**3GPP TSG RAN WG1 #109-e R1-2204850**

**e-Meeting, May 9th – 20th, 2022**

**Agenda Item: 8.16.2**

**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 [109-e-R17-UE-features-52-71GHz-01] during RAN1 #109-e. According to the Chairman’s Notes:

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| [109-e-R17-UE-features-52-71GHz-01] Email discussion on UE features for supporting NR from 52.6 GHz to 71 GHz – Ralf (AT&T)* 1st check point for LS to RAN2: May 13
* Final check point for any remaining issues: May 20
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The following was discussed and/or agreed during RAN1 #109-e within the scope of [109-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 #109-e

The following is the moderator’s summary of contributions submitted to RAN1 #109-e in this agenda item.

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | 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 | [A UE that supports FG 24-2 must indicate this FG is supported][Note: This FG is only supported in bands for shared spectrum operation] | Optional withcapability signalling |

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| Company | Summary |
| Huawei/HiSilicon/SIA [2] | In RANP#95-e, the following agreement had been reached [2]. * Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”

The UE feature list prepared by RAN1 should be updated accordingly.For 24-1b, it is still pending on “[A UE that supports FG 24-2 must indicate this FG is supported]”. To our understanding, it is not necessary because all basic uplink capabilities to fulfil the initial access procedures have been captured in FG24-1a, which is already the prerequisite of 24-2. Moreover, FG24-2 is applied for both licensed band unlicensed band while FG24-1b is only for unlicensed band from our perspective. The sentence of “[A UE that supports FG 24-2 must indicate this FG is supported]” should be deleted from the note column of FG24-1b.***Proposal 2: Delete the sentence of “[A UE that supports FG 24-2 must indicate this FG is supported]” in the note column of FG24-1b.***

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | 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 | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| ZTE/Sanechips [3] | In RAN plenary #95 e-meeting, the notes under FG 24-1b, 24-4b and 24-1c was further clarified and the following conclusion was achieved:

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| Updated Proposal 5 (option 2): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with“This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations” |

According to the above agreement, we propose to update the notes as “This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations”.**Proposal 1: Update the notes in FG 24-1b, FG 24-4b and FG 24-1c as “This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations”.** |
| Vivo [4] | After RAN1#108, it is not decided yet applicable spectrum type of wideband PRACH, i.e., unlicensed band only or not. This issue is then discussed in RAN#95-e meeting with the following proposal agreed:Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”Then 24-1b and 24-4b should be updated to capture RAN agreement.Proposal 1: For FG 24-1b and 24-4b, replace “[Note: This FG is only supported in bands for shared spectrum operation]” with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”.On 24-1b, another issue is whether “A UE that supports FG 24-2 must indicate this FG is supported”, the same handling as NRU should be adopted, i.e. 10-27 in [1]. It is clearly that wideband PRACH is not a basic FG for any scenario. Therefore, there is no need to bundle 24-2 and 24-1b together. Proposal 2: For 24-1b, remove “A UE that supports FG 24-2 must indicate this FG is supported”. |
| Samsung [5] |  |
| Ericsson [6] | In RAN#95-e the following agreement was made:Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”Based on this we propose 1. Modify note in FG 24-1b, 24-1c, 24-4b, 24-4c, 24-5c as shown below to capture RAN#95-e agreement

In previous meetings, there was discussion on whether or not FG 24-1b (wideband PRACH) and FG 24-1c (multi-RB PUCCH) should be mandatory for a UE that supports standalone operation in FR2-2, i.e., a UE that supports FG 24-2. Additionally, it was discussed whether or not FG 24-1c should be mandatory for a UE that supports UL in FR2-2. In our view, these features should not be mandatory since not all deployment scenarios are coverage limited. We understand that for a standalone deployment, there is no mechanism to indicate UE capability for wideband PRACH/multi-RB during initial access; however, if a network indicates in SIB1 that either of these features should be used, and the UE does not support them, the UE simply cannot access the system.However, even if the network indicates legacy PRACH (L = 139) and legacy PUCCH (single RB), it is still useful for the UE to indicate capability for FG 24-1b/c after initial access from the perspective that the network can capture statistics on UE support for these features. Once a significant fraction of the UE fleet supports wideband PRACH/multi-RB PUCCH, then the features 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 it still makes sense that the feature is defined as "Optional with capability signaling."1. Modify FG 24-1b and FG 24-1c as follows such that these FGs are not mandatory for either standalone operation or if the UE supports UL.

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| 24-1b | Wideband PRACH for 120 kHz in FR2-2 | 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 | ~~[A UE that supports FG 24-2 must indicate this FG is supported]~~~~[Note: This FG is only supported in bands for shared spectrum operation]~~This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-1b/24-1c/24-4b/24-4c/24-5c, RAN#95-e has decided to replace “Note: This FG is only supported in bands for shared spectrum operation” for “this FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations” given that these features are generally to deal with PSD limitation required in some regions. It can be confirmed without any technical discussion, in order to follow RAN decision. Also, for FG24-1b/24-1c, there is an FFS on whether to have a Note that makes these features mandatory in a certain case, e.g., when a UE supports FG24-2 (i.e., SA operation in FR2-2 with 120kHz SCS). We actually support the Note, i.e., prefer to ask UEs supporting SA to mandatorily support these FGs to make them available even during initial access. Without the Note, these FGs will be just optional ones in any scenario, which means gNB in general cannot configure them for initial access since gNB does not have prior knowledge on whether UEs support them or not. believe it is essential to have such a Note for these features since NW may not be able to configure these features for any UEs during initial access. We believe these FGs are well understood as features for improving coverage performance under PSD limitation. Thus, if they are not available during initial access, practical coverage is limited in SA scenario even if they are available after initial access. Although SA operation without them could work (with limited coverage), we hope to make these FGs available regardless of scenarios, including SA. We also believe the same note would be essential for FG24-4b and 24-4c for UE supporting 24-3.

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | 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 | A UE that supports FG 24-2 in a band where PSD limitation applies must indicate this FG is supportedNote: This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| Nokia/Nokia Shanghai Bell [10] | * + Implement the following agreement has been reached in RAN#95-e [3]:
		- Replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “**This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations**”
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| LG Electronics [11] |  |
| MediaTek Inc. [12] | Whether the FG 24-1b 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.

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|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | 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  |  | Optional ~~[~~with~~/without]~~capability signallingThis FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations~~[A UE that supports 24-2 must indicate this FG is supported]~~ |

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| Intel Corporation [13] | 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.Based on this we propose the following:**Proposal 1: FG 24-1b and 24-1c add/keep the note that “A UE that support FG24-2 must indicated this FG is supported”.**

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| 24-1b | Wideband PRACH for 120 kHz in FR2-2 | 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 | ~~[~~A UE that supports FG 24-2 must indicate this FG is supported~~]~~[Note: This FG is only supported in bands for shared spectrum operation] | Optional with capability signalling |

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|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH 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 | [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 | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon/SIA [2] | In RANP#95-e, the following agreement had been reached [2]. * Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”

The UE feature list prepared by RAN1 should be updated accordingly.For 24-1c, the issue on “[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]” is not resolved. According to the agreement in RANP#95-e, “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”. However, even in unlicensed bands, PSD limitations do not apply in all regions. However, FG24-1a, FG24-2 or even the whole FR2-2 would include both licensed band and unlicensed band regardless of the region. In our view, in practice, it is not necessary for a UE that only supports licensed band to report this capability. For the UE operating on the unlicensed band without PSD limitation, this FG is also redundant. Thus, we propose to delete the sentence of “[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]”in the note column. ***Proposal 3: Delete the sentence of “[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]” in the note column of FG24-1c.***

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|  | 24-1c | Multi-RB supportPUCCH 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 | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| ZTE/Sanechips [3] | In RAN plenary #95 e-meeting, the notes under FG 24-1b, 24-4b and 24-1c was further clarified and the following conclusion was achieved:

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| Updated Proposal 5 (option 2): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with“This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations” |

According to the above agreement, we propose to update the notes as “This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations”.**Proposal 1: Update the notes in FG 24-1b, FG 24-4b and FG 24-1c as “This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations”.** |
| Vivo [4] | Similar with wideband PRACH, the note should be updated and there is no need to bundle the following FG with any other FG.Proposal 3: For FG 24-1c, 24-4c and 24-5c, replace “This FG is only supported in bands for shared spectrum operation” with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”.Proposal 4: For 24-1c, remove “[A UE that supports FG 24-2 must indicate this FG is supported]”. |
| Samsung [5] |  |
| Ericsson [6] | In RAN#95-e the following agreement was made:Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”Based on this we propose 1. Modify note in FG 24-1b, 24-1c, 24-4b, 24-4c, 24-5c as shown below to capture RAN#95-e agreement

In previous meetings, there was discussion on whether or not FG 24-1b (wideband PRACH) and FG 24-1c (multi-RB PUCCH) should be mandatory for a UE that supports standalone operation in FR2-2, i.e., a UE that supports FG 24-2. Additionally, it was discussed whether or not FG 24-1c should be mandatory for a UE that supports UL in FR2-2. In our view, these features should not be mandatory since not all deployment scenarios are coverage limited. We understand that for a standalone deployment, there is no mechanism to indicate UE capability for wideband PRACH/multi-RB during initial access; however, if a network indicates in SIB1 that either of these features should be used, and the UE does not support them, the UE simply cannot access the system.However, even if the network indicates legacy PRACH (L = 139) and legacy PUCCH (single RB), it is still useful for the UE to indicate capability for FG 24-1b/c after initial access from the perspective that the network can capture statistics on UE support for these features. Once a significant fraction of the UE fleet supports wideband PRACH/multi-RB PUCCH, then the features 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 it still makes sense that the feature is defined as "Optional with capability signaling."1. Modify FG 24-1b and FG 24-1c as follows such that these FGs are not mandatory for either standalone operation or if the UE supports UL.

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| --- | --- | --- | --- | --- | --- | --- |
| 24-1c | Multi-RB supportPUCCH 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 | Per band | ~~[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~~This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-1b/24-1c/24-4b/24-4c/24-5c, RAN#95-e has decided to replace “Note: This FG is only supported in bands for shared spectrum operation” for “this FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations” given that these features are generally to deal with PSD limitation required in some regions. It can be confirmed without any technical discussion, in order to follow RAN decision. Also, for FG24-1b/24-1c, there is an FFS on whether to have a Note that makes these features mandatory in a certain case, e.g., when a UE supports FG24-2 (i.e., SA operation in FR2-2 with 120kHz SCS). We actually support the Note, i.e., prefer to ask UEs supporting SA to mandatorily support these FGs to make them available even during initial access. Without the Note, these FGs will be just optional ones in any scenario, which means gNB in general cannot configure them for initial access since gNB does not have prior knowledge on whether UEs support them or not. believe it is essential to have such a Note for these features since NW may not be able to configure these features for any UEs during initial access. We believe these FGs are well understood as features for improving coverage performance under PSD limitation. Thus, if they are not available during initial access, practical coverage is limited in SA scenario even if they are available after initial access. Although SA operation without them could work (with limited coverage), we hope to make these FGs available regardless of scenarios, including SA. We also believe the same note would be essential for FG24-4b and 24-4c for UE supporting 24-3.

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|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH 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 | A UE that supports 24-2 in a band where PSD limitation applies must indicate this FG is supportedThis FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| Nokia/Nokia Shanghai Bell [10] | * + Implement the following agreement has been reached in RAN#95-e [3]:
		- Replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “**This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations**”
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| LG Electronics [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.

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|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB supportPUCCH 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 |  | Optional with capability signalling~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]~~This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations |

 |
| Intel Corporation [13] | 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.Based on this we propose the following:**Proposal 1: FG 24-1b and 24-1c add/keep the note that “A UE that support FG24-2 must indicated this FG is supported”.**

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| 24-1c | Multi-RB supportPUCCH 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 | Per band | ~~[~~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 | Optional with capability signalling |

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|  24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB support for initial access in FR2-2 | 1. Support 120KHz SSB for initial access in FR2-2 | 24-1, 24-1a | N/A | N/A | 120KHz SSB based initial access in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon/SIA [2] |  |
| ZTE/Sanechips [3] | For FG 24-2 and FG24-3, we can observe from FG list that these two FGs are described as “N/A” in the column “Need for the gNB to know if the feature is supported”, while described as “optional with capability singalling” in the column “Mandatory/Optional”. It is unclear whether the corresponding capabilities should be signalled or not according to the current description. In our view, if the capability is allowed to be signalled, then gNB need to know if this feature/capability is supported. Correspondingly, “N/A” in the column “Need for the gNB to know if the feature is supported” should be updated. However, during initial access, there is no UE capability. From this point of view, it would be better to update “optional with capability singalling” as “optional without capability singalling” in the column “Mandatory/Optional” and keep “N/A” in “N/A” in the column “Need for the gNB to know if the feature is supported”. If the above mentioned issue cannot be handled in RAN1, it can be handed over to RAN2 for decision whether “N/A” in the column “Need for the gNB to know if the feature is supported” need to be updated or “optional with capability singalling” in the column “Mandatory/Optional” need to be updated as “optional without capability singalling”.**Proposal 2: Clarify whether the capability corresponding to FG 24-2 and FG 24-3 should be signalled to gNB from RAN1 point of view, or this issue is left to RAN2 for decision.** |
| Vivo [4] |  |
| Samsung [5] |  |
| Ericsson [6] |  |
| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-2/3, RAN2 has sent an LS [2] to RAN1 in this e-meeting, in which the following has been asked:

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| C) R1 24-2 and 24-3Both of the features have N/A in the column of “Need for the gNB to know if the feature is supported” while indicate in the column of “Mandatory/Optional” as “optional with capability signalling”. From RAN2 perspective, if there is no need for gNB to know whether a feature is supported or not, no capability signalling should be defined. RAN2 also noticed that there are other features in NTN that have such ambiguities (e.g. R1 26-1/26-8 for NTN WI). RAN2 would like to know whether such capabilities are really “optional with capability signalling” |

In our understanding, these FGs are intended for UE supporting DC and/or SA operation, which requires similar PHY functionalities but potentially different implementations. * When DC is operated for a UE for which RRC connection has been established via another (e.g., lower) band already, NW needs to know whether the UE supports DC in FR2-2 or not. For this purpose, FG24-2/24-3 should be optional with capability signaling.
* When SA is operation for a UE for which no RRC connection has been established, NW does not need to know whether the UE supports SA in FR2-2 (rather these is no way to do so before initial access). For this purpose, “Need for the gNB to know if the feature is supported” can be N/A.

Since we believe the current FG structure captures the intention above well, we do not see the need to have changes in terms of RAN2’s question (though they are clarified for RAN2 in the form of reply LS). Meanwhile, if one argues that the current FG structure is confusing, we are open to consider measures to avoid that. One potential resolution could be to divide each FG into two, one is for DC, and the other is for SA. For DC, depending on the related SCS, FG24-2 or 24-3 can be reused with the change of “Need for the gNB to know if the feature is supported” from N/A to Yes. For SA, a new FG with similar contents to FG24-2 or FG24-3 depending on its relevant SCS can be considered, with the change on “Mandatory/optional” from “Optional with capability signaling” to “Optional without capability signaling”. FG24-2 or FG24-3 can be defined as prerequisite.  |
| Nokia/Nokia Shanghai Bell [10] |  |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] |  |

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|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB support for initial access in FR2-2 | 1. Support 480KHz SSB for initial in FR2-2 | 24-2, 24-4, 24-4a | N/A | N/A | 480KHz SSB for initial access in FR2-2 is not supported | per band | N/A | N/A | N/A |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon/SIA [2] |  |
| ZTE/Sanechips [3] | For FG 24-2 and FG24-3, we can observe from FG list that these two FGs are described as “N/A” in the column “Need for the gNB to know if the feature is supported”, while described as “optional with capability singalling” in the column “Mandatory/Optional”. It is unclear whether the corresponding capabilities should be signalled or not according to the current description. In our view, if the capability is allowed to be signalled, then gNB need to know if this feature/capability is supported. Correspondingly, “N/A” in the column “Need for the gNB to know if the feature is supported” should be updated. However, during initial access, there is no UE capability. From this point of view, it would be better to update “optional with capability singalling” as “optional without capability singalling” in the column “Mandatory/Optional” and keep “N/A” in “N/A” in the column “Need for the gNB to know if the feature is supported”. If the above mentioned issue cannot be handled in RAN1, it can be handed over to RAN2 for decision whether “N/A” in the column “Need for the gNB to know if the feature is supported” need to be updated or “optional with capability singalling” in the column “Mandatory/Optional” need to be updated as “optional without capability singalling”.**Proposal 2: Clarify whether the capability corresponding to FG 24-2 and FG 24-3 should be signalled to gNB from RAN1 point of view, or this issue is left to RAN2 for decision.** |
| Vivo [4] |  |
| Samsung [5] |  |
| Ericsson [6] |  |
| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-2/3, RAN2 has sent an LS [2] to RAN1 in this e-meeting, in which the following has been asked:

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| C) R1 24-2 and 24-3Both of the features have N/A in the column of “Need for the gNB to know if the feature is supported” while indicate in the column of “Mandatory/Optional” as “optional with capability signalling”. From RAN2 perspective, if there is no need for gNB to know whether a feature is supported or not, no capability signalling should be defined. RAN2 also noticed that there are other features in NTN that have such ambiguities (e.g. R1 26-1/26-8 for NTN WI). RAN2 would like to know whether such capabilities are really “optional with capability signalling” |

In our understanding, these FGs are intended for UE supporting DC and/or SA operation, which requires similar PHY functionalities but potentially different implementations. * When DC is operated for a UE for which RRC connection has been established via another (e.g., lower) band already, NW needs to know whether the UE supports DC in FR2-2 or not. For this purpose, FG24-2/24-3 should be optional with capability signaling.
* When SA is operation for a UE for which no RRC connection has been established, NW does not need to know whether the UE supports SA in FR2-2 (rather these is no way to do so before initial access). For this purpose, “Need for the gNB to know if the feature is supported” can be N/A.

Since we believe the current FG structure captures the intention above well, we do not see the need to have changes in terms of RAN2’s question (though they are clarified for RAN2 in the form of reply LS). Meanwhile, if one argues that the current FG structure is confusing, we are open to consider measures to avoid that. One potential resolution could be to divide each FG into two, one is for DC, and the other is for SA. For DC, depending on the related SCS, FG24-2 or 24-3 can be reused with the change of “Need for the gNB to know if the feature is supported” from N/A to Yes. For SA, a new FG with similar contents to FG24-2 or FG24-3 depending on its relevant SCS can be considered, with the change on “Mandatory/optional” from “Optional with capability signaling” to “Optional without capability signaling”. FG24-2 or FG24-3 can be defined as prerequisite.  |
| Nokia/Nokia Shanghai Bell [10] |  |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] |  |

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|  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 (Xs,Ys) = (4,1)3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot (with Xs=4), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y) = (4, 3) and (7, 3) are supported5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD[7. 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 each slot of the slot group, 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 each slot of the slot group.] | 24-1 | Yes | N/A | 480KHz SCS for DL is not supported | Perband | N/A | N/A | N/A |  | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon/SIA [2] | The 7th component of “[7. 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 each slot of the slot group, 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 each slot of the slot group.]”on the MO configuration for group 2) CSS is still pending because whether to further restrict monitoring occasions for the group 2) CSS is under discussion. In RAN1 108-e, the following working assumption on group 2) CSS was reached.* + Working assumption: For Group (2) SSs
		- For Type0/0A/2 CSS
			* The slots indicated in *monitoringSlotsWithinSlotGroup-r17* are not restricted to be consecutive
			* The number of slots configured for multi-slot PDCCH monitoring in *monitoringSlotsWithinSlotGroup-r17* can be up to L
		- For Type1 CSS without dedicated RRC
			* The number of slots configured for multi-slot PDCCH monitoring in *monitoringSlotsWithinSlotGroup-r17* per slot group of slots should be no larger than M, where M is FFS

It is observed that no additional restriction is added for type0/0A/2 CSS. Moreover, for Type1 CSS without dedicated RRC, we do not think it should be treated differently from the other CSSs in group 2) because it restricts maximum number of MOs within the RAR window. The detail discussion can be found in our companion paper [6] submitted to AI8.2.2. Thus, we propose to remove the bracket on the component 7 for FG24-4 and FG24-5. ***Proposal 5: Support to remove bracket on component 7 in FG24-4 and FG24-5.***

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|  | 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 (Xs,Ys) = (4,1)3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot (with Xs=4), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y) = (4, 3) and (7, 3) are supported5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD7. 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 each slot of the slot group, 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 each slot of the slot group. | 24-1 | Yes | N/A | 480KHz SCS for DL is not supported | Perband | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| ZTE/Sanechips [3] | In RAN1#107bis e-meeting, monitoring capability within slots of Group (2) SSs (type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) was specified. The following agreement was made:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ 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 each 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 each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

Therefore, we suggest to confirm the yellow highlighting part and remove its bracket for FG 24-4 and FG 24-5 based on the agreement made so far. As we elaborate in the Tdoc of AI 8.2.2, Group (2) SSs monitoring locations can be anywhere within a slot group of X slots similar as in Rel-15/16 and we don’t expect other restrictions for Group (2) SSs. If other limitation for Group (2) SSs which we do not prefer to is intrduced, we can futher update the table.**Proposal 3: Confirm the yellow highlighting part and remove the bracket for FG 24-4 and FG 24-5:** |
| Vivo [4] |  |
| Samsung [5] |  |
| Ericsson [6] | For FG 24-4 and 24-5, the open issue is to address the FFS on the mandatory monitoring capability for Group (2) search spaces (type 1 CSS w/o RRC and type 0/0A/2 CSS). On this issue, the following agreement was made in RAN1#107bis-e which defines the mandatory capability:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ 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 each 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 each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

Regarding the last bullet of the above agreement, there was continued discussion on whether or not to introduce other limitation for Group (2) SSs. The following agreement was made (only latter part shown) which contains a working assumption for Group (2) SSs.**Agreement**…* Introduce new parameter *monitoringSlotsWithinSlotGroup-r17*
	+ Two sizes L are supported for this parameter: L=4 bits and L=8 bits
	+ Each bit in *monitoringSlotsWithinSlotGroup-r17* represents a slot in a group of L slots
	+ The parameter *monitoringSlotsWithinSlotGroup-r17* is applied in each of the L slots as determined by *monitoringSlotPeriodicityAndOffset-r17* and *duration-r17*.
	+ A slot in each group of L slots is configured for multi-slot PDCCH monitoring if the corresponding bit in *monitoringSlotsWithinSlotGroup-r17* is set to '1'
		- Note: Further configuration of the monitoring symbols in such a slot is done by *monitoringSymbolsWithinSlot*
	+ For Group (1) SSs
		- The slots indicated in the bitmap should be consecutive per group of L slots
		- The number of slots configured for multi-slot PDCCH monitoring per slot group of slots should be no larger than according to at least one of the supported by a UE

* + Working assumption: For Group (2) SSs
		- For Type0/0A/2 CSS
			* The slots indicated in *monitoringSlotsWithinSlotGroup-r17* are not restricted to be consecutive
			* The number of slots configured for multi-slot PDCCH monitoring in *monitoringSlotsWithinSlotGroup-r17* can be up to L
		- For Type1 CSS without dedicated RRC
			* The number of slots configured for multi-slot PDCCH monitoring in *monitoringSlotsWithinSlotGroup-r17* per slot group of slots should be no larger than M, where M is FFS

The description of Component 7 in FG 24-4 and 24-5 is still in square brackets as follows:[7. 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 each slot of the slot group, 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 each slot of the slot group.]While this text is consistent with the RAN1#107bis-e agreement shown above, it may require further modification based on the above working assumption from RAN1#108-e (which itself contains an FFS). Since Group (2) monitoring is still under discussion it is fair to say that Component 7 should still be left in square brackets until discussion on this issue is concluded.1. For FG 24-4 and FG 24-5, leave the text description of Component 7 in square brackets until discussion in concluded on monitoring of Group (2) SSs.
 |
| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-4 and FG24-5, an FFS point is component 7 for Type 0/0A/2 CSS and Type 1 CSS without dedicated RRC configuration. In WI, the detail is almost completed already, except for the handling of Type 1 CSS without dedicated RRC configuration. Since it is still under WI discussion, we think it would be better to wait for WI progress a bit more for this issue.

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|  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 (Xs,Ys) = (4,1)3. Multi-PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot (with Xs=4), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y) = (4, 3) and (7, 3) are supported5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD[7. 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 each slot of the slot group, 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 each slot of the slot group.] | 24-1 | Yes | N/A | 480KHz SCS for DL is not supported | Perband | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell [10] |  |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] | The main issue for component 7 is that there is still on-going discussion the whether what is the default/mandatory monitoring capability related to CSS monitoring. Given that this has more to do with design aspect of CSS monitoring for 480 kHz and 960 kHz, our preference is to wait for further agreement to be made in the 8.2.2 PDCCH enhancement agenda for NR up to 71 GHz WI.**Proposal 2: Revise component 7 of FG24-4 and FG24-5 after further conclusion is made on CSS PDCCH monitoring in PDCCH enhancement agenda of NR up to 71 GHz WI.** |

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|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2 | 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 | [Note: This FG is only supported in bands for shared spectrum operation] | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon/SIA [2] | In RANP#95-e, the following agreement had been reached [2]. * Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”

The UE feature list prepared by RAN1 should be updated accordingly.

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|  | 24-4b | Wideband PRACH for 480 kHz in FR2-2 | 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 | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| ZTE/Sanechips [3] | In RAN plenary #95 e-meeting, the notes under FG 24-1b, 24-4b and 24-1c was further clarified and the following conclusion was achieved:

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| Updated Proposal 5 (option 2): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with“This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations” |

According to the above agreement, we propose to update the notes as “This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations”.**Proposal 1: Update the notes in FG 24-1b, FG 24-4b and FG 24-1c as “This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations”.** |
| Vivo [4] | After RAN1#108, it is not decided yet applicable spectrum type of wideband PRACH, i.e., unlicensed band only or not. This issue is then discussed in RAN#95-e meeting with the following proposal agreed:Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”Then 24-1b and 24-4b should be updated to capture RAN agreement.Proposal 1: For FG 24-1b and 24-4b, replace “[Note: This FG is only supported in bands for shared spectrum operation]” with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”. |
| Samsung [5] |  |
| Ericsson [6] | In RAN#95-e the following agreement was made:Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”Based on this we propose 1. Modify note in FG 24-1b, 24-1c, 24-4b, 24-4c, 24-5c as shown below to capture RAN#95-e agreement

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| --- | --- | --- | --- | --- | --- | --- |
| 24-4b | Wideband PRACH for 480 kHz in FR2-2 | PRACH with 480KHz and length 571  | 24-4a | Per band | ~~[Note: This FG is only supported in bands for shared spectrum operation]~~This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-1b/24-1c/24-4b/24-4c/24-5c, RAN#95-e has decided to replace “Note: This FG is only supported in bands for shared spectrum operation” for “this FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations” given that these features are generally to deal with PSD limitation required in some regions. It can be confirmed without any technical discussion, in order to follow RAN decision.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2 | 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 | Note: This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulationsA UE that supports FG 24-3 in a band where PSD limitation applies must indicate this FG is supported | Optional with capability signalling |

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| Nokia/Nokia Shanghai Bell [10] | * + Implement the following agreement has been reached in RAN#95-e [3]:
		- Replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “**This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations**”
 |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 | 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 | This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon/SIA [2] | In RANP#95-e, the following agreement had been reached [2]. * Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”

The UE feature list prepared by RAN1 should be updated accordingly.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 | 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 | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations  | Optional with capability signalling |

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| ZTE/Sanechips [3] |  |
| Vivo [4] | Similar with wideband PRACH, the note should be updated and there is no need to bundle the following FG with any other FG.Proposal 3: For FG 24-1c, 24-4c and 24-5c, replace “This FG is only supported in bands for shared spectrum operation” with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”. |
| Samsung [5] |  |
| Ericsson [6] | In RAN#95-e the following agreement was made:Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”Based on this we propose 1. Modify note in FG 24-1b, 24-1c, 24-4b, 24-4c, 24-5c as shown below to capture RAN#95-e agreement

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 | Support multi-RB PUCCH format 0/1/4 for 480 kHz | 24-4a | Per band | ~~This FG is only supported in bands under PSD limitation in shared spectrum operation~~This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

 |
| OPPO [7] |  |
| Apple [8] | For FG24-1b/24-1c/24-4b/24-4c/24-5c, RAN#95-e has decided to replace “Note: This FG is only supported in bands for shared spectrum operation” for “this FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations” given that these features are generally to deal with PSD limitation required in some regions. It can be confirmed without any technical discussion, in order to follow RAN decision. |
| NTT DOCOMO, INC. [9] |

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|  24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 | 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 | This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulationsA UE that supports FG 24-3 in a band where PSD limitation applies must indicate this FG is supported | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell [10] | * + Implement the following agreement has been reached in RAN#95-e [3]:
		- Replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “**This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations**”
 |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] |  |

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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 (Xs,Ys)=(8,1)3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot (with Xs=8), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y)= (7, 3) is supported5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD[7. 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 each slot of the slot group, 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 each slot of the slot group.] | 24-1 | Yes | N/A | 960KHz SCS support for DL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon/SIA [2] | The 7th component of “[7. 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 each slot of the slot group, 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 each slot of the slot group.]”on the MO configuration for group 2) CSS is still pending because whether to further restrict monitoring occasions for the group 2) CSS is under discussion. In RAN1 108-e, the following working assumption on group 2) CSS was reached.* + Working assumption: For Group (2) SSs
		- For Type0/0A/2 CSS
			* The slots indicated in *monitoringSlotsWithinSlotGroup-r17* are not restricted to be consecutive
			* The number of slots configured for multi-slot PDCCH monitoring in *monitoringSlotsWithinSlotGroup-r17* can be up to L
		- For Type1 CSS without dedicated RRC
			* The number of slots configured for multi-slot PDCCH monitoring in *monitoringSlotsWithinSlotGroup-r17* per slot group of slots should be no larger than M, where M is FFS

It is observed that no additional restriction is added for type0/0A/2 CSS. Moreover, for Type1 CSS without dedicated RRC, we do not think it should be treated differently from the other CSSs in group 2) because it restricts maximum number of MOs within the RAR window. The detail discussion can be found in our companion paper [6] submitted to AI8.2.2. Thus, we propose to remove the bracket on the component 7 for FG24-4 and FG24-5. ***Proposal 5: Support to remove bracket on component 7 in FG24-4 and 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 (Xs,Ys)=(8,1)3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot (with Xs=8), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y)= (7, 3) is supported5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD7. 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 each slot of the slot group, 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 each slot of the slot group. | 24-1 | Yes | N/A | 960KHz SCS support for DL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| ZTE/Sanechips [3] | In RAN1#107bis e-meeting, monitoring capability within slots of Group (2) SSs (type 1 CSS without dedicated RRC configuration and type0, 0A, and 2 CSS) was specified. The following agreement was made:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ 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 each 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 each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

Therefore, we suggest to confirm the yellow highlighting part and remove its bracket for FG 24-4 and FG 24-5 based on the agreement made so far. As we elaborate in the Tdoc of AI 8.2.2, Group (2) SSs monitoring locations can be anywhere within a slot group of X slots similar as in Rel-15/16 and we don’t expect other restrictions for Group (2) SSs. If other limitation for Group (2) SSs which we do not prefer to is intrduced, we can futher update the table.**Proposal 3: Confirm the yellow highlighting part and remove the bracket for FG 24-4 and FG 24-5:** |
| Vivo [4] |  |
| Samsung [5] |  |
| Ericsson [6] | For FG 24-4 and 24-5, the open issue is to address the FFS on the mandatory monitoring capability for Group (2) search spaces (type 1 CSS w/o RRC and type 0/0A/2 CSS). On this issue, the following agreement was made in RAN1#107bis-e which defines the mandatory capability:**Agreement**Clarify earlier agreement as follows:* A UE capable of multi-slot monitoring mandatorily supports monitoring Group (2) SSs according to FG 3-1 within each of the Xs slots of a slot-group, such that:
	+ 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 each 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 each slot of the slot group.
* Continue discussion on whether or not introducing other limitation for Group (2) SSs in RAN1#108-e.

Regarding the last bullet of the above agreement, there was continued discussion on whether or not to introduce other limitation for Group (2) SSs. The following agreement was made (only latter part shown) which contains a working assumption for Group (2) SSs.**Agreement**…* Introduce new parameter *monitoringSlotsWithinSlotGroup-r17*
	+ Two sizes L are supported for this parameter: L=4 bits and L=8 bits
	+ Each bit in *monitoringSlotsWithinSlotGroup-r17* represents a slot in a group of L slots
	+ The parameter *monitoringSlotsWithinSlotGroup-r17* is applied in each of the L slots as determined by *monitoringSlotPeriodicityAndOffset-r17* and *duration-r17*.
	+ A slot in each group of L slots is configured for multi-slot PDCCH monitoring if the corresponding bit in *monitoringSlotsWithinSlotGroup-r17* is set to '1'
		- Note: Further configuration of the monitoring symbols in such a slot is done by *monitoringSymbolsWithinSlot*
	+ For Group (1) SSs
		- The slots indicated in the bitmap should be consecutive per group of L slots
		- The number of slots configured for multi-slot PDCCH monitoring per slot group of slots should be no larger than according to at least one of the supported by a UE

* + Working assumption: For Group (2) SSs
		- For Type0/0A/2 CSS
			* The slots indicated in *monitoringSlotsWithinSlotGroup-r17* are not restricted to be consecutive
			* The number of slots configured for multi-slot PDCCH monitoring in *monitoringSlotsWithinSlotGroup-r17* can be up to L
		- For Type1 CSS without dedicated RRC
			* The number of slots configured for multi-slot PDCCH monitoring in *monitoringSlotsWithinSlotGroup-r17* per slot group of slots should be no larger than M, where M is FFS

The description of Component 7 in FG 24-4 and 24-5 is still in square brackets as follows:[7. 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 each slot of the slot group, 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 each slot of the slot group.]While this text is consistent with the RAN1#107bis-e agreement shown above, it may require further modification based on the above working assumption from RAN1#108-e (which itself contains an FFS). Since Group (2) monitoring is still under discussion it is fair to say that Component 7 should still be left in square brackets until discussion on this issue is concluded.**Proposal: For FG 24-4 and FG 24-5, leave the text description of Component 7 in square brackets until discussion in concluded on monitoring of Group (2) SSs.** |
| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-4 and FG24-5, an FFS point is component 7 for Type 0/0A/2 CSS and Type 1 CSS without dedicated RRC configuration. In WI, the detail is almost completed already, except for the handling of Type 1 CSS without dedicated RRC configuration. Since it is still under WI discussion, we think it would be better to wait for WI progress a bit more for this issue.

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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 (Xs,Ys)=(8,1)3. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements4. Within the Ys = 1 slot (with Xs=8), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y)= (7, 3) is supported5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD[7. 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 each slot of the slot group, 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 each slot of the slot group.] | 24-1 | Yes | N/A | 960KHz SCS support for DL is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell [10] |  |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] | The main issue for component 7 is that there is still on-going discussion the whether what is the default/mandatory monitoring capability related to CSS monitoring. Given that this has more to do with design aspect of CSS monitoring for 480 kHz and 960 kHz, our preference is to wait for further agreement to be made in the 8.2.2 PDCCH enhancement agenda for NR up to 71 GHz WI.**Proposal 2: Revise component 7 of FG24-4 and FG24-5 after further conclusion is made on CSS PDCCH monitoring in PDCCH enhancement agenda of NR up to 71 GHz WI.** |

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|  24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 | 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 | This FG is only supported in bands under PSD limitation in shared spectrum operation | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon/SIA [2] | In RANP#95-e, the following agreement had been reached [2]. * Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”

The UE feature list prepared by RAN1 should be updated accordingly.

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|  | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 | 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 | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| ZTE/Sanechips [3] |  |
| Vivo [4] | Similar with wideband PRACH, the note should be updated and there is no need to bundle the following FG with any other FG.Proposal 3: For FG 24-1c, 24-4c and 24-5c, replace “This FG is only supported in bands for shared spectrum operation” with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”. |
| Samsung [5] |  |
| Ericsson [6] | In RAN#95-e the following agreement was made:Final Proposal 5 (agreed): replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations”Based on this we propose 1. Modify note in FG 24-1b, 24-1c, 24-4b, 24-4c, 24-5c as shown below to capture RAN#95-e agreement

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| --- | --- | --- | --- | --- | --- | --- |
| 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 | Support multi-RB PUCCH format 0/1/4 for 960 kHz | 24-5a | Per band | ~~This FG is only supported in bands under PSD limitation in shared spectrum operation~~This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] |

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|  24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 | 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 | This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell [10] | * + Implement the following agreement has been reached in RAN#95-e [3]:
		- Replace the notes under FGs 24-1c, 24-4c and 24-5c for multi-RB PUCCH, and replace the bracketed notes under FGs 24-1b and 24-4b for wideband PRACH, with “**This FG is only supported when PSD limitation applies within FR2-2 based on the regional regulations**”
 |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] |  |

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

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon/SIA [2] | In the RAN1#108-e, the following agreement on the LBT bandwidth was reached. As a compromise, the LBT bandwidth was defined as channel which includes at least the active BWP. Thus, the component of “[2. Support LBT performed per carrier/BWP bandwidth]” should be updated as “Support LBT performed per channel at least includes the active UL BWP bandwidth for single carrier UL transmission”.**Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213

**Agreement**For LBT for single carrier DL transmission to a UE, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth
* The BW that at least includes the active DL BWP bandwidth is captured as “channel” in 37.213

For LBT for single carrier DL transmission to multiple UEs, from each UE point of view, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth that includes the active DL BWP of multiple UEs

***Proposal 6： The component 2 in FG24-6 and FG24-7 should be updated as “Support LBT performed per channel that at least includes the active UL BWP bandwidth for single carrier UL transmission”*.**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-6 | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 1 channel access procedure2. Support LBT performed per channel at least includes active UL 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 | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

 |
| ZTE/Sanechips [3] | Regarding LBT bandwidth, the following agreement has been achieved in the last meeting:

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| **Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213

**Agreement**For LBT for single carrier DL transmission to a UE, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth
* The BW that at least includes the active DL BWP bandwidth is captured as “channel” in 37.213

For LBT for single carrier DL transmission to multiple UEs, from each UE point of view, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth that includes the active DL BWP of multiple UEs
 |

According to the above conclusion, we propose to remove “per carrier” from component 2 and brackets of “Support LBT performed per carrier/BWP bandwidth”.**Proposal 4:** **Remove “per carrier” from Component 2 in FG24-6 and FG 24-7.** |
| Vivo [4] |  |
| Samsung [5] |  |
| Ericsson [6] | For FG 24-6 and FG 24-7, there is an FFS on Component 2 on the LBT bandwidth. However, the following agreement was made in RAN1#108-e:**Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213

Based on this, it seems the square brackets can be resolved by defining LBT per channel as defined in 37.213 Clause 4.4:[37.213 Clause 4.4]When a gNB/UE senses a channel for availability to perform DL/UL transmission(s), the channel for sensing includes at least the corresponding active DL/UL bandwidth part(s) for the DL/UL transmission(s).1. For FG 24-6, revise the description of Component 2 to capture the RAN1#108-e agreement on LBT bandwidth.

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| --- | --- | --- | --- | --- | --- | --- |
| 24-6 | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 1 channel access procedure~~[~~2. Support LBT performed per channel, as defined in 37.213 Clause 4.4 ~~carrier/BWP bandwidth]~~ | 24-1a | per band | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

 |
| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-6 and FG24-7, an agreement has been made in the last e-meeting as follows. It should be reflected for both of them.

|  |
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| **Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213
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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-6 | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 1 channel access procedure2. Support LBT performed per at least UL 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 | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell [10] |  |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] | In prior RAN#1 meeting, the following was concluded:

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| **Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213

**Agreement**For LBT for single carrier DL transmission to a UE, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth
* The BW that at least includes the active DL BWP bandwidth is captured as “channel” in 37.213

For LBT for single carrier DL transmission to multiple UEs, from each UE point of view, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth that includes the active DL BWP of multiple UEs
 |

 In light of these agreements, it may be preferred to align the terminology and update the text for feature 24-6 and 24-7 as follows:

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

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|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-7 | Type 2 channel access procedure in uplink for FR2-2 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 | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon/SIA [2] | In the RAN1#108-e, the following agreement on the LBT bandwidth was reached. As a compromise, the LBT bandwidth was defined as channel which includes at least the active BWP. Thus, the component of “[2. Support LBT performed per carrier/BWP bandwidth]” should be updated as “Support LBT performed per channel at least includes the active UL BWP bandwidth for single carrier UL transmission”.**Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213

**Agreement**For LBT for single carrier DL transmission to a UE, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth
* The BW that at least includes the active DL BWP bandwidth is captured as “channel” in 37.213

For LBT for single carrier DL transmission to multiple UEs, from each UE point of view, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth that includes the active DL BWP of multiple UEs

***Proposal 6： The component 2 in FG24-6 and FG24-7 should be updated as “Support LBT performed per channel that at least includes the active UL BWP bandwidth for single carrier UL transmission”*.**

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|  | 24-7 | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 2 channel access procedure2. Support LBT performed per channel at least includes active ULBWP 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 | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| ZTE/Sanechips [3] | Regarding LBT bandwidth, the following agreement has been achieved in the last meeting:

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| **Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213

**Agreement**For LBT for single carrier DL transmission to a UE, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth
* The BW that at least includes the active DL BWP bandwidth is captured as “channel” in 37.213

For LBT for single carrier DL transmission to multiple UEs, from each UE point of view, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth that includes the active DL BWP of multiple UEs
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According to the above conclusion, we propose to remove “per carrier” from component 2 and brackets of “Support LBT performed per carrier/BWP bandwidth”.**Proposal 4:** **Remove “per carrier” from Component 2 in FG24-6 and FG 24-7.** |
| Vivo [4] |  |
| Samsung [5] |  |
| Ericsson [6] | For FG 24-6 and FG 24-7, there is an FFS on Component 2 on the LBT bandwidth. However, the following agreement was made in RAN1#108-e:**Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213

Based on this, it seems the square brackets can be resolved by defining LBT per channel as defined in 37.213 Clause 4.4:[37.213 Clause 4.4]When a gNB/UE senses a channel for availability to perform DL/UL transmission(s), the channel for sensing includes at least the corresponding active DL/UL bandwidth part(s) for the DL/UL transmission(s).1. For FG 24-7, revise the description of Component 2 to capture the RAN1#108-e agreement on LBT bandwidth.

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| 24-7 | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 2 channel access procedure~~[~~2. Support LBT performed per channel, as defined in 37.213 Clause 4.4 ~~carrier/BWP bandwidth]~~ | 24-1a, 24-6 | per band | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| OPPO [7] |  |
| Apple [8] |  |
| NTT DOCOMO, INC. [9] | For FG24-6 and FG24-7, an agreement has been made in the last e-meeting as follows. It should be reflected for both of them.

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| **Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213
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|  24. NR\_ext\_to\_71GHz | 24-7 | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 2 channel access procedure2. Support LBT performed per at least UL 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 | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| Nokia/Nokia Shanghai Bell [10] |  |
| LG Electronics [11] |  |
| MediaTek Inc. [12] |  |
| Intel Corporation [13] | In prior RAN#1 meeting, the following was concluded:

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| **Agreement**For LBT for single carrier UL transmission, UE performs LBT over a BW that at least includes the active UL BWP bandwidth* The BW that at least includes the active UL BWP bandwidth is captured as “channel” in 37.213

**Agreement**For LBT for single carrier DL transmission to a UE, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth
* The BW that at least includes the active DL BWP bandwidth is captured as “channel” in 37.213

For LBT for single carrier DL transmission to multiple UEs, from each UE point of view, gNB performs LBT over a bandwidth that at least includes the active DL BWP bandwidth configured for that UE.* This does not rule out gNB implementation to perform LBT over a wider bandwidth that includes the active DL BWP of multiple UEs
 |

 In light of these agreements, it may be preferred to align the terminology and update the text for feature 24-6 and 24-7 as follows:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-7 | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 2 channel access procedure~~[~~2. Support LBT performed per ~~carrier/BWP bandwidth]~~ channel bandwidth | 24-1a, 24-6 | per band | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 120/480/960 kHz | 24-1 | Yes | N/A | 32 DL HARQ processes for FR 2-2 is not supported | FFS | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon/SIA [2] |  |
| ZTE/Sanechips [3] | For FG 24-8 and FG 24-9, the main divergence is these two features are per UE, per BC, per Band or per FSPC. Form our point of view, our first preference is per UE which is beneficial to achieve the unified definition in different Frequency range. For FSPC, it can indeed provide more flexibility, but it also brings some complexity in signalling design aspect. For the sake of progress, we think that either per band or per BC can be a compromise way.**Proposal 5: Support FG 24-8 and FG 24-9 to be defined as per UE (1st preference), per band or per BC.** |
| Vivo [4] |  |
| Samsung [5] | 32 HARQ processes in DL/UL is not a considered as mandatorily needed in implementation but an optimization. In this sense, enforcing the FG of 32 HARQ processes in DL/UL as per UE or per band would be too inefficient in terms of UE over-designing or under-reporting, especially if the UE is in general wants to include FR2-2 as an add-on to other CA combinations. Setting the type as per UE or per band will enforce the UE to potentially drop the support of certain CA combination. Such concern could happen in current release (up to RAN4 design of CA combo), or happen in later releases when new CA combo may be introduced, and we should not restrict ourselves in the implementation from the very beginning. For example, assume band A as a FR2-2 band for which a UE considers the support of 32 HARQ, and further assume band B and band C as non-FR2-2 bands which can be a part of CA combo with band A. Then, for (A, B) CA combo, there are total 32+16=48 HARQ when band A has 32 HARQ. For (A, B, C) CA combo, there are total 32+16+16=64 HARQ when band A has 32 HARQ. Hence, if a UE wants to support (A, B, C) and 32 HARQ on band A, then it forces a UE to support total 64 HARQ, which deprives a UE of considerable amount of control on its memory budget which it is supposed to be given. In this case, it is much more desirable to allow a UE to limit total HARQ to 48 while also supporting (A, B, C) CA combo. However, if 32 HARQ is per-band, there is no chance to support so. A UE needs to have 64 total HARQ unless it decides to drop support of either 32 HARQ on band A altogether or (A, B, C) combo itself.The issue with above example can be avoided/mitigated by support the FGs per BC, but still it could be undesirable in a more complicated scenario. For example, if band A and B are FR2-2 bands while band C is a non-FR2-2 band, then 32 HARQ on both A and B would mean total 80 HARQ in (A, B, C) combo. If a UE has memory budget of 64 HARQ, then it could have supported (A, B, C) while supporting 32 HARQ only in either band A or B. To allow this, the FG as FSPC is needed.Overall, if there is only single FG which needs to be FSPC in the entire Rel-17, it should be the one for 32 HARQ processes, since the number of HARQ processes has the most direct relevance and impact to the amount of memory in the modem.**Proposal: Revise FG 24-8 as follow:**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 120/480/960 kHz | 24-1 | Yes | N/A | 32 DL HARQ processes for FR 2-2 is not supported | ~~FFS~~ FSPC | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |

 |
| Ericsson [6] | For FG 24-8 and FG 24-9, there is an FFS on the granularity of the capability signaling. In RAN1#108-e there was discussion on whether the signaling should be "per band" or "per FSPC." Our preference is "per band" consistent with the other FGs defined for NR up to 71 GHz. We have concerns on "per FSPC," since it leads to complicated UE capability processing at the gNB which cannot be underestimated. Capability processing is already a major task in the gNB considering the large number of capabilities that have been defined over 3 releases of 5G. Signaling capabilities per band at least keeps the processing in check. If capabilities are signaled per CC per band combination, the capability processing demand becomes too large. Furthermore, it complicates management of multiple carriers in a CA combination. The gNB would need to account for different capabilities on a per CC level across the whole fleet of UEs. For example, one UE could indicate support for four carriers but support 32 HARQ processes on two CCs, while another may indicate three carriers and support only 32 HARQ processes on one of the three CCs and so on. This creates too much complexity at the gNB side for managing these different permutations.One argument that was used in the last meeting against per band capability signaling was that if a UE supports 32 HARQ processes in Band A and 16 in each of Bands B and C, then per band signaling would require the UE to support 32 + 16 + 16 = 64 HARQ processes for the band combination (A,B,C). It was stated that if this exhausts the UE's memory resources, then the UE would need to declare that it cannot support band combination (A,B,C) if it declares support for 32 HARQ processes for Band A. However, this argument does not seem to provide any motivation for why the capability signaling would need to be per CC within a band combination. Moreover, with per-band capability signaling, the UE can utilize other existing capabilities (e.g. related to peak rate signaling such as MIMO layers, BW, etc) to indicate a suitable peak rate that it can support for the band combination (A,B,C) with 32 HARQ processes indicated for band A without exhausting the UE’s memory resources. Finally, it is noted that UE soft buffer handling in NR is left to UE implementation providing significant freedom in managing memory resources. 1. Support "per band" capability signaling for FG 24-8.

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| --- | --- | --- | --- | --- | --- | --- |
| 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 120/480/960 kHz | 24-1 | ~~FFS~~Per band | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |

 |
| OPPO [7] | Considering the capability requirements of supporting 32 HARQ processes are different in single carrier case and CA case, more CCs require high UE cost if the capability is not differentiated per CC, so we think it is beneficial report this capability per FSPC instead of per UE or per band, to leave more flexibility for UE implementation and cost consideration. **Proposal 2: for FG 24-8 and FG 24-9, supporting ‘per FSPC’ for 32 HARQ processes.**  |
| Apple [8] | In RAN1 #108-e, the FG type for both FGs was kept as FFS. We support an FSPC to prevent a situation where the UE under-reports its capability to ensure that it can support the # of HARQ processes in a carrier aggregation scenario**.**   |
| NTT DOCOMO, INC. [9] | Type of FG24-8 and 24-9 is still FFS. Our preference is generally to avoid having too much reporting overhead, while we understand that there is a need for some implementations to have finer granularity for reporting of this FG. We would be ok with defining this as per-FSPC, if preferred by majority.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 120/480/960 kHz | 24-1 | Yes | N/A | 32 DL HARQ processes for FR 2-2 is not supported | per UE | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell [10] | * + RAN1#108-e agreed on a **per band** FG 26-5 (NTN) on Increasing the number of HARQ processes, with following candidate values for UL and DL, respectively:
		- Candidate component values for (X,Y): {(16,32),(32,16),(32,32)}
	+ We do not see any technical reason why such per band indication would be suitable for NTN but unsuitable for FR2-2. In RAN1#108-e some companies argued that FSPC would be needed for the sake of limiting the number of carriers where the feature would be supported. In our view this is an inappropriate usage of FSPC signaling, as a mere limitation on the number of carriers where FGs 24-8/9 could be configured would suffice, while not stealing deployment flexibility from the gNB to choose the carriers where the UEs are operating, and without adding unnecessary overhead and complexity to the capability signalling.
	+ We propose **Per band** indication for these FGs.
 |
| LG Electronics [11] |  |
| MediaTek Inc. [12] | In RAN1 #108-e meeting, the signaling of 32 DL/UL HARQ processes for FR2-2 was discussed. In particular, per band and per FSPC are under consideration. If the signaling is restricted to per band, it may force UE to be conservative on reporting the CA capability. Therefore, to allow UE to have flexible HARQ buffer management in CA operation and utilize the 32 HARQ buffer efficiently, per FSPC is more desirable.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | 1. Support 32 HARQ processes in DL for 120/480/960 kHz
 | Per FSPC | Optional |

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| Intel Corporation [13] |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 120/480/960 kHz | 24-1 | Yes | N/A | 32 DL HARQ processes for FR 2-2 is not supported | FFS | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon/SIA [2] |  |
| ZTE/Sanechips [3] | For FG 24-8 and FG 24-9, the main divergence is these two features are per UE, per BC, per Band or per FSPC. Form our point of view, our first preference is per UE which is beneficial to achieve the unified definition in different Frequency range. For FSPC, it can indeed provide more flexibility, but it also brings some complexity in signalling design aspect. For the sake of progress, we think that either per band or per BC can be a compromise way.**Proposal 5: Support FG 24-8 and FG 24-9 to be defined as per UE (1st preference), per band or per BC.** |
| Vivo [4] |  |
| Samsung [5] | 32 HARQ processes in DL/UL is not a considered as mandatorily needed in implementation but an optimization. In this sense, enforcing the FG of 32 HARQ processes in DL/UL as per UE or per band would be too inefficient in terms of UE over-designing or under-reporting, especially if the UE is in general wants to include FR2-2 as an add-on to other CA combinations. Setting the type as per UE or per band will enforce the UE to potentially drop the support of certain CA combination. Such concern could happen in current release (up to RAN4 design of CA combo), or happen in later releases when new CA combo may be introduced, and we should not restrict ourselves in the implementation from the very beginning. For example, assume band A as a FR2-2 band for which a UE considers the support of 32 HARQ, and further assume band B and band C as non-FR2-2 bands which can be a part of CA combo with band A. Then, for (A, B) CA combo, there are total 32+16=48 HARQ when band A has 32 HARQ. For (A, B, C) CA combo, there are total 32+16+16=64 HARQ when band A has 32 HARQ. Hence, if a UE wants to support (A, B, C) and 32 HARQ on band A, then it forces a UE to support total 64 HARQ, which deprives a UE of considerable amount of control on its memory budget which it is supposed to be given. In this case, it is much more desirable to allow a UE to limit total HARQ to 48 while also supporting (A, B, C) CA combo. However, if 32 HARQ is per-band, there is no chance to support so. A UE needs to have 64 total HARQ unless it decides to drop support of either 32 HARQ on band A altogether or (A, B, C) combo itself.The issue with above example can be avoided/mitigated by support the FGs per BC, but still it could be undesirable in a more complicated scenario. For example, if band A and B are FR2-2 bands while band C is a non-FR2-2 band, then 32 HARQ on both A and B would mean total 80 HARQ in (A, B, C) combo. If a UE has memory budget of 64 HARQ, then it could have supported (A, B, C) while supporting 32 HARQ only in either band A or B. To allow this, the FG as FSPC is needed.Overall, if there is only single FG which needs to be FSPC in the entire Rel-17, it should be the one for 32 HARQ processes, since the number of HARQ processes has the most direct relevance and impact to the amount of memory in the modem.**Proposal: Revise FG 24-9 as follow:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 120/480/960 kHz | 24-1 | Yes | N/A | 32 ~~DL~~ UL HARQ processes for FR 2-2 is not supported | ~~FFS~~ FSPC | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for ~~DL~~ UL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for ~~DL~~ UL in FR2-2 | Optional with capability signalling |

 |
| Ericsson [6] | For FG 24-8 and FG 24-9, there is an FFS on the granularity of the capability signaling. In RAN1#108-e there was discussion on whether the signaling should be "per band" or "per FSPC." Our preference is "per band" consistent with the other FGs defined for NR up to 71 GHz. We have concerns on "per FSPC," since it leads to complicated UE capability processing at the gNB which cannot be underestimated. Capability processing is already a major task in the gNB considering the large number of capabilities that have been defined over 3 releases of 5G. Signaling capabilities per band at least keeps the processing in check. If capabilities are signaled per CC per band combination, the capability processing demand becomes too large. Furthermore, it complicates management of multiple carriers in a CA combination. The gNB would need to account for different capabilities on a per CC level across the whole fleet of UEs. For example, one UE could indicate support for four carriers but support 32 HARQ processes on two CCs, while another may indicate three carriers and support only 32 HARQ processes on one of the three CCs and so on. This creates too much complexity at the gNB side for managing these different permutations.One argument that was used in the last meeting against per band capability signaling was that if a UE supports 32 HARQ processes in Band A and 16 in each of Bands B and C, then per band signaling would require the UE to support 32 + 16 + 16 = 64 HARQ processes for the band combination (A,B,C). It was stated that if this exhausts the UE's memory resources, then the UE would need to declare that it cannot support band combination (A,B,C) if it declares support for 32 HARQ processes for Band A. However, this argument does not seem to provide any motivation for why the capability signaling would need to be per CC within a band combination. Moreover, with per-band capability signaling, the UE can utilize other existing capabilities (e.g. related to peak rate signaling such as MIMO layers, BW, etc) to indicate a suitable peak rate that it can support for the band combination (A,B,C) with 32 HARQ processes indicated for band A without exhausting the UE’s memory resources. Finally, it is noted that UE soft buffer handling in NR is left to UE implementation providing significant freedom in managing memory resources. 1. Support "per band" capability signaling for 24-9.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 120/480/960 kHz | 24-1 | ~~FFS~~Per band | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |

 |
| OPPO [7] | Considering the capability requirements of supporting 32 HARQ processes are different in single carrier case and CA case, more CCs require high UE cost if the capability is not differentiated per CC, so we think it is beneficial report this capability per FSPC instead of per UE or per band, to leave more flexibility for UE implementation and cost consideration. **Proposal 2: for FG 24-8 and FG 24-9, supporting ‘per FSPC’ for 32 HARQ processes.**  |
| Apple [8] | In RAN1 #108-e, the FG type for both FGs was kept as FFS. We support an FSPC to prevent a situation where the UE under-reports its capability to ensure that it can support the # of HARQ processes in a carrier aggregation scenario**.**   |
| NTT DOCOMO, INC. [9] | Type of FG24-8 and 24-9 is still FFS. Our preference is generally to avoid having too much reporting overhead, while we understand that there is a need for some implementations to have finer granularity for reporting of this FG. We would be ok with defining this as per-FSPC, if preferred by majority.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 120/480/960 kHz | 24-1 | Yes | N/A | 32 DL HARQ processes for FR 2-2 is not supported | per UE | N/A | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell [10] | * + RAN1#108-e agreed on a **per band** FG 26-5 (NTN) on Increasing the number of HARQ processes, with following candidate values for UL and DL, respectively:
		- Candidate component values for (X,Y): {(16,32),(32,16),(32,32)}
	+ We do not see any technical reason why such per band indication would be suitable for NTN but unsuitable for FR2-2. In RAN1#108-e some companies argued that FSPC would be needed for the sake of limiting the number of carriers where the feature would be supported. In our view this is an inappropriate usage of FSPC signaling, as a mere limitation on the number of carriers where FGs 24-8/9 could be configured would suffice, while not stealing deployment flexibility from the gNB to choose the carriers where the UEs are operating, and without adding unnecessary overhead and complexity to the capability signalling.
	+ We propose **Per band** indication for these FGs.
 |
| LG Electronics [11] |  |
| MediaTek Inc. [12] | In RAN1 #108-e meeting, the signaling of 32 DL/UL HARQ processes for FR2-2 was discussed. In particular, per band and per FSPC are under consideration. If the signaling is restricted to per band, it may force UE to be conservative on reporting the CA capability. Therefore, to allow UE to have flexible HARQ buffer management in CA operation and utilize the 32 HARQ buffer efficiently, per FSPC is more desirable.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | 1. Support 32 HARQ processes in UL for 120/480/960 kHz
 | Per FSPC | Optional |

 |
| Intel Corporation [13] |  |

**Others**

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon/SIA [2] | In RAN#108-e, the multiple PDSCH/PUSCH scheduling by single DCI has been extended to FR2-1 for 120kHz SCS due to its scheduling efficiency to achieve high throughput. During the discussion and also noted in the Chair’s note, whether such FGs can be further extended to other SCS and FR can be further discussed. For UL, it is already supported for all SCSs in FR1 and FR2-1 when multiple PUSCHs scheduled by single DCI are consecutive. Extending the support of non-contiguous allocation to the 15/30/60kHz SCSs in FR1 and 60kHz SCS in FR2-1 same as those agreed for FR2-1 and FR2-2 for 120kHz/480kHz/960kHz could reduce scheduling overhead and PDCCH monitoring complexity without introducing additional standardization effort. Due to the same reason, we also support to extend multiple PDSCH scheduling by single DCI to 15/30/60kHz SCS in FR1 and 60kHz SCS in FR2-1.***Proposal 4: Define new feature groups to support multiple PDSCH scheduling by single DCI and multiple PUSCH scheduling by single DCI for other SCSs in FR1 and FR2-1.***

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

In RAN1#108-e, it was agreed to further discuss whether 32 HARQ processes can be extended for FR2-1 [5]. In FR2-2, the reason to introduce 32 HARQ processes for FR2-1 is to avoid HARQ processes starvation when multiple PDSCH is scheduled by a single DCI. It is also beneficial when gNB configuring small number of DL/UL switching point in a long periodicity, as discussed in NR-U. Considering multiple PDSCH scheduling by single DCI is extended to FR2-1 for 120kHz SCS, it would be straightforward to extend 32 HARQ processes to FR2-1 as well. In order to avoid ambiguity on the number of HARQ processes during potential BWP switching between 60kHz SCS and 120kHz SCS，we support to extend 32 HARQ processes for 60kHz SCS in FR2-1 as well. UE should report support of 32 HARQ processes in FR2-1 for 60kHz and 120kHz together in a single FG. ***Proposal 7: Introduce FGs to support 32 UL HARQ and 32 DL HARQ processes for both 60kHz/120kHz SCS in FR2-1.***

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

In RAN1#108-e, additional 4 capability reports on the number of CCs with Rel-17 PDCCH monitoring only or combination of PDCCH monitoring with earlier releases in different serving cells are introduced as follows. * Case 4: Capability on the number of CCs with Rel-17 monitoring capability only
* Case 5: Capability on the number of CCs with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
* Case 6: Capability on the number of CCs with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
* Case 7: Capability on the number of CCs with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells

Similar to Rel-16, separate FGs should be introduced correspondingly. The detail text for each FG are in appendix. ***Proposal 8: Introduce separate FGs corresponding to the additional 4 cases on the capability on the number of CCs with different monitoring capability combinations as agreed in RAN1#108-e. The definition of the FGs are provided in appendix.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-Xa | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells- Candidate value for the component: {[4, 5, …, , 16]} | 24-4, 24-5 | Yes | N/A |  |  | N/A | N/A | N/A |  | Optional with capability signaling  |
|  | 24-Xb | Mix of Rel. 17 PDCCH monitoring capability and Rel.15 and/or Rel.16 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability, Rel-16 monitoring capability and/or Rel-17 monitoring capability on different serving cells | 24-4, 24-5 | Yes |  |  |  |  |  |  |  | Optional with capability signaling |
|  | 24-Xc | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 15- Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[4, 5, …, 16]} | 24-Xb | Yes | N/A |  |  | N/A | N/A | N/A |  | Optional with capability |
|  | 24-Xd | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 15- Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3,4, 5, …, 16]} | 24-Xb | Yes | N/A |  |  | N/A | N/A | N/A |  | Optional with capability |
|  | 24-Xe | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 15- Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {[4, 5, …, 16]} | 24-Xb | Yes | N/A |  |  | N/A | N/A | N/A |  | Optional with capability |

In RAN1#108-e, the PDCCH monitoring capabilities in NR-DC scenario are still pending. When a UE is configured for NR-DC operation with a total of downlink cells on both the MCG and the SCG, UE capability signaling and the corresponding new RRC parameters for the following 4 additional cases should be supported:* Case 4: All the downlink cells have SCS configuration .

* Case 5: downlink cells have SCS configuration , the UE is provided *monitoringCapabilityConfig* = *r15monitoringcapability* for  downlink cells, the UE is not provided *monitoringCapabilityConfig* = *r16monitoringcapability* for any downlink cell.

* Case 6: downlink cells have SCS configuration , the UE is provided *monitoringCapabilityConfig* = *r16monitoringcapability* for  downlink cells, and the UE is not provided *monitoringCapabilityConfig* = *r15monitoringcapability* for any downlink cell.

* Case 7: downlink cells have SCS configuration , the UE is provided *monitoringCapabilityConfig* = *r15monitoringcapability* for  downlink cells and *monitoringCapabilityConfig* = *r16monitoringcapability* for  downlink cells.

The detail discussion can be found in our companion paper [6].***Proposal 9: Introduce separate FGs corresponding to the additional 4 cases on the capability on the number of CCs with different monitoring capability combinations when a UE is configured with NR-DC. The definition of the FGs are provided in appendix.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | 24-Xf | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells | Supported combination of (*pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-4, 24-5 | Yes | N/A |  |  | N/A | N/A | N/A |  | Optional with capability |
|  | 24-Xg | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-Xb | Yes | N/A |  |  | N/A | N/A | N/A |  | Optional with capability |
|  | 24-Xh | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-Xb | Yes | N/A |  |  | N/A | N/A | N/A |  | Optional with capability |
|  | 24-Xj | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | 24-Xb | Yes | N/A |  |  | N/A | N/A | N/A |  | Optional with capability |

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| ZTE/Sanechips [3] | 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 all SCSs for 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 to all SCSs for FR 1 and even for FR 2-1.**Proposal 6: Enhancements on multiple PUSCH/PDSCH scheduling by single DCI can be considered to be applied to all SCSs for FR1 and FR2-1 as optional features.** |
| Vivo [4] |  |
| Samsung [5] |  |
| Ericsson [6] | In RAN1#108-e the following agreement was made regarding UE capabilities for per-slot group PDCCH monitoring (also referred to as multi-slot monitoring):**Agreement*** For serving cells configured with 480 or 960 kHz SCS, the serving cells with the same SCS and value are grouped together to determine a total BD/CCE budget for that group and the per-cell BD/CCE budget within the group.

* Support UE capability signaling for 4 additional cases :
	+ Case 4: Capability on the number of CCs with Rel-17 monitoring capability only
		- Range of pdcch-BlindDetectionCA-R17: {[4, 5, …, , 16]}
	+ Case 5: Capability on the number of CCs with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[4, 5, …, 16]}
	+ Case 6: Capability on the number of CCs with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3, 4, …, 16]}
	+ Case 7: Capability on the number of CCs with Rel-15 monitoring capability , Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17 : {[4, 5, …, 16]}
* For the case with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells (case 7) or any combination of 2 of the capabilities (i.e. case 5, and case 6), the UE will report one or more combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) as UE capability. If UE reports more than one combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17), as in Rel-16, the gNB configures which combination for the UE to use for scaling PDCCH monitoring capability if the number of CCs configured is larger than the reported capability.
* FFS: Extension to NR-DC scenario

As shown in this agreement, UE capability signaling is agreed for 4 additional cases, hence new UE feature groups need to be defined to cover these cases. There is ongoing discussion in AI 8.2.2 on appropriate candidate values for the corresponding capability parameters, and once that discussion is concluded, the agreed values can be included into the definition of the new feature groups.1. Define new FGs as shown below to cover multi-slot PDCCH monitoring for Cases 4, 5, 6, and 7 in the RAN1#108-e agreement for carrier aggregation.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Type** | **Note** | **Mandatory/Optional** |
| 24-11 | Number of CCs for BD/CCE scaling for DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Supported value(s) of *pdcch-BlindDetectionCAr17* for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability (per group of Xs slots) on all the serving cells. | 24-4 and/or 24-5 | Per band | Candidate values of *pdcch-BlindDetectionCAr17*:[4,5, …,16] | Optional with capability signalling |
| 24-12 | Number of CCs for BD/CCE scaling for DL CA with mix of Rel-17 and Rel-15 PDCCH monitoring capability on different serving cells | Supported combinations(s) of {*pdcch-BlindDetectionCAr17, pdcch-BlindDetectionCAr15}* for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with mix of Rel-17 monitoring capability (per group of Xs slots) and Rel-15 PDCCH monitoring capability (per slot) on different serving cells. | 24-4 and/or 24-5 | Per band | Candidate values of the summation of *pdcch-BlindDetectionCAr17 and pdcch-BlindDetectionCAr15*:{4,5, …,16}Candidate values of *pdcch-BlindDetectionCAr17*:{1,2, …,15}Candidate values of *pdcch-BlindDetectionCAr15*:{1,2, …,15} | Optional with capability signalling |
| 24-13 | Number of CCs for BD/CCE scaling for DL CA with mix of Rel-17 and Rel-16 PDCCH monitoring capability on different serving cells | Supported combinations(s) of {*pdcch-BlindDetectionCAr17, pdcch-BlindDetectionCAr16}* for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with mix of Rel-17 monitoring capability (per group of Xs slots) and Rel-16 PDCCH monitoring capability (per span) on different serving cells. | 24-4 and/or 24-5 | Per band | Candidate values of the summation of *pdcch-BlindDetectionCAr17 and pdcch-BlindDetectionCAr16*:{4,5, …,16}Candidate values of *pdcch-BlindDetectionCAr17*:{1,2, …,15}Candidate values of *pdcch-BlindDetectionCAr16*:{1,2, …,15} | Optional with capability signalling |
| 24-14 | Number of CCs for BD/CCE scaling for DL CA with mix of Rel-17, Rel-16, and Rel-15 PDCCH monitoring capability on different serving cells | Supported combinations(s) of {*pdcch-BlindDetectionCAr17, pdcch-BlindDetectionCAr16, pdcch-BlindDetectionrCA15}* for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with mix of Rel-17 monitoring capability (per group of Xs slots), Rel-16 PDCCH monitoring capability (per span), and Rel-15 PDCCH monitoring (per slot) on different serving cells. | 24-4 and/or 24-5 | Per band | Candidate values of the summation of *pdcch-BlindDetectionCAr17, pdcch-BlindDetectionCAr16, and pdcch-BlindDetectionCAr17*:{4,5, …,16}Candidate values of *pdcch-BlindDetectionCAr17*:{1,2, …,15}Candidate values of *pdcch-BlindDetectionCAr16*:{1,2, …,15}Candidate values of *pdcch-BlindDetectionCAr15*:{1,2, …,15} | Optional with capability signalling |

In the RAN1#108-e agreement shown in the previous section, there is an FFS on extension of the UE capability definitions for carrier aggregation to the NR-DC scenario. Since any new FG has ASN.1 impact, it would be wise to define "place holder" FGs for NR-DC such that RAN2 can at least define the signaling. RAN1 can then continue to work on the description of the new FGs. Further discussion is needed in RAN1#109-e on how many new FGs are required to cover possible combinations of Rel-15 (per-slot), Rel-16 (per-span), and Rel-17 (per-slot group) PDCCH monitoring.1. Define new "place holder" FGs to cover multi-slot PDCCH monitoring for for the NR-DC scenario.

In RAN1#107bis-e, the following conclusion was reached:**Conclusion**Potential indications of UE capability related to a limited support of cross-carrier scheduling e.g. as a function of |μPDCCH − μPDSCH| can be discussed as part of the UE capability discussion.We do not support addition of such a UE capability. RAN4 has defined inter-band carrier aggregation combinations between FR1 and FR2-2, and given that FR1 bands are defined with SCS as low as 15 kHz and that FR2-2 bands are defined with SCS up to 960 kHz, we don't think that additional SCS restrictions should not be introduced if the UE supports such a band combination. This would mean that the SCS difference can be as large as |μPDCCH − μPDSCH| = 6.1. Do not introduce a UE capability on the supported value(s) of the SCS difference |μPDCCH − μPDSCH| for cross-carrier scheduling.
 |
| OPPO [7] |  |
| Apple [8] | In RAN1 #108-e, multiple PDSCH scheduling was extended to 120 kHz in FR2-1 (Multiple PDSCH scheduling by single DCI for 120kHz in FR2-1) with a note to continue discussion on extending 24-1f to other SCSs. We do not support extension to other SCSs in FR2-1 as we do not think it is needed. In RAN1 #108-e, multiple PUSCH scheduling was extended to 120 kHz in FR2-1 (Multiple PUSCH scheduling by single DCI for 120kHz in FR2-1) with a note to continue discussion on extending 24-1g to other SCSs. **We do not support extension to other SCSs in FR2-1 as we do not think it is needed.**In RAN1 #1080e, the following agreements were reached:**Agreement*** For serving cells configured with 480 or 960 kHz SCS, the serving cells with the same SCS and value are grouped together to determine a total BD/CCE budget for that group and the per-cell BD/CCE budget within the group.

* Support UE capability signaling for 4 additional cases :
	+ Case 4: Capability on the number of CCs with Rel-17 monitoring capability only
		- Range of pdcch-BlindDetectionCA-R17: {[4, 5, …, , 16]}
	+ Case 5: Capability on the number of CCs with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[4, 5, …, 16]}
	+ Case 6: Capability on the number of CCs with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3, 4, …, 16]}
	+ Case 7: Capability on the number of CCs with Rel-15 monitoring capability , Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17 : {[4, 5, …, 16]}
* For the case with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells (case 7) or any combination of 2 of the capabilities (i.e. case 5, and case 6), the UE will report one or more combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) as UE capability. If UE reports more than one combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17), as in Rel-16, the gNB configures which combination for the UE to use for scaling PDCCH monitoring capability if the number of CCs configured is larger than the reported capability.
* FFS: Extension to NR-DC scenario

Corresponding FGs need to be captured as follows:* **Feature Group 24-x1:**  Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells
	+ **Components:** Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells
		- Candidate value for the component: FFS
	+ **Prerequisite:** 24-4 or 24-5
	+ **Mandatory/Optional:** Optional with capability signalling
* **Feature Group 24-x2:** Mix of Rel. 15 PDCCH monitoring capability and Rel. 17 PDCCH monitoring capability on different carriers
	+ **Components:** Support Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
	+ **Prerequisite:** 24-4 or 24-5
	+ **Mandatory/Optional:** Optional with capability signalling
* **Feature Group 24-x3:** Mix of Rel. 16 PDCCH monitoring capability and Rel. 17 PDCCH monitoring capability on different carriers
	+ **Components:** Support Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
	+ **Prerequisite:** 11-2,24-4 or 24-5
	+ **Mandatory/Optional:** Optional with capability signalling
* **Feature Group 24-x4:** Mix of Rel. 15 PDCCH monitoring capability, Rel. 16 PDCCH monitoring capability and Rel. 17 PDCCH monitoring capability on different carriers
	+ **Components:** Support Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
	+ **Prerequisite:** 11-2,24-4 or 24-5
	+ **Mandatory/Optional:** Optional with capability signalling
* **Feature Group 24-x5 :** Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 15 and Rel. 17 PDCCH monitoring capabilities on different carriers
	+ **Components:** Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17)
		- * Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15
			* Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 15
		- The minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability and the capability on the number of CCs with Rel-17 PDCCH monitoring capability is FFS
	+ **Prerequisite:** Feature Group 24-x2
	+ **Mandatory/Optional:** Optional with capability signalling
* **Feature Group 24-x6 :** Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 16 and Rel. 17 PDCCH monitoring capabilities on different carriers
	+ **Components:** Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17)
		- * Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15
			* Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 15
		- The minimum of the summation of capability on the number of CCs with Rel-16 PDCCH monitoring capability and the capability on the number of CCs with Rel-17 PDCCH monitoring capability is FFS
	+ **Prerequisite:** Feature Group 24-x3
	+ **Mandatory/Optional:** Optional with capability signalling
* **Feature Group 24-x7 :** Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 15, Rel. 16 and Rel. 17 PDCCH monitoring capabilities on different carriers
	+ **Components:** Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17)
		- * Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 16
			* Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 16
			* Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 16
		- The minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability, capability on the number of CCs with Rel-16 PDCCH monitoring capability, and the capability on the number of CCs with Rel-17 PDCCH monitoring capability is FFS
	+ **Prerequisite:** Feature Group 24-x4
	+ **Mandatory/Optional:** Optional with capability signalling

In RAN1 #107-bis-e, the following conclusion was reached:

|  |
| --- |
| ConclusionPotential indications of UE capability related to a limited support of cross-carrier scheduling e.g. as a function of |μPDCCH − μPDSCH| can be discussed as part of the UE capability discussion. |

* 1. In a scenario with different numerologies between PDSCH and PUCCH, a large differential between the SCSs may result in a large gap between a transmitted PDSCH(s) and its corresponding PUCCH. In one simple example, assume that the transmission occurs such that the HARQ is on FR1 with the SCS set to 15 kHz which is equivalent to 32 480 kHz slots. A frame structure of DDDSU would require an aggregation of up to 96 slots. The maximum differential changes from 8 (120 kHz to 15 kHz) to 64 (960 kHz to 15 kHz). As such, a UE should be able to signal a value K such that |μPDCCH − μPDSCH| ≤ k, where k ≥ 3.
	2. *Secondly, the maximum number of carriers that can be simultaneously scheduled from a single carrier should be defined as a UE capability.* This may be necessary given the possible increase in the bandwidth of the different transmissions, and the increase in data rate for the new SCSs.
 |
| NTT DOCOMO, INC. [9] | 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 1:** 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

**Proposal 3:** For the question asked by RAN2 on FG24-2/3, the following alternatives can be considered:* Alt-1: No update on FG24-2/24-3. Clarify these are intended for both DC and SA operation in the form of LS reply to RAN2.
* Alt-2: The existing FG24-2/24-3 are updated to clarify these FGs are dedicated for DC operation, with the change of “Need for the gNB to know if the feature is supported” from N/A to Yes. New FGs are introduced for SA operation for each of 120 and 480 kHz SCS, based on the existing FG24-2 and 24-3, respectively, with the change on “Mandatory/optional” from “Optional with capability signaling” to “Optional without capability signaling”.
	+ The updated FG24-2 and 24-3 can be prerequisite of the new FGs, respectively.

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 4:** 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 | Yes | N/A | Time domain HARQ-ACK bundling for Type 1 HARQ codebook for 120 kHz SCS is not supported | 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 | Time domain HARQ-ACK bundling for Type 2 HARQ codebook for 120 kHz SCS is not supported | 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 | Time domain HARQ-ACK bundling for Type 1 HARQ codebook for 480 kHz SCS is not supported | 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 | Time domain HARQ-ACK bundling for Type 2 HARQ codebook for 480 kHz SCS is not supported | 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 | Time domain HARQ-ACK bundling for Type 1 HARQ codebook for 960 kHz SCS is not supported | 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 | Time domain HARQ-ACK bundling for Type 2 HARQ codebook for 960 kHz SCS is not supported | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

There are also other issues for which some new capabilities has to be introduced, based on the following agreement reached at the last e-meeting:

|  |
| --- |
| **Agreement*** For serving cells configured with 480 or 960 kHz SCS, the serving cells with the same SCS and value are grouped together to determine a total BD/CCE budget for that group and the per-cell BD/CCE budget within the group.

* Support UE capability signaling for 4 additional cases :
	+ Case 4: Capability on the number of CCs with Rel-17 monitoring capability only
		- Range of pdcch-BlindDetectionCA-R17: {[4, 5, …, , 16]}
	+ Case 5: Capability on the number of CCs with Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R15: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[4, 5, …, 16]}
	+ Case 6: Capability on the number of CCs with Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17 and pdcch-BlindDetectionCA-R16: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3, 4, …, 16]}
	+ Case 7: Capability on the number of CCs with Rel-15 monitoring capability , Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells
		- pdcch-BlindDetectionCA-R15 for Rel-15 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R16 for Rel-16 PDCCH monitoring capability
		- pdcch-BlindDetectionCA-R17 for Rel-17 PDCCH monitoring capability
		- Range of pdcch-BlindDetectionCA-R17, pdcch-BlindDetectionCA-R16, and pdcch-BlindDetectionCA-R15: {[1, 2, …, 15]}
			* Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17 : {[4, 5, …, 16]}
* For the case with Rel-15 monitoring capability, Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells (case 7) or any combination of 2 of the capabilities (i.e. case 5, and case 6), the UE will report one or more combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) as UE capability. If UE reports more than one combination of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17), as in Rel-16, the gNB configures which combination for the UE to use for scaling PDCCH monitoring capability if the number of CCs configured is larger than the reported capability.
* FFS: Extension to NR-DC scenario
 |

In short, similar to pdcch-BlindDetectionCA-R16, some new FGs related to pdcch-BlindDetectionCA-R17 needs to be implemented as per the agreement above. In general, we believe Rel-16 URLLC FGs (i.e., FG11-2 series) would be very good references to implement the agreement above. Just to follow the same formulation could be almost sufficient. An issue we would like to raise here would be whether/how to define reporting on the support of non-aligned PDCCH monitoring resource across CCs. In Rel-16, span-level arrangement is reported via *supportedSpanArrangement*. With this, UE can report whether to support PDCCH monitoring in non-aligned span in a slot. For multi-slot PDCCH monitoring, meanwhile, slot-level alignment as well as span-level alignment may need to be considered. That is, the following four cases can be identified:* Case 1: Support aligned PDCCH monitoring resource only, with both slot-level and span-level (or symbol-level) granularity
* Case 2: Support aligned and non-aligned PDCCH monitoring resource with span-level (or symbol-level) granularity, while supporting aligned PDCCH monitoring resource only with slot-level granularity
* Case 3: Support aligned and non-aligned PDCCH monitoring resource with both slot-level and span-level (or symbol-level) granularity
* Case 4 (but we see no need to consider): Support aligned and non-aligned PDCCH monitoring resource with slot-level granularity, while supporting aligned PDCCH monitoring resource only with span-level (or symbol-level) granularity

We think whether to differentiate the first three cases per UE capability reporting should be discussed. Case 4 seems not essential since symbol-level alignment in different slots would not be meaningful in our view. For the first three cases, we believe case 1 should be differentiated from the other two, while whether to differentiate case 2 and case 3 may be divergent. We slightly prefer to differentiate case 2 and case 3, i.e., define separate reporting between whether to support symbol-level non-aligned PDCCH monitoring and slot-level non-aligned PDCCH monitoring, since it could achieve a good trade-off between 1) alleviating the concern on UE implementation complexity and 2) alleviating the concern on operation flexibility. In summary, we propose the following new FGs as in Table 2.2-3: **Proposal 5:** Add new FGs for multi-slot PDCCH monitoring in case of CA, as in Table 2.2-3Table 2.2-3: The proposed additional FGs

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-14 | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per slot-group when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells  | 1. Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per slot group when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells- Candidate value for the component: {4, 5, …, 16)2. Supported span arrangement for CA- Candidate value for the component: a) aligned monitoring only with both slot-level and span-level granularity; orb) aligned monitoring only with slot-level granularity, and aligned monitoring and non-aligned monitoring with span-level granularity; orc) aligned monitoring and non-aligned monitoring with both slot-level and span-level granularity | 24-4 or 24-5 | Yes | N/A | Rel. 17 PDCCH monitoring for CA is not supported | Per BC | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-14a | Mix of Rel-17 PDCCH monitoring capability and Rel. 15 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability and Rel-17 monitoring capability on different serving cells | 24-4 or 24-5 | Yes | N/A | Mix of Rel-17 PDCCH monitoring capability and Rel. 15 PDCCH monitoring capability on different carriers is not supported | Per FS | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-14b | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 15 and Rel-17 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 152. Supported span arrangement for CA- Candidate value for the component: a) aligned monitoring only with both slot-level and span-level granularity; orb) aligned monitoring only with slot-level granularity, and aligned monitoring and non-aligned monitoring with span-level granularity; orc) aligned monitoring and non-aligned monitoring with both slot-level and span-level granularity | 24-14a | Yes | N/A | Mix of Rel-17 PDCCH monitoring capability and Rel. 15 PDCCH monitoring capability on different carriers is not supported | Per BC | N/A | N/A | N/A | The minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability and the capability on the number of CCs with Rel-17 PDCCH monitoring capability is 4 | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-14c | Mix of Rel-17 PDCCH monitoring capability and Rel. 16 PDCCH monitoring capability on different carriers | Support Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells | 24-4 or 24-5 | Yes | N/A | Mix of Rel-17 PDCCH monitoring capability and Rel. 16 PDCCH monitoring capability on different carriers is not supported | Per FS | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-14d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 16 and Rel-17 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 152. Supported span arrangement for CA- Candidate value for the component: a) aligned monitoring only with both slot-level and span-level granularity; orb) aligned monitoring only with slot-level granularity, and aligned monitoring and non-aligned monitoring with span-level granularity; orc) aligned monitoring and non-aligned monitoring with both slot-level and span-level granularity | 24-14c | Yes | N/A | Mix of Rel-17 PDCCH monitoring capability and Rel. 16 PDCCH monitoring capability on different carriers is not supported | Per BC | N/A | N/A | N/A | The minimum of the summation of capability on the number of CCs with Rel-16 PDCCH monitoring capability and the capability on the number of CCs with multi-slot PDCCH monitoring capability is 3 | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-14e | Mix of Rel-17 PDCCH monitoring capability and Rel. 15 PDCCH monitoring capability and Rel. 16 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability and Rel-16 monitoring capability and Rel-17 monitoring capability on different serving cells | 24-4 or 24-5 | Yes | N/A | Mix of Rel-17 PDCCH monitoring capability and Rel-15 monitoring capability and Rel. 16 PDCCH monitoring capability on different carriers is not supported | Per FS | N/A | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-14f | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 15, Rel. 16 and Rel-17 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 152. Supported span arrangement for CA- Candidate value for the component: a) aligned monitoring only with both slot-level and span-level granularity; orb) aligned monitoring only with slot-level granularity, and aligned monitoring and non-aligned monitoring with span-level granularity; orc) aligned monitoring and non-aligned monitoring with both slot-level and span-level granularity | 24-14e | Yes | N/A | Mix of Rel-17 PDCCH monitoring capability and Rel-15 monitoring capability and Rel. 16 PDCCH monitoring capability on different carriers is not supported | Per BC | N/A | N/A | N/A | The minimum of the summation of capability on the number of CCs with Rel-16 PDCCH monitoring capability and the capability on the number of CCs with multi-slot PDCCH monitoring capability is 4 | Optional with capability signalling |

We show a brief set of analysis [9] 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 6:** 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 1:** 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 7:** 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 mannerOn 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 8:** 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 9:** 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 10:** 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*
 |
| Nokia/Nokia Shanghai Bell [10] |  |
| LG Electronics [11] | * **Multi-PDSCH (or multi-PUSCH) scheduling DCI**

In [2], the extension of multi-PDSCH or multi-PUSCH scheduling to other SCSs than 120/480/960 kHz is captured as NOTE in the corresponding agreements. In our view, multi-PXSCH scheduling DCI introduced for FR2-2 can also be applicable to other frequency ranges since this feature is band-agnostic and beneficial in terms of DCI overhead reduction. Therefore, we suggest to extend the applicability of multi-PXSCH scheduling DCI to FR2-1 60 kHz SCS as well as FR1 15/30/60 kHz SCSs.**Proposal: Extend the applicability of multi-PDSCH scheduling DCI and multi-PUSCH scheduling DCI to FR1 15/30/60 kHz SCSs and FR2-1 60 kHz SCS, and adopt the following new UE features accordingly.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-1h | Multiple PDSCH scheduling by single DCI for 60kHz in FR2-1 and for 15/30/60kHz in FR1 | 1. Multi-PDSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs2. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | Multiple PDSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 or FR2-1 | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-1i | Multiple PUSCH scheduling by single DCI for 60kHz in FR2-1 and for 15/30/60kHz in FR1 | 1. Multi-PUSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs with non-contiguous allocation | Multiple PUSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 or FR2-1 with non-contiguous allocation | Optional with capability signalling |

* **32 HARQ processes**

In RAN1#108-e meeting, it was discussed whether 32 HARQ processes can be configured also for FR2-1. If this feature is to be supported for FR2-1, it should be applicable to all SCSs (i.e., 60 kHz and 120 kHz SCSs) in FR2-1. Otherwise (i.e., if 32 HARQ processes will be supported only for 120 kHz SCS but not for 60 kHz SCS in FR2-1), we have to figure out the following issues, in case that a BWP in a FR2-1 serving cell is configured with 120 kHz SCS and another BWP in the serving cell is configured with 60 kHz SCS, as discussed in [3].• Issue 1: Whether the number of HARQ processes is configured per cell (as in Rel-16) or per BWP/SCS• Issue 2: Whether to perform data soft combining after BWP switching• Issue 3: The number of HARQ processes for the serving cell to generate type-3 HARQ-ACK codebookTherefore, in order not to reopen the consequent technical issues, the configurability of 32 HARQ processes should be applicable to both of 60 kHz and 120 kHz SCSs, if introduced in FR2-1.**Proposal: If 32 HARQ processes related UE feature is to be supported for FR2-1, it should be applicable to all SCSs (i.e., 60 kHz and 120 kHz SCSs) in FR2-1.*** **Time domain HARQ-ACK bundling for multi-PDSCH scheduling**

In [4], it was proposed to add new feature groups corresponding to time domain HARQ-ACK bundling which is introduced to bundle HARQ-ACK information of multiple PDSCHs scheduled by a single DCI. We tend to agree that new feature groups are required for indicating if a UE supports time domain HARQ-ACK bundling. However, different from [2] where feature groups are created per SCS per codebook type, in order to reduce the overhead of UE capability signaling, it is preferable to add corresponding feature groups depending on codebook types (not depending on SCS values).**Proposal: Add FGs 24-11 and 24-11a corresponding to HARQ-ACK time domain bundling for multi-PDSCH scheduling for type-1 and type-2 HARQ-ACK codebook, respectively, as follows.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-11 | HARQ-ACK time domain bundling for Type-1 HARQ-ACK codebook for multi-PDSCH scheduling | Support HARQ-ACK time domain bundling for Type-1 HARQ-ACK codebook for multi-PDSCH scheduling | 24-1d or 24-4 or 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-11a | HARQ-ACK time domain bundling for Type-2 HARQ-ACK codebook for multi-PDSCH scheduling | Support HARQ-ACK time domain bundling for Type-2 HARQ-ACK codebook for multi-PDSCH scheduling | 24-1d or 24-4 or 24-5 |  |  |  | Per band |  |  |  |  | Optional with capability signalling |

 |
| 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 3: Add FGs for m-TRP multi-PDSCH scheduling as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 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 |

 |
| Intel Corporation [13] |  |

# Discussion/Approval Items during RAN1 #109-e — First Checkpoint

After review of contributions submitted to RAN1 #109-e in this agenda item, the following topics were identified by the moderator for discussion/approval during RAN1 #109-e. Please note the following:

* For FGs 24-2 and 24-3, proposals will be discussed in [109-e-R17-UE-features] “Email discussion on incoming LS (R1-2205090) on updated Rel-17 RAN1 UE features list for NR by May 13 – Ralf (AT&T)”
* For FGs 24-4 and 24-5, proposals will be discussed after further progress is made in the corresponding maintenance agenda item
* For, FGs 24-8 and 24-9, proposals will be discussed by GTW

**General comments**

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| Company | Comments/Questions/Suggestions |
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# Issue 1: FG 24-1b

After review of contributions submitted to RAN1 #109-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 | 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 | ~~[A UE that supports FG 24-2 must indicate this FG is supported]~~~~[Note: This FG is only supported in bands for shared spectrum operation]~~ This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional withcapability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 2: FG 24-1c

After review of contributions submitted to RAN1 #109-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 | 24-1c | Multi-RB supportPUCCH 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 | ~~[A UE that supports [24-1a/24-2/FR2-2] must indicate this FG is supported]~~This FG is only applicable when ~~supported in bands under~~ PSD limitation ~~in shared spectrum operation~~ applies within FR2-2 based on the regional regulations | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 3: FG 24-4b

After review of contributions submitted to RAN1 #109-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 | 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 | ~~[Note:~~ This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations ~~supported in bands for shared spectrum operation]~~ | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 4: FG 24-4c

After review of contributions submitted to RAN1 #109-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 | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 | 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 | This FG is only applicable when ~~supported in bands under~~ PSD limitation applies within FR2-2 based on the regional regulations ~~in shared spectrum operation~~ | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 5: FG 24-5c

After review of contributions submitted to RAN1 #109-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 | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 | 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 | This FG is only applicable when ~~supported in bands under~~ PSD limitation applies within FR2-2 based on the regional regulations ~~in shared spectrum operation~~ | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 6: FG 24-6

After review of contributions submitted to RAN1 #109-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 | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 1 channel access procedure~~[~~2. Support LBT performed per channel, as defined in 37.213 Clause 4.4 ~~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 | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 7: FG 24-7

After review of contributions submitted to RAN1 #109-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 | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 2 channel access procedure~~[~~2. Support LBT performed per channel, as defined in 37.213 Clause 4.4 ~~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 | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Issue 8: New FGs

The following new FGs were proposed in contributions submitted to RAN1 #109-e in this agenda item. Please indicate which rows should be discussed as part of this email discussion during RAN1 #109-e.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-1h | Multiple PDSCH scheduling by single DCI for 60kHz in FR2-1 and for 15/30/60kHz in FR1 | 1. Multi-PDSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs2. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | FFS | Yes | N/A | Multiple PDSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 or FR2-1 | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1i | Multiple PUSCH scheduling by single DCI for 60kHz in FR2-1 and for 15/30/60kHz in FR1 | 1. Multi-PUSCH scheduling by single DCI for the operation with 15/30/60 kHz SCSs with non-contiguous allocation | FFS | Yes | N/A | Multiple PUSCH scheduling by single DCI for 15/30/60kHz is not supported in FR1 or FR2-1 with non-contiguous allocation | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-8a | 32 DL HARQ processes for FR 2-1 | Support 32 HARQ processes in DL for 60/120 kHz | FFS | Yes | N/A | 32 DL HARQ processes for FR 2-2 is not supported | FFS | FFS | FFS | FFS | A UE supporting 32 maximum number of HARQ processes for 120 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 60 kHz SCS for DL in FR2-1 | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-9a | 32 UL HARQ processes for FR 2-1 | Support 32 HARQ processes in UL for 60/120 kHz | FFS | Yes | N/A | 32 DL HARQ processes for FR 2-2 is not supported | FFS | FFS | FFS | FFS | A UE supporting 32 maximum number of HARQ processes for 120 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 60 kHz SCS for DL in FR2-1 | Optional with capability signaling |
| 24. NR\_ext\_to\_71GHz | 24-11a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells- Candidate value for the component: {[4, 5, …, , 16]} | FFS | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signaling  |
| 24. NR\_ext\_to\_71GHz | 24-11b | Mix of Rel. 17 PDCCH monitoring capability and Rel.15 and/or Rel.16 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability, Rel-16 monitoring capability and/or Rel-17 monitoring capability on different serving cells | FFS | Yes | N/A | Mix of Rel. 17 PDCCH monitoring capability and Rel.15 and/or Rel.16 PDCCH monitoring capability on different carriers is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signaling |
| 24. NR\_ext\_to\_71GHz | 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 15- Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {[4, 5, …, 16]} | FFS | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | FFS | FFS | FFS | FFS |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 15- Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {[3,4, 5, …, 16]} | FFS | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | FFS | FFS | FFS | FFS |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17)- Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15- Candidate values for pdcch-BlindDetectionCA-R17 is 1 to 15- Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {[4, 5, …, 16]} | FFS | Yes | N/A | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | FFS | FFS | FFS | FFS |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells | Supported combination of (*pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | FFS | Yes | N/A | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells is not supported | FFS | FFS | FFS | FFS |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11g | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | FFS | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | FFS | FFS | FFS | FFS |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11h | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | FFS | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers is not supported | FFS | FFS | FFS | FFS |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11i | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17*, *pdcch-BlindDetectionSCG-UE-r17*) | FFS | Yes | N/A | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel.17 , Rel.16 and Rel. 15 PDCCH monitoring capabilities on different carriers is not supported | FFS | FFS | FFS | FFS |  | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-12a | 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 | FFS | Yes | N/A | Time domain HARQ-ACK bundling for Type 1 HARQ codebook for 120 kHz SCS is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12b | 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 | FFS | Yes | N/A | Time domain HARQ-ACK bundling for Type 2 HARQ codebook for 120 kHz SCS is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12c | 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 | FFS | Yes | N/A | Time domain HARQ-ACK bundling for Type 1 HARQ codebook for 480 kHz SCS is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12d | 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 | FFS | Yes | N/A | Time domain HARQ-ACK bundling for Type 2 HARQ codebook for 480 kHz SCS is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12e | 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 | FFS | Yes | N/A | Time domain HARQ-ACK bundling for Type 1 HARQ codebook for 960 kHz SCS is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-12f | 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 | FFS | Yes | N/A | Time domain HARQ-ACK bundling for Type 2 HARQ codebook for 960 kHz SCS is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13a | 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  | FFS | Yes | N/A | Single-DCI based SDM scheme multi-PDSCH DL grant for 120 kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13b | 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 | FFS | Yes | N/A | Single-DCI based SDM scheme multi-PDSCH DL grant for 480kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13c | 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 | FFS | Yes | N/A | Single-DCI based SDM scheme multi-PDSCH DL grant for 960kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13d | 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  | FFS | Yes | N/A | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13e | 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 | FFS | Yes | N/A | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13f | 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 | FFS | Yes | N/A | Single-DCI based FDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13g | 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  | FFS | Yes | N/A | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 120 kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13h | 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 | FFS | Yes | N/A | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 480kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13i | 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 | FFS | Yes | N/A | Single-DCI based FDMSchemeB multi-PDSCH DL grant for 960kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13j | 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  | FFS | Yes | N/A | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 120 kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13k | 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 | FFS | Yes | N/A | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 480kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-13l | 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 | FFS | Yes | N/A | Single-DCI based TDMSchemeA multi-PDSCH DL grant for 960kHz SCS in FR2-2 is not supported | FFS | FFS | FFS | FFS |  | Optional with capability signalling |

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| Company | Comments/Questions/Suggestions |
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# Discussion/Approval Items during RAN1 #109-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]***

**General comments**

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| Company | Comments/Questions/Suggestions |
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# Issue 1: FG

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

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| Company | Comments/Questions/Suggestions |
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# Discussion/Approval Items during RAN1 #109-e — Third Checkpoint

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

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

**General comments**

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| Company | Comments/Questions/Suggestions |
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# Issue 1: FG

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

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| Company | Comments/Questions/Suggestions |
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# Summary of Final Proposals for Agreements

This Section summarizes the final proposals for agreement in RAN1 #109-e by email. There are no tables for comments.

***[All comments must be directly made on the RAN1 email reflector]***

Companies can continue to update their comments in the previous Sections, however, these are no longer monitored by the moderator. Any such comments will be for archival purposes only and will not influence the outcome of this email discussion. Any objection to any of the proposals in this Section must be voiced directly on the RAN1 email reflector.

## Final Proposals for Agreement by the First Check Point

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

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## Final Proposals for Agreement by the Second Check Point

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

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# Conclusion

In addition to the agreements in Section 6, that were reached by email during RAN1 #109-e, the following was agreed by GTW during RAN1 #109-e:

# References

1. R1-2202929, Updated RAN1 UE features list for Rel-17 NR after RAN1 #108-e including remaining RAN1 issues, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2203083, Rel-17 UE features for extension to 71 GHz, Huawei/HiSilicon/SIA
3. R1-2203295, Rel-17 UE features for 52.6 to 71GHz, ZTE/Sanechips
4. R1-2203530, Remaining issues on UE features for NR operation from 52.6GHz to 71GHz, vivo
5. R1-2203878, Views on UE features for supporting NR from 52.6 GHz to 71 GHz, Samsung
6. R1-2204115, UE features for extending current NR operation to 71 GHz, Ericsson
7. R1-2204136, Discussion on UE features for FR2-2, OPPO
8. R1-2204219, Views on Rel-17 Beyond 52.6 GHz UE features, Apple
9. R1-2205111, Views on UE features for supporting NR in FR2-2, NTT DOCOMO, INC.
10. R1-2204587, On UE features for supporting NR from 52.6 GHz to 71 GHz, Nokia/Nokia Shanghai Bell
11. R1-2204625, Discussion on UE features for NR above 52.6 GHz, LG Electronics
12. R1-2204708, Views on UE features for supporting NR from 52.6 GHz to 71 GHz, MediaTek Inc.
13. R1-2204780, Discussion on UE capabilities for extending NR up to 71 GHz, Intel Corporation