (Xs,Ys).We don't agree to Component #1, since support of (Xs,Ys) = (2,1) is not agreed. It was discussed in the GTW on Monday, but there is not consensus so far. Hence, we propose the following. Alternatively, this can be put in yellow or square brackets until this issue is decided.~~1.) Multiple-slot PDCCH monitoring for 480KHz with (X,Y)=(2,1)~~Question: what happened to FG 24-4g? Is it now superseded by FG 24-4f?**Agreement*** For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS
	+ A SS is monitored within Y consecutive slots within a slot group of X slots
	+ The Y consecutive slots can be located anywhere within the slot group of X slots
		- Note: There is no requirement to align the Y consecutive slots across UEs or with slot n0
	+ The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups
	+ BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots
* For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS
	+ SS monitoring locations can be anywhere within a slot group of X slots, with the following exception
		- BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.
* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)
			* Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8
* A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slots
	+ For Y>1: FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)
	+ For 960 kHz SCS For Y=1: FG3-5b with *set1* = (7, 3)
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ The following supersedes FG3-5b and FG3-1 definition:
	+ Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD
	+ Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD
 |
| NTT DOCOMO | We think the contents of this FG could be a part of FG 24-4, more specifically, component 2 with removing the explicit (X, Y) value. Not sure how much it is needed.  |
| Futurewei | (X,Y)=(2,1) was not yet agreed. Moreover, (X,Y) = (4,2) is optionally supported for multi-slot PDCCH , therefore it cannot be concluded that without it “Enhanced PDCCH monitoring for 480KHz in FR2-2 is not supported” |
| Huawei/HiSilicon | “Components”: Remove component 1. (2,1) is not agreed.“Prerequisite”: Remove 3-1. We have made some changes in 3-1 when adopted to multiple-slot PDCCH monitoring (similar argument as for removal of 3-5b as a prerequisite for 24-4) |
| ZTE, Sanechips | For Component 1, since there is no any conclusions as far, so propose removing it from the current FG.We agree new added component from Ericsson, specific wording can be further polished. |
| Apple | Remove (X,Y) = (2,1)Add component suggested by Erisson with modification on unicast behavior in agreement as shown below:* + The following supersedes FG3-5b and FG3-1 definition:
	+ Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD
	+ Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD
 |
| Samsung | Similar comments as in Issue 9. (Xs,Ys)=(2,1) is FFS and still under discussion.  |

# Issue 14: FG 24-5

After review of contributions submitted to RAN1 #107bis-e 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 | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(8,1) ~~slots~~~~FFS:~~ 3. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements | 24-1, 3-5b | Yes | N/A | 960KHz SCS support for DL is not supported | ~~[~~Per ~~UE/~~band~~]~~ | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | According to the agreement on multi-slot monitoring capability from RAN1#107-e, there are components missing from the description of FG 24-5 that are related to the intra-slot monitoring capability that was part of the agreement (see highlighted text below). During the spec review discussions after RAN1#107-e, the 38.213 spec editor preferred not to add the intra-slot monitoring capability description to 38.213; rather, he said that the highlighted part of the agreement should be captured in the UE capability spreadsheet. Hence, we propose to capture the intra-slot monitoring capability aspect as additional components to this FG description. Note that it is not sufficient to simply add FG 3-5b as a pre-requisite FG, since in the RAN1#107-e agreement we made modifications to FG 3-5b for the multi-slot scenario. Hence, we propose to add the following components:3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with *set1* = (7, 3) symbols4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes Component 6 of FG 3-5b) Note that in 38.213, the notation (Xs,Ys) is used for per-slot group monitoring to avoid confusion with (X,Y) defined for per-span monitoring. Hence (X,Y) should be changed to (Xs,Ys).**Agreement*** For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS
	+ A SS is monitored within Y consecutive slots within a slot group of X slots
	+ The Y consecutive slots can be located anywhere within the slot group of X slots
		- Note: There is no requirement to align the Y consecutive slots across UEs or with slot n0
	+ The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups
	+ BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots
* For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS
	+ SS monitoring locations can be anywhere within a slot group of X slots, with the following exception
		- BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.
* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)
			* Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8
* A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slots
	+ For Y>1: FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)
	+ For 960 kHz SCS For Y=1: FG3-5b with *set1* = (7, 3)
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ The following supersedes FG3-5b and FG3-1 definition:
	+ Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD
	+ Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD
 |
| NTT DOCOMO | We generally believe this FG should be treated in the same manner as for FG24-4. It can be considered to treat this after agreeing on FG24-4.  |
| Futurewei | Multiple PDSCH scheduling is an enhancement therefore should not be mandatory for the support of 960kHz SCS as implied by “960KHz SCS support for DL is not supported” |
| Huawei, HiSilicon | **Prerequisite:** Our understanding is that 3-5b should be removed. We have made multiple changes in 3-5b in the agreement for Multiple-slot PDCCH monitoring including: 1) Supported spans in 3-5b can be in any configured slots while the supported set1 and set2 spans from 3-5b in multiple-slot PDCCH monitoring can only be within configured Y consecutive slots of X slots. 2) only set1 for 960 kHz SCS For Y=1 is supported. Set3 is not supported. 3) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD (instead of per span as in 3-5b); 4) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD (instead of per span as in 3-5b)Keeping 3-5b as a prerequisite implies that 3-5b in its original form and without any of the above changes should be supported.  |
| ZTE, Sanechips | For Component 3, same view as FG 24-4.We agree also the new added components from Ericsson, specific wording can be further polished. |
| Apple | Similar behavior to FG 24-4 |
| Samsung | Similar comments as in Issue 9.  |

# Issue 15: FG 24-5a

After review of contributions submitted to RAN1 #107bis-e 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 | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~[~~3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS~~]~~ | 24-5 | Yes | N/A | 960KHz SCS support for UL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | We support the proposal for FG 24-5a |
| NTT DOCOMO | Same view as for FG24-5.  |
| Futurewei | Multi-PUSCH scheduling by single DCI is an enhancement, not mandatory for UL 960 SCS support |
| Huawei, HiSilicon | **Prerequisite:** Add 24-1a (Basic FR2-2 UL support) as a prerequisite. According to the WID, A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access):

|  |
| --- |
| * Note: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)
 |

Support of 960 kHz for UL while not supporting 120 kHz for UL would be a violation of above Note from the WID.  |
| LG Electronics | We are fine with adding 24-1a as a prerequisite. |
| ZTE, Sanechips | For Component 3, same view as FG 24-4a. |
| Apple | Similar to FG 24-4a |
| Samsung | We are ok with the proposal.  |
| Intel | Ok with changes. |

# Issue 16: FG 24-5c

The following was agreed by GTW on Monday, Jan 17, 2022.

**Agreement: 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 | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | Support multi-RB PUCCH format 0/1/4 for 960 kHz | 24-5a | Yes | N/A | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signallingThis FG is only supported in bands under PSD limitation in shared spectrum operation |

# Issue 17: FG 24-5f

After review of contributions submitted to RAN1 #107bis-e 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 | 24-5f | Enhanced PDCCH monitoring for 960KHz | 1.) Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(4,1) 2.) Multiple-slot PDCCH monitoring for 960KHz with (X,Y)= (4,2)3.) Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(8,4) ~~slots~~ | 24-5, 3-1 | Yes | N/A | Enhanced PDCCH monitoring for 960KHz is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | According to the agreement on multi-slot monitoring capability from RAN1#107-e, there is a component missing from the description of FG 24-5f that is related to the intra-slot monitoring capability that was part of the agreement (see highlighted text below). During the spec review discussions after RAN1#107-e, the 38.213 spec editor preferred not to add the intra-slot monitoring capability description to 38.213; rather, he said that the highlighted part of the agreement should be captured in the UE capability spreadsheet. Hence, we propose to capture the intra-slot monitoring capability aspect as additional components to this FG description. Note that it is not sufficient to simply add FG 3-1 as a pre-requisite FG, since in the RAN1#107-e agreement the reference to FG 3-1 only applies to the so-called Group (1) search spaces in the Ys slots. It is still being discussed in AI 8.2.2 the behavior for the so-called Group (2) search spaces. Hence, we propose to add the following component for now (applicable to Group (1) SSs), and then come back later and potentially add an additional component for Group (2) once an agreement has been made.3. Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-1Note that in 38.213, the notation (Xs,Ys) is used for per-slot group monitoring to avoid confusion with (X,Y) defined for per-span monitoring. Hence (X,Y) should be changed to (Xs,Ys).**Agreement*** For Group (1) SS: Type 1 CSS with dedicated RRC configuration and type 3 CSS, UE specific SS
	+ A SS is monitored within Y consecutive slots within a slot group of X slots
	+ The Y consecutive slots can be located anywhere within the slot group of X slots
		- Note: There is no requirement to align the Y consecutive slots across UEs or with slot n0
	+ The location of the Y consecutive slots within the slot group of X slots is maintained across different slot groups
	+ BD attempts for all Group (1) SSs are restricted to fall within the same Y consecutive slots
* For Group (2) SS: Type 1 CSS without dedicated RRC configuration and type 0, 0A, and 2 CSS
	+ SS monitoring locations can be anywhere within a slot group of X slots, with the following exception
		- BD attempts for Type0-CSS for SSB/CORESET 0 multiplexing pattern 1, and additionally for Type0A/2-CSS if *searchSpaceId* = 0, occur in slots with index n0 and n0+X0, where n0 is as in Rel-15, X0=4 for 480 kHz SCS and X0=8 for 960 kHz SCS.
* Supported combinations of (X,Y)
	+ A UE capable of multi-slot monitoring mandatorily supports
		- For SCS 480 kHz: (X,Y) = (4,1)
		- For SCS 960 kHz: (X,Y) = (8,1)
	+ A UE capable of multi-slot monitoring optionally supports
		- For SCS 480 kHz: (X,Y) = (4,2)
		- For SCS 960 kHz: (X,Y) = (8,4), (4,2), (4,1)
			* Working assumption: BD/CCE budget for (4,2), (4,1) is half that of X=8
* A UE capable of multi-slot monitoring mandatorily supports the following PDCCH monitoring within Y slots
	+ For Y>1: FG3-1 (monitoring Group (1) SSs in the first 3 OFDM symbols of each of the Y slots)
	+ For 960 kHz SCS For Y=1: FG3-5b with *set1* = (7, 3)
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]
	+ The following supersedes FG3-5b and FG3-1 definition:
	+ Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of X slots per scheduled CC for FDD
	+ Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of X slots per scheduled CC for TDD
 |
| NTT DOCOMO | Same view as for FG24-5.  |
|  |  |
| Huawei/HiSilicon | “Prerequisite”: Remove 3-1. We have made some changes in 3-1 when adopted to multiple-slot PDCCH monitoring (similar argument as for removal of 3-5b as a prerequisite for 24-5) |
| Apple | Similar view as FG 24-5f |
| Samsung | Similar comments as in Issue 9.  |

# Issue 18: FG 24-6

After review of contributions submitted to RAN1 #107bis-e 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 | 24-6 | ~~Support [~~Type 1~~]~~ channel access procedure in uplink for FR2-2 ~~unlicensed operation~~ with shared spectrum channel access  | 1. Support ~~[~~Type 1~~]~~ channel access procedure
2. ~~[~~Support LBT performed per ~~carrier/~~BWP bandwidth~~]~~
 | 24-1a | Yes | N/A | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling~~[~~A UE that supports FR2-2 must indicate this FG is supported when required by regulation~~]~~ |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | We support the proposal.  |
| Huawei/HiSilicon | Components: Whether LBT is per BWP BW or carrier BW is an ongoing discussion in 8.2.6 AI and we think it is better to be decided there. Suggest to revert the change in component 11 [2?] and include both carrier/BWP as options. |
| LG Electronics | We share the view with Huawei. |
| ZTE, Sanechips | For component 11, it can be determined after the relevant conclusion on LBT bandwidth is confirmed in AI 8.2.6. |
| Apple | Same as HW. |
| Samsung | We are ok with the proposal in general, and the issue of “per carrier/BWP bandwidth” is still under discussion.  |
| Intel | Ok with changes, agree that per carrier/BWP is being discussed. |

# Issue 19: FG 24-7

After review of contributions submitted to RAN1 #107bis-e 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 | 24-7 | ~~Support [~~Type 2~~]~~ channel access procedure in uplink for FR2-2 ~~unlicensed operation~~ with shared spectrum channel access | 1. Support ~~[~~Type 2~~]~~ channel access procedure2. Support LBT performed per BWP bandwidth | 24-1a, 24-6 | Yes | N/A | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling~~[~~A UE that supports FR2-2 must indicate this FG is supported when required by regulation~~]~~ |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| NTT DOCOMO | We support the proposal.  |
| Huawei/HiSilicon | Components: Whether LBT is per BWP BW or carrier BW is an ongoing discussion in 8.2.6 AI and we think it is better to be decided there. Suggest to include both carrier/BWP as options. |
| LG Electronics | We share the view with Huawei. |
| ZTE, Sanechips | For component 2, it can be determined after the relevant conclusion on LBT bandwidth is confirmed in AI 8.2.6. |
| Apple | Same as HW. |
| Samsung | We are ok with the proposal in general, and the issue of “per carrier/BWP bandwidth” is still under discussion.  |
| Intel | Ok with changes, agree that per carrier/BWP is being discussed. |

# Issue 20: FG 24-10

After review of contributions submitted to RAN1 #107bis-e 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 | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS |  | Yes | N/A | Additional beam switching time delay is not supported | Per UE | N/A | N/A | N/A | Candidate value set: 56 or 112 symbols | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | We support the proposal for FG 24-10 |
| NTT DOCOMO | We are fine with the proposal.  |
| Futurewei | We are OK with the proposal. |
| Huawei/HiSilicon | OK. |
| LG Electronics | Support this proposal. |
| ZTE, Sanechips | Support  |
| Apple | We are fine with the proposal |
| Samsung | We are ok with the proposal. |
| Intel | Ok with changes. |

# New FGs

The following new FGs were proposed in contributions submitted to RAN1 #107bis-e in this agenda item. **Please indicate in the table below which of these proposed FGs should be discussed in RAN1 #107bis-e.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11 | HARQ-ACK bundling for Type 1 HARQ codebook multi-PDSCH scheduling for 120 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-1d | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-11a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-1d | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12 | HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | 24-4 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 480 kHz SCS | 24-4 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13 | HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 960 kHz SCS | Support HARQ-ACK bundling for Type 1 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-5 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13a | HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 960 kHz SCS | Support HARQ-ACK bundling for Type 2 HARQ codebook for multi-PDSCH scheduling for 120 kHz SCS | 24-5 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-14 | Time gap for UE beam switching | A time gap of 1 OFDM symbol for UE beam switching for 480 kHz/960 kHz |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1g | Single-DCI based SDM scheme multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2  |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4g | Single-DCI based SDM scheme multi-PDSCH DL grant for 480kHz SCS in FR2-2 | Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5g | Single-DCI based SDM scheme multi-PDSCH DL grant for 960kHz SCS in FR2-2 | Support of single-DCI based SDM scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2  |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5h | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeA scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2  |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 480kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5i | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 960kHz SCS in FR2-2 | Support of single-DCI based FDMSchemeB scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 120kHz SCS in FR2-2  |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 | Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 480kHz SCS in FR2-2 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5j | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 | Support of single-DCI based TDMSchemeA scheme for multi-PDSCH scheduling for 960kHz SCS in FR2-2 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Ericsson | FGs for HARQ-ACK bundling:We are not quite sure why the UE features for HARQ-ACK bundling are needed. For Type-1 HARQ codebook, use of HARQ-ACK bundling results in legacy UE behavior, so why is a capability needed? For Type-2 codebook, at least if the number of HARQ-ACK bundling groups is equal to 1, again, this results in legacy behavior. Hence, we think that it is may only be needed to have a UE capability for Type-2 when the number of HARQ bundling groups is > 1.FG for time gap for UE beam switching:Our understanding is that there has not yet been any agreement on this in AI 8.2.4 on beam management, hence it is too early to include this.FGs for Multi-TRPWe are concerned about the introduction of so many FGs. UE capability checking at the gNB is not a trivial task, hence exploding the number of FGs can cause quite some complexity. It seems like there should be existing FGs fro multi-TRP that can be leveraged, rather than defining a dozen (!) new FGs. It does not seem necessary to make these FGs SCS dependent. |
| NTT DOCOMO | FGs for HARQ-ACK bundling:If “it results in the legacy behavior” is common understanding, we are happy to consider them as just mandatory without capability signalling for Type 1. FG for time gap for UE beam switchingAgree that it would be good to wait for WI progress. FG for m-TRPIt seems they are the extension of the Rel-16 features, We believe there are many other issues which is similar to them. Maybe how to handle the applicability of Rel-16 UE features to FR2-2 should be determined. |
| Futurewei | We prefer to wait for RAN1 decision on UE beam switching gap. |
| Samsung | FGs for HARQ-ACK bundling:We believe such a UE capability may be needed, but may not be SCS-specific manner. We are ok with supporting the UE capability if it’s defined generically for all SCSs.FG for time gap for UE beam switchingWe believe this UE capability is needed, but after the agreement from 8.2.4. FGs for Multi-TRPNot sure we need SCS-specific FG for this purpose. |
| LG Electronics | We share the view with Samsung. For HARQ-ACK bundling and m-TRP related FGs, we prefer to have SCS-independent FGs. |

# Discussion/Approval Items during RAN1 #107bis-e — 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]***

**Note: Consistent with other work items, anything related to Release 16 feature groups should be discussed in agenda item 8.2 “Maintenance on Supporting NR from 52.6GHz to 71 GHz” or in email discussion [107bis-e-R17-RRC] “LS to RAN2 on updated Rel-17 RRC parameters”**

**Note: There is currently no consensus to introduce new FGs. This discussion can be revisited at RAN1 #108-e.**

**General comments**

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
|  |  |

# Issue 1: FG 24-1a

**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 | 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 1392. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | 24-1 | Yes | N/A | UL in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | While not our 1st preference, we would be ok accept the suggested changes. |
| LG Electronics | Still, we prefer to add the following text in the note column, since we think this FG should be a basic feature for DL+UL SCell, PScell, and PCell.This FG is a part of basic operation for following scenarios defined in TS38.300* Scenario A2, B, C, D and E
 |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 2: FG 24-1b

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz  | ~~[~~24-1a~~]~~ | Yes | N/A | Wideband PRACH for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~capability signallingNote: This FG is only supported in bands for shared spectrum operation~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]~~ |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | We think it is critical that wideband PRACH and PUCCH is mandatory supported for SA if the UE support UL. Otherwise, for deployments where NW wishes to leverage wider coverage, there is no method to support a wider coverage. The whole motivation to even introduce wideband PRACH and PUCCH is gone in this case.If companies do not prefer to have 24-1a also support 24-1b together, we think this should only be the case for NSA. Therefore, we suggest changing the [per band] to “per BC” and add a note “in case FG 24-1a is supported in SA deployment, UE is required to also indicate support for FG24-1b”We are ok with other changes suggested. |
| LG Electronics | Still, we prefer to add the following text in the note column, since we think this FG should be a basic feature for PScell and PCell.This FG is a part of basic operation for following scenarios defined in TS38.300* Scenario B, C, D and E

@ Intel,Even though we understand the intention (which is similar to ours), could you elaborate on the difference between “per band” and “per BC” signaling? |
| Qualcomm | Support the proposal in general. However for the note “This FG is only supported in bands for shared spectrum operation”, as clarified in the first online session, longer PRACH in WID objective is not subject to shared spectrum operation. Thus we believe the note is not needed. |
| vivo | Support the proposal.  |

# Issue 3: FG 24-1c

**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 | 24-1c | Multi-RB support PUCCH format 0/1/4 for 120 kHz in FR2-2 | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a | Yes | N/A | Multi-RB supportPUCCH format 0/1/4 for 120 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]~~This FG is only supported in bands under PSD limitation in shared spectrum operation  |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | We think it is critical that wideband PRACH and PUCCH is mandatory supported for SA if the UE support UL. Otherwise, for deployments where NW wishes to leverage wider coverage, there is no method to support a wider coverage. The whole motivation to even introduce wideband PRACH and PUCCH is gone in this case.If companies do not prefer to have 24-1a also support 24-1b together, we think this should only be the case for NSA. Therefore, we suggest changing the [per band] to “per BC” and add a note “in case FG 24-1a is supported in SA deployment, UE is required to also indicate support for FG24-1b”We are ok with other changes suggested. |
| LG Electronics | Still, we prefer to add the following text in the note column, since we think Multi-RB PUCCH format 0/1 for 120 kHz should be a basic feature for PScell, and Pcell.Multi-RB PUCCH format 0/1 is a part of basic operation for following scenarios defined in TS38.300* Scenario B, C, D and E
 |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 4: FG 24-1d

**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 | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | ~~[~~24-1~~]~~ | Yes | N/A | Multiple PDSCH scheduling by single DCI for 120kHz is not supported | Per band | N/A | N/A | N/A | FFS: to extend this FG to other frequency ranges such as FR1 and FR2-1 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with the suggestions. |
| LG Electronics | Support the proposal |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 5: FG 24-1e

**Proposal: 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 | 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 | Per band | N/A | N/A | N/A | FFS: to extend this FG to other frequency ranges such as FR1 and FR2-1 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with the suggestions. |
| LG Electronics | Support the proposal |
| Qualcomm | Support the proposal |
| vivo | Support the proposal. Just one comment on FFS part: this FG is for 120KHz and how extend it to FR1? Suggest to delete FR1 |

# Issue 6: FG 24-2

**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 | 24-2 | 120KHz SSB support for ~~SA/DC~~ initial access in FR2-2 | 1. Support 120KHz SSB for ~~SA/DC~~ initial access in FR2-2 | ~~[~~24-1, 24-1a~~]~~ | N/A | N/A | 120KHz SSB based ~~stand-alone~~ initial access in FR2-2 is not supported | ~~N/A~~ Per band | N/A | N/A | N/A | ~~per band~~~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~ capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with the suggestions. |
| LG Electronics | We are OK with the proposal. |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 7: FG 24-3

**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 | 24-3 | 480KHz SSB support for ~~SA/DC~~ initial access in FR2-2 | 1. Support 480KHz SSB for ~~SA/DC~~ initial access in FR2-2 | ~~24-1[~~, 24-2, 24-4, 24-4a~~]~~ | ~~FFS~~ N/A | N/A | 480KHz SSB for initial access in FR2-2 is not supported | ~~[per UE][~~per band~~]~~ | N/A | N/A | N/A | ~~FFS: whether to split this FG for SA and DC~~ | Optional ~~[~~with~~/without]~~ capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with the suggestions. |
| LG Electronics | We are OK with the proposal. |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 8: FG 24-4

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 480KHz with ~~X=4 slots~~ (Xs,Ys) = (4,1)~~FFS:~~ 3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with set2 = (4, 3) and (7, 3) symbols5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes Component 6 of FG 3-5b)  | 24-1 | Yes | N/A | 480KHz SCS for DL is not supported | ~~[~~Per ~~UE/~~band~~]~~ | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| LG Electronics | The component 6 can be revised as follows, since component 6 cannot be found in FG 3-5b:6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b) |
| Qualcomm | Support the proposal. LGE’s update is good for us |
| Intel | We are in general OK with all updates from Moderator. For the 4th bullet, since it only captures behavior related to Group (1) SS, it sounds more complete to add a FFS for Group (2) SS as placeholder. The exact wording on Group (2) SS can be elaborated later. Further, the wording ‘according to FG 3-5b with *set2* = (4, 3) and (7, 3) symbols’ should be revised since it is not exactly FG 3-5b. The agreement from RAN1#107-e is to do modification based on existing FG 3-5b. That is, the definition of span is reused, however, there are only maximum two spans in the Y=1 slot with a minimum gap of 4 symbols (consequence of *set2* = (4, 3) and (7, 3))* + For 480 kHz SCS For Y=1: FG3-5b with *set2* = (4, 3) and (7, 3) with a modification with maximum two monitoring spans in a slot
		- [FL Note: The first number is the minimum gap in symbols between the start of two spans, the second number is the span duration in symbols (cf. TS 38.822)]

4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with set2 = (4, 3) and (7, 3) symbols. * FFS limitation on other SS sets.
 |
| vivo | We think the 3rd bullet could be a separate FG. We understand that the peak data rate can’t be achieved without multi-PDSCH scheduling due to multi-slot PDCCH monitoring. However, for a UE not targeting high data rate, there is no need to implement multi-PDSCH scheduling and related complicated HARQ enhancement to save cost. A separate FG for this is more flexible to adapt different UE’s requirement. |

# Issue 9: FG 24-4a

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-23. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-1a, 24-4 | Yes | N/A | 480KHz SCS support for UL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with changes. |
| LG Electronics | We are OK with the proposal. |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 10: FG 24-4b

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2 ~~[with/without shared spectrum channel access]~~ | PRACH with 480KHz and length 571  | 24-4a | Yes | N/A | Wideband PRACH for 480 kHz in FR2-2 is not supported | Per band | N/A | N/A | N/A | ~~FFS: whether to split this FG for SA and DC~~~~[Agreement:~~~~Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH]~~ | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Similarly with 120kHz FG24-1b, we think this should be supported in case 24-4a is supported and in SA. We think it is critical that wideband PRACH and PUCCH is mandatory supported for SA if the UE support UL. Otherwise, for deployments where NW wishes to leverage wider coverage, there is no method to support a wider coverage. The whole motivation to even introduce wideband PRACH and PUCCH is gone in this case.If companies do not prefer to have 24-4a also support 24-4b together, we think this should only be the case for NSA. Therefore, we suggest changing the [per band] to “per BC” and add a note “in case FG 24-4a is supported in SA deployment, UE is required to also indicate support for FG24-4b”We are ok with other changes suggested. |
| LG Electronics | Similar to FG 24-1b, the following text needs to be added in the note column.Note: This FG is only supported in bands for shared spectrum operation |
| Qualcomm | Support the proposal. For LGE’s comment, as clarified during the first online session, for PRACH longer sequence, the objective in WID is not considered under shared spectrum access. So we believe the note is not needed. |
| vivo | Agree with LG that an additional note is needed similar to FG 24-1b. |

# Issue 11: FG 24-4f

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | [1.) Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys)=(2,1)]2.) Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys)=~~[~~(4,2)~~] slots~~3. Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-1 | 24-4 | Yes | N/A | Enhanced PDCCH monitoring for 480KHz in FR2-2 is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| LG Electronics | The following text needs to be added:4. For (Xs,Ys)=(4,2), processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-1)5. For (Xs,Ys)=(4,2), processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-1) |
| Qualcomm | Support the proposal. LGE’s change seems to be right. |
| Intel | For component 3, it is not clear about the exact meaning ‘according to FG 3-1’. Further, a FFS for Group (2) SS can be added as placeholder3. Within each of the Ys = 2 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-1. * FFS limitation on other SS sets
 |
| vivo | Support the proposal and agree with LG and Intel’s comment. |

# Issue 12: FG 24-5

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1) ~~slots~~~~FFS:~~ 3. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements3. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with set1 = (7, 3) symbols4. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-5b)5. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes Component 6 of FG 3-5b) | 24-1 | Yes | N/A | 960KHz SCS support for DL is not supported | ~~[~~Per ~~UE/~~band~~]~~ | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| LG Electronics | Similar to FG 24-4, the component 6 can be revised as follows, since component 6 cannot be found in FG 3-5b:6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-5b) |
| Qualcomm | Support the proposal. Agree with LGE’s change |
| Intel | Similar to the comments to FG 24-4. For the 4th bullet, we prefer to add a FFS for Group (2) SS as placeholder. Further, the wording ‘according to FG 3-5b with *set2* = (4, 3) and (7, 3) symbols’ should be revised since it is not exactly FG 3-5b. 4. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with set1 = (7, 3) symbols. * FFS limitation on other SS sets.
 |
| vivo | We think the 3rd bullet could be a separate FG. We understand that the peak data rate can’t be achieved without multi-PDSCH scheduling due to multi-slot PDCCH monitoring. However, for a UE not targeting high data rate, there is no need to implement multi-PDSCH scheduling and related complicated HARQ enhancement to save cost. A separate FG for this is more flexible to adapt different UE’s requirement. |

# Issue 13: FG 24-5a

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~[~~3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS~~]~~ | 24-1a, 24-5 | Yes | N/A | 960KHz SCS support for UL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with changes. |
| LG Electronics | We are OK with the proposal. |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 14: FG 24-5f

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-5f | Enhanced PDCCH monitoring for 960KHz | 1.) Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(4,1) 2.) Multiple-slot PDCCH monitoring for 960KHz with (X,Y)= (4,2)3.) Multiple-slot PDCCH monitoring for 960KHz with (X,Y)=(8,4) ~~slots~~3. Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-1 | 24-5 | Yes | N/A | Enhanced PDCCH monitoring for 960KHz is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| LG Electronics | We propose the following changes.1. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(4,1) 2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)= (4,2)3. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,4) ~~slots~~4. Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-15. Within the Ys = 1 slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-5b with set1 = (7, 3) symbols6. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD (This supersedes corresponding component of FG 3-1 or FG 3-5b)7. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD (This supersedes corresponding component of FG 3-1 or FG 3-5b) |
| Qualcomm | Just to clarify, for components 1,2,3, the UE can report any subset of them, instead of supporting all components, right? |
| Intel | Similar to FG 24-4f, for component 3, it is not clear about the exact meaning ‘according to FG 3-1’. Further, a FFS for Group (2) SS can be added as placeholder3. Within each of the Ys = 2 or 4 slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS according to FG 3-1. * FFS limitation on other SS sets
 |
| vivo | Same question as Qualcomm |

# Issue 15: FG 24-6

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-6 | ~~Support [~~Type 1~~]~~ channel access procedure in uplink for FR2-2 ~~unlicensed operation~~ with shared spectrum channel access  | 1. Support ~~[~~Type 1~~]~~ channel access procedure[2. Support LBT performed per carrier/BWP bandwidth] | 24-1a | Yes | N/A | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling~~[~~A UE that supports FR2-2 must indicate this FG is supported when required by regulation~~]~~ |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with changes. |
| LG Electronics | We are OK with the proposal. |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 16: FG 24-7

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-7 | ~~Support [~~Type 2~~]~~ channel access procedure in uplink for FR2-2 ~~unlicensed operation~~ with shared spectrum channel access | 1. Support ~~[~~Type 2~~]~~ channel access procedure[2. Support LBT performed per carrier/BWP bandwidth] | 24-1a, 24-6 | Yes | N/A | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling~~[~~A UE that supports FR2-2 must indicate this FG is supported when required by regulation~~]~~ |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with changes. |
| LG Electronics | We are OK with the proposal. |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Issue 17: FG 24-10

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-10 | Additional beam switching time delay | Supported additional beam switching time delay d for 480 kHz SCS |  | Yes | N/A | Additional beam switching time delay is not supported | Per UE | N/A | N/A | N/A | Candidate value set: 56 or 112 symbols | Optional with capability signalling |

***[Please only comment in the table if you are NOT okay with the proposed agreement]***

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Ok with changes. |
| LG Electronics | We are OK with the proposal. |
| Qualcomm | Support the proposal |
| vivo | Support the proposal |

# Conclusion

After further discussion on the RAN1 email reflector the following was agreed as part of this email discussion:

# References

1. R1-2112902, Updated RAN1 UE features list for Rel-17 NR after RAN1 #107-e, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2200050, Rel-17 UE features for extension to 71 GHz, Huawei/HiSilicon
3. R1-2200099, Discussions on UE features for NR operation from 52.6GHz to 71GHz, vivo
4. R1-2200217, UE features for supporting NR from 52.6 GHz to 71 GHz, Samsung
5. R1-2200247, Views on Rel-17 UE features for supporting NR in FR2-2, NTT DOCOMO, INC.
6. R1-2200266, Discussion on UE features for 52.6 to 71GHz, ZTE/Sanechips
7. R1-2200312, UE features for NR from 52.6 Ghz to 71 Ghz, Qualcomm Incorporated
8. R1-2200330, Discussion on UE feature for FR2-2, OPPO
9. R1-2200390, Discussion on UE capability for extending NR up to 71 GHz, Intel Corporation
10. R1-2200408, UE features for extending current NR operation to 71 GHz, Ericsson
11. R1-2200431, Views on Rel-17 Beyond 52.6 GHz UE features, Apple
12. R1-2200543, Views on UE features for supporting NR from 52.6 GHz to 71 GHz, MediaTek Inc.
13. R1-2200582, Discussion on UE features for NR above 52.6 GHz, LG Electronics
14. R1-2200623, On UE features for supporting NR from 52.6 GHz to 71 GHz, Nokia/Nokia Shanghai Bell