**3GPP TSG RAN WG1 #107-e R1-2111808**

**e-Meeting, November 11th – 19th, 2021**

**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 [107-e-R17-UE-features-52-71GHz-01] during RAN1 #107-e. According to the Chairman’s Notes:

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| [107-e-R17-UE-features-52-71GHz-01] Email discussion UE features for supporting NR from 52.6 GHz to 71 GHz – Ralf (AT&T)* 1st check point: November 15
* Final check point: November 19
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The following was discussed and/or agreed during RAN1 #107-e within the scope of [107-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 #107-e

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

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|  24. NR\_ext\_to\_71GHz | 24-1 | Basic FR2-2 [DL] support | 1. Support 120KHz SCS [transmission and] reception [for initial/non-initial access][2. Support multi-RB PUCCH format 0/1/4 for 120 kHz][3. PRACH with 120KHz SCS and length 139[/571/1151]][4. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-2][5. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2][6. Support multi-PUSCH[/PDSCH] scheduling by single DCI for the operation with 120 kHz SCS] |  |  |  | FR2-2 is not supported | [per UE][per band] |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

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| Company | Summary |
| Huawei/HiSilicon  | * **FG name:** We think the basic support of FR2-2 should include both DL and UL. This FG applies to both licensed and unlicensed band operation. Although the LAA with DL only mode is one of the supported scenario as NRU, it does not mean to support a UE only support DL.
* **Component 1:** This component is duplicating the rest of components in the FG. It can be removed if more detail components in the bracket are finally approved.
* **Component 2:** The component of enhanced PUCCH format 0/1/4 with multi-RB should be a separated FG because it is also supported for 480 kHz and 960 kHz SCS. In addition, the support of enhanced PUCCH format 0/1/4 is only applicable to unlicensed band operation due to limitation on PSD in regulation. At maximum 16 RB are supported for all numerologies according to the agreement in RAN1#106. In NR-U Rel-16, enhanced PUCCH format 0/1/2/3 with PRB interlace resource mapping is set as a separate FG10-3a.
* **Component 3:** The component of wideband PRACH for 120 kHz SCS with sequence length of 571 and 1171 should be a separate FG because it is only applicable for unlicensed band. Considering wideband PRACH with length of 571 is supported for 480 kHz SCS in RAN1#106b-e, it can be listed as one of the component. Similar method is adopted in NRU that wideband PRACH is set as a separate FG10-27.
* **Component 4/5:** we support to remove the bracket.
* **Component 6:** The component of “Support multi-PUSCH/PDSCH scheduling by single DCI for the operation with 120 kHz SCS” should be a separate FG from Basic FR2-2 [DL] support, similar as FG10-17 in NR-U Rel-16 and finally extended to FR2-1 for 120kHz SCS.

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| 24. NR\_ext\_to\_71GHz | 24-1 | Basic FR2-2 support |  1. Support 120KHz SSB for initial access in FR2-23. PRACH with 120KHz SCS and length 1394. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-25. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 |  |  |  | FR2-2 is notsupported | [per UE][per band] |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |
|  24. NR\_ext\_to\_71GHz | 24-? | Wideband PRACH | Enhanced PRACH design for operation with shared spectrum channel access by adopting a single long ZC sequence, with ZC sequence = 1151 for 120kHz and ZC sequence = 571 for 120kHz /480kHz.  | 24-1, [24-4]  |  |  |  |  |  |  |  | Agreement:* For initial access and non-initial access use cases, support 120kHz PRACH SCS with sequence length L=571, 1151 (in addition to L=139) for PRACH Formats A1~A3, B1~B4, C0, and C2.

…Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH. Agreement:Additionally, support PRACH length L=571 for 480kHz |  24. NR\_ext\_to\_71GHz |
|  24. NR\_ext\_to\_71GHz | 24-? | PUCCH format 0/1/4 with multi RB | 1. Support [2,…, 16] RB for PUCCH format 0 and format 1 for 120kHz/480kHz/960kHz
2. Support [2,…, 16] RB for PUCCH format 4 for 120kHz/480kHz/960kHz
 | 24-1, 24-4, 24-5 |  |  |  |  |  |  |  | Agreement:The maximum configured number of RBs, N\_RB, for enhanced PF 0/1/4 is given by 16 RBs for 120 kHz SCSAgreement:The maximum configured number of RBs, N\_RB, for enhanced PF 0/1/4 is given by 16 RBs for 480 and 960 kHz SCS (same as for 120 kHz SCS). |  24. NR\_ext\_to\_71GHz |
|  24. NR\_ext\_to\_71GHz | 24-? | Multiple PDSCH/PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 960 kHz SCS
 | 24-1,  |  |  |  |  |  |  |  | Agreement:* The maximum number of PDSCHs/ PUSCHs that can be scheduled with a single DCI in Rel-17 is 8 for SCS of 120, 480 and 960 kHz.

FFS: Whether UE capability is introduced for restricting the maximum number of PDSCHs or PUSCHs that can be scheduled with a single DCI. |  24. NR\_ext\_to\_71GHz |

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| Nokia/Nokia Shanghai Bell  | * SSB support for non-initial access should be mentioned in this FG as well
* Confirm components 2-6
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| OPPO  | Since a UE that supports FR2-2 must indicate FR2-2 is supported, we prefer to have very basic features in this group to lower the bar for accessing FR2-2. The other features can be grouped into FG 24-1a. The proposed FG24-1 and FG 24-1a are as follows.

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| 24-1 | Basic FR2-2 support  | 1. Support 120KHz SCS transmission and reception for initial/non-initial access2. Support multi-RB PUCCH format 0/1 for 120 kHz3. PRACH with 120KHz SCS and length 1394. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-25. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 |
| 24-1a | FR2-2 support  | 1. Support multi-RB PUCCH format 4 for 120 kHz2. PRACH with 120KHz SCS and length 571/11513. Support multi-PUSCH[/PDSCH] scheduling by single DCI for the operation with 120 kHz SCS |

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| Ericsson  | In our view, it would be better to restructure the basic feature groups to support the following deployment scenarios for FR2-2 with 120 kHz SCS. We note that a similar approach was used for NR-U in Rel-16 for aligning basic feature groups with deployment scenarios.1. CA with PCell in FR1 (or FR2-1) + SCell (DL-only) in FR2-2
2. CA/DC with PCell in FR1 (or FR2-1) + (P)SCell (DL+UL) in FR2-2
3. Standalone operation in FR2-2, i.e., PCell in FR2-2

This means that FG 24-1 should contain only the components that are needed for Scenario #1 which is based on DL-only (non-standalone) operation in FR2-2. A separate basic FG should then be created to support UL non-standalone operation in FR2-2, with only the needed components to support Scenario #2. To support standalone operation in FR2-2 (Scenario #3), Component #3 in FG 24-1 related to long-sequence PRACH for initial access should be included in FG 24-2.**Proposal: FG 24-1 should be a basic feature group for DL only (non-standalone) operation in FR2-2 with 120 kHz SCS. Hence, only Component #1 (for non-initial access), Component #4, and Component #6 (Multi-PDSCH scheduling) should be contained in FG 24-1.****Proposal: Create a separate feature group FG 24-1a for basic UL non-standalone operation in FR2-2 for 120 kHz SCS. Component #3 (long sequence PRACH) should be restricted to non-initial access. Component #4 of FG 24-1 can be removed, since it is assumed that FG 24-1 would be a pre-requisite for FG 24-1a.**According to the above proposals, the FG structure would look like the following assuming that FG 24-1 would be a pre-requisite for FG 24-1a, and both of these would be pre-requisites for FG 24-2:

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| 24-1 | Basic FR2-2 ~~[~~DL~~]~~ support | 1. Support 120KHz SCS ~~[transmission and]~~ reception ~~[~~for ~~initial/~~non-initial access~~]~~~~[2. Support multi-RB PUCCH format 0/1/4 for 120 kHz]~~~~[3. PRACH with 120KHz SCS and length 139[/571/1151]]~~~~[~~4. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-2~~]~~~~[5. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2]~~~~[~~6. Support multi-~~PUSCH[/~~PDSCH~~]~~ scheduling by single DCI for the operation with 120 kHz SCS~~]~~ |
| 24-1a | Basic FR2-2 UL support  | 1. Support 120KHz SCS transmission for non-initial access2. Support multi-RB PUCCH format 0/1/4 for 120 kHz3. PRACH with 120KHz SCS and length 139/571/1151 for non-initial access4. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-25. Support multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS |

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| Intel Corporation  |  |
| Samsung  | RAN and RAN1 have agreed to support 120 kHz SCS as the default numerology for supporting NR from 52.6 GHz to 71 GHz, and support 480 kHz and 960 kHz as optional numerologies subject to UE’s capability. Based on this principle, basic support for NR from 52.6 GHz to 71 GHz with 120 kHz SCS should be a mandatory UE feature, with the type of the UE feature as per band. Meanwhile, only essential operation with 120 kHz SCS should be considered as component(s) of the basic support, wherein essential operation can be understood as the minimum set of features supporting development scenarios in FR2-2. Considering there are agreed development scenarios with DL only or UL only on FR2-2, it’s beneficial to distinguish DL and UL as two separate basic FR2-2 feature groups, without using each other as a prerequisite feature group. Moreover, other than the basic DL reception and UL transmission, features as multi-RB PUCCH format, PRACH format, and multi-PUSCH/PDSCH scheduling shall be separate features with FG 24-1 as the prerequisite feature group. **Proposal: For FG 24-1:****• Separate DL and UL operations to be two basic FGs;****• Separate out features other than basic DL/UL operation as new feature groups with FG 24-1 as the prerequisite feature group;****• “Type” of the FG is “per band”.** |
| Apple  | 1. In FG 24-1, separate DL and UL FGs should be created
2. In FG 24-1 item 1, “Support 120KHz SCS [transmission and] reception for [initial/non-initial access]”
	1. remove “transmission and” to make this a DL only FG
	2. Keep “[initial access/non-initial access]” based on the following agreements

From WID:* In addition to 120kHz, support 480 kHz SSB for initial access with support of CORESET#0/Type0-PDCCH configuration in the MIB with following constraints:
	+ Note: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)

Agreement in RAN#92-e, June 14-18, 2021In addition to 120kHz, support **480** kHz SSB for initial access with support of CORESET0/Type0-PDCCH configuration in the MIB with following constraints:* Limited sync raster entry numbers
	+ It is assumed that RAN4 supports a channelization design which results in the total number of synchronization raster entries considering both licensed and unlicensed operation in a 52.6 – 71 GHz band no larger than **665** (Note: the total number of synchronization raster entries in FR2 for band n259 + n257 is 599). If the assumption cannot be satisfied, it’s up to RAN4 to decide its applicability to bands in 52.6 – 71 GHz.
* only 480kHz CORESTE#0/Type0-PDCCH SCS supported for 480 kHz SSB SCS.
* SSB time domain candidate resource pattern (within a slot or pair of slots) for 480 and 960kHz SSB are identical
* Prioritize support SSB-CORESET0 multiplexing pattern 1. Other patterns discussed on a best effort basis.
* 960 kHz numerology for the SSB is not supported by the UE for initial access in Rel-17.

Note: Strive to minimize specification impact by reusing tables for CORESET#0 and type0-PDCCH CSS set configuration defined for FR2 in Rel-15, as much as possibleNote: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)Note: Dependency or lack thereof for a UE supporting 480kHz and/or 960kHz numerology for data and control to also support 480kHz SSB numerology for initial access is to be tackled as part of UE capability discussion.1. In FG 24-1 Item 2 “[2. Support multi-RB PUCCH format 0/1/4 for 120 kHz]” should be moved to a separate FG
2. In FG 24-1 Item 3, “[3. PRACH with 120KHz SCS and length 139[/571/1151]]” should be moved to separate FGs
	1. PRACH sequence with 571 and 1151 should be optional feature as in NRU.
3. In FG 24-1 Item 4 “[4. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-2] and item 6 with PDSCH “[6. Support multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS]” should be kept in the basic DL FG
4. In FG 24-1 Item 5 “[5. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2] and item 6 with PUSCH [6. Support multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS], should be moved to a separate basic UL FG
5. FG 24-1 can be a per UE feature
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| vivo [9] | On 24-1, it should be a minimum set of features as long as a UE supports operation from 52.6-71GHz. As indicated in WID, NR/NR-U operation in the 52.6GHz to 71GHz can be in stand-alone or aggregated via CA or DC with an anchor carrier. For a UE supporting non-standalone case (e.g. CA) operation in the 52.6GHz to 71GHz, there will be no need to support multi-RB PUCCH and PRACH transmission. Besides, according to current WID [2], a design target says ‘support enhancement for PUCCH format 0/1/4 to increase the number of RBs under PSD limitation in shared spectrum operation’. This also means multi-RB PUCCH should not be a basic feature for general FR2-2 support since FR2-2 could be licensed band as well. Besides, there is no motivation to put multi-PUSCH/PDSCH scheduling as a basic feature for 120KHz SCS.

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** |
| 24-1 | Basic FR2-2 [DL] support | 1. Support 120KHz SCS [transmission and] reception [for initial/non-initial access][2. Support multi-RB PUCCH format 0/1/4 for 120 kHz][3. PRACH with 120KHz SCS and length 139[/571/1151]][4. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-2][5. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2][6. Support multi-PUSCH[/PDSCH] scheduling by single DCI for the operation with 120 kHz SCS] |  |

Proposal: Remove ‘2. multi-RB PUCCH format 0/1/4’, ‘3. PRACH with 120KHz SCS and length 139/571/1151’ and ‘6. multi-PUSCH[/PDSCH] scheduling by single DCI’ from basic FR2-2 support and list them as independent UE feature.  |
| ZTE/Sanechips [10] | 3GPP TS 38.300 specifies five scenarios for shared spectrum access operation:- Scenario A: Carrier aggregation between NR in licensed spectrum (SpCell) and NR in shared spectrum (SCell);- Scenario A.1: SCell is not configured with uplink (DL only);- Scenario A.2: SCell is configured with uplink (DL+UL).- Scenario B: Dual connectivity between LTE in licensed spectrum and NR in shared spectrum (PSCell);- Scenario C: NR in shared spectrum (PCell);- Scenario D: NR cell in shared spectrum and uplink in licensed spectrum;- Scenario E: Dual connectivity between NR in licensed spectrum (PCell) and NR in shared spectrum (PSCell).In Scenario A.1 as shown above, SCell is configured with downlink only. That means a UE can have no uplink transmission in FR2-2 at all. Thus, we propose to have separate FR2-2 FG for supporting DL reception and UL transmission.**Proposal: Propose to have separate FR2-2 FG for supporting DL reception and UL transmission.**According to the following agreements of RAN1 #104-e and #106b-e meeting, single DCI scheduled multiple PDSCHs/PUSCHs have been approved for FR2-2. But we need to further discuss whether component on single DCI scheduled multiple PDSCHs/PUSCHs should be regarded as the basic FG for DL/UL.Agreement: (RAN1 #104-e)* The maximum number of PDSCHs that can be scheduled with a single DCI in Rel-17 is 8 for SCS of 480 and 960 kHz.
	+ FFS: Further restrictions for 480 kHz to 4
	+ FFS: A UE capability to select between 4 and 8 for 480 kHz SCS
	+ Note: Multi-PDSCH scheduling for the case of 120 kHz SCS is still FFS as per prior agreement. This case can be addressed after this FFS has been decided.
* The maximum number of PUSCHs that can be scheduled with a single DCI in Rel-17 is 8.
	+ FFS: Further restrictions for 120 kHz and 480 kHz SCS
	+ FFS: A UE capability to select between different values for 120 kHz and 480 kHz SCS

Agreement: (RAN1 #106b-e)Confirm the working assumption from RAN1#106-e with the following modification.Working assumption: (RAN1#106-e)Scheduling multiple PDSCHs by single DL DCI applies to 120 kHz in addition to 480 and 960 kHz at least in FR2-2.* ~~FFS: Further limitations on maximum number of PDSCHs~~
* Note: Further limitations (in addition to what was agreed earlier) on the maximum number of PDSCHs or PUSCHs can be separately discussed for all SCSs.

**Proposal: Further discuss whether component on single DCI scheduled multiple PDSCHs/PUSCHs should be regarded as the basic FG for DL/UL.**In RAN1 #104 e-meeting, the following agreement on supporting PRACH sequence length for 120kHz was achieved.Agreement:* For initial access and non-initial access use cases, support 120kHz PRACH SCS with sequence length L=571, 1151 (in addition to L=139) for PRACH Formats A1~A3, B1~B4, C0, and C2.
* For non-initial access use cases,
	+ if 480kHz and/or 960 kHz SSB SCS is agreed to be supported, support 480 and/or 960 kHz PRACH SCS with sequence length L=139 for PRACH Formats A1~A3, B1~B4, C0, and C2, respectively.
		- FFS: support of sequence length L = 571, 1151
* FFS: Support of 480 and/or 960 kHz PRACH SCS for initial access use cases, if 480 and/or 960 kHz SSB SCS is agreed to be supported for initial access

We can observe for the above agreement that PRACH sequence length L=139, 571, 1151 have been supported for 120kHz SCS. Based on this, we have no see reason not to support PRACH sequence length L= 571, 1151 in basic FG for UL. But we are open to discuss whether 120KHz PRACH SCS with sequence length L=571/1151 should be regarded as basic feature for FR2-2. .**Proposal: 120KHz PRACH SCS with sequence length L=139 should at least be regarded as basic feature for FR2-2.** **Proposal: Modify basic FG24-1 for DL as follows:**

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| Index | Feature group | Components | Prerequisite feature groups |
| 24-1 | Basic FR2-2 ~~[~~DL~~]~~ support | 1. Support 120KHz SCS SSB for initial/non-initial access~~[transmission and] reception [for initial/non-initial access]~~~~[2. Support multi-RB PUCCH format 0/1/4 for 120 kHz]~~~~[3. PRACH with 120KHz SCS and length 139[/571/1151]]~~2. ~~[~~ Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-2~~]~~~~[5. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2]~~~~3. [6. Support multi-PUSCH[/PDSCH] scheduling by single DCI for the operation with 120 kHz SCS]~~ |  |

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| LG Electronics [11] | Similar to NR-U UE feature discussion, it is expected that basic feature groups will be defined for corresponding deployment scenarios. With this regard, for instance, only DL-related component(s) in FG 24-1 (e.g., Support 120 kHz SCS reception for non-initial access) or FG 24-4 (e.g., 480KHz SCS for DL data and control channels and reference signal reception in FR2-2) could be needed for LAA deployment scenario case. Therefore, it is preferred to split DL-related FG(s) and UL-related FG(s) to be able to define basic feature groups depending on deployment scenario.**Proposal : At least for FG 24-1 and FG 24-4, split DL-related FG(s) and UL-related FG(s) to be able to define basic feature groups depending on deployment scenario.**UE capability to support multi-PXSCH scheduling DCI is captured as a component of each FG corresponding to 120, 480, or 960 kHz SCS. However, multi-PXSCH scheduling DCI introduced from 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 make separate FGs for multi-PXSCH scheduling DCI and support them in frequency ranges other than FR2-2.**Proposal: Define separate feature groups for multi-PDSCH scheduling DCI and multi-PUSCH scheduling DCI such that the feature can be supported in frequency ranges other than FR2-2.** |
| NTT DOCOMO, INC. [12] | On this issue, we are open for either way regarding some components captured currently. For example, component #2 and #3 are the features supported in WI discussion to deal with regional regulations. Since it may not be essential in all the regions, separate FGs could be considered. However, we believe some other components should be defined as the basic feature, rather than separate ones, such as component #4 and #5. In component #4 and #5, the use of 120 kHz SCS for data and control channels and reference signals are captured for DL and UL, respectively. We do not see any need to separate DL and UL for such cases. It rather makes capability reporting more redundant without any motivation. For component#6, although we clearly agreed to support multi-PUSCH/PDSCH scheduling by single DCI with 120 kHz SCS, it may not be an essential feature in case of 120 kHz SCS as multi-slot PDCCH monitoring is not considered. Also, any feature regarding the operation in unlicensed bands will be optional as well as Cat-3 LBT support. Given the situation, we think component #6 can be defined as a separate optional feature. With those in mind, we support to include component #1, #4,　and #5 in basic feature FG24-1.Another aspect related to FG24-1 is whether to include initial access aspect, which is also related to FG24-2. We think the current wording in FG24-1 is a bit unclear. It may be interpreted as “both initial access procedures and non-initial access procedure are supported” or “to support initial access related signals/channels”. Our understanding is this sentence is to show the support of whether initial and/or non-initial access procedures are supported. Therefore, some wordings, e.g., “procedure”, should be added. If the bracket is removed with keeping the sentence as it is, initial access procedure with 120 kHz SCS will be a basic feature, which implies that the current FG24-2 should be removed. If we keep FG24-2 as a separate one as in the current list, we have to remove “initial/” within the bracket in FG24-1 to remove the bracket, which implies initial access procedure with 120 kHz SCS will be an optional feature. On this issue, while we prefer to reduce the number of FGs in general, assuming LAA-like use case together with licensed band(s), a separate feature for initial access with 120 kHz SCS may be a proper way in our view. **Proposal: Regarding FG24-1 (to be basic feature for FR2-2 support):*** **Components #2 and #3 could be defined separately**
* **Components #1, #4, and #5 should be included**
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| MediaTek Inc. [13] | We view this FG as basic UE feature for operating in FR2-2 and we suggest to split into UL and DL basic features to enable operation in a cell not configured with uplink. For the components, we suggest to include specific types of channels/signals instead of transmission and reception in the description to avoid ambiguity. We also suggest to separate the multi-RB PUCCH feature and wideband PRACH feature into other FGs as optional enhancements.

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| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  ~~24. NR\_ext\_to\_71GHz~~ | ~~24-1~~ | ~~General Basic FR2-2 [DL] support~~ | ~~1. Support 120KHz SCS [transmission and] reception for [initial/non-initial access]~~~~[2. Support multi-RB PUCCH format 0/1/4 for 120 kHz]~~~~[3. PRACH with 120KHz SCS and length 139[/571/1151]]~~~~[4. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-2]~~~~[5. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2]~~~~[6. Support multi-PUSCH[/PDSCH] scheduling by single DCI for the operation with 120 kHz SCS]~~ |  | ~~Optional with capability signalling~~~~[A UE that supports FR2-2 must indicate this FG is supported]~~ |
| 24. NR\_ext\_to\_71GHz | 24-1-1 | General FR2-2 support for DL | 1. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-2
 |  | Optional with capability signalingThis FG is a part of basic DL operation in FR2-2  |
| 24. NR\_ext\_to\_71GHz | 24-1-2 | General FR2-2 support for UL | 1. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2
2. Support PRACH with 120KHz subcarrier spacing and length 139 in FR2-2
 |  | Optional with capability signalingThis FG is a part of basic UL operation in FR2-2 |

Based on our comments on FG 24-1, we suggest to introduce FGs for multi-RB PUCCH format 0/1/4 enhancements based on the following agreements:Agreement:The maximum configured number of RBs, N\_RB, for enhanced PF 0/1/4 is given by 16 RBs for 120 kHz SCS.Agreement:The maximum configured number of RBs, N\_RB, for enhanced PF 0/1/4 is given by 16 RBs for 480 and 960 kHz SCS (same as for 120 kHz SCS).Proposal: Add FGs for multi-RB PUCCH format 0/1/4 as follows

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| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-Z-1 | 120kHz multi-RB PUCCH format 0/1/4 for FR2-2 unlicensed operation | 1. Support multi-RB PUCCH format 0/1 enhancements with configured integer number of RB in the range [1,… ,16]
2. Support multi-RB PUCCH format 4 enhancements with configured integer number of RB in the range [1,… ,16] that fulfil the requirement $2^{α\_{2}}∙3^{α\_{3}}∙5^{α\_{5}}$ where $α\_{2},α\_{3},α\_{5}$ is a set of non-negative integers
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-Z-2 | 480kHz multi-RB PUCCH format 0/1/4 for FR2-2 unlicensed operation | 1. Support multi-RB PUCCH format 0/1 enhancements with configured integer number of RB in the range [1,… ,16]
2. Support multi-RB PUCCH format 4 enhancements with configured integer number of RB in the range [1,… ,16] that fulfil the requirement $2^{α\_{2}}∙3^{α\_{3}}∙5^{α\_{5}}$ where $α\_{2},α\_{3},α\_{5}$ is a set of non-negative integers
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-Z-3 | 960kHz multi-RB PUCCH format 0/1/4 for FR2-2 unlicensed operation | 1. Support multi-RB PUCCH format 0/1 enhancements with configured integer number of RB in the range [1,… ,16]
2. Support multi-RB PUCCH format 4 enhancements with configured integer number of RB in the range [1,… ,16] that fulfil the requirement $2^{α\_{2}}∙3^{α\_{3}}∙5^{α\_{5}}$ where $α\_{2},α\_{3},α\_{5}$ is a set of non-negative integers
 |  | Optional |

In RAN1 #106bis e meeting, the following agreement regarding m-TRP multi-PDSCH scheduling reception is achieved.Agreement:The working assumption in RAN1#106-e is confirmed with the following update:For multi-PDSCH scheduling for multi-TRPs, support a single DCI field ‘Transmission Configuration Indication’ as in Rel-16 TCI state indication mechanism for multi-TRPs* The single DCI field ‘Transmission Configuration Indication’ indicates one or two TCI states associated with a code point for single DCI based multi-TRP mechanism
	+ When two TCI states are indicated, reuse Rel-16 association rules to apply the two TCI states for each PDSCH scheduled by a multi-PDSCH scheduling DCI
* The single DCI field ‘Transmission Configuration Indication’ indicates only one TCI state associated with a code point for multi-DCI based multi-TRP mechanism
* Reuse Rel-16 RRC configuration and MAC CE activation/deactivation methods for the one or two TCI states
* ~~FFS: Details of multiple TCI state association with multiple PDSCHs~~
* Within the TDRA table for multi-PDSCH scheduling, the UE does not expect to be configured with the higher layer parameter repetitionNumber

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-U-1 | 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-U-2 | 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-U-3 | 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-V-1 | 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-V-2 | 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-V-3 | 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-R-1 | 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-R-2 | 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-R-3 | 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-Q-1 | 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-Q-2 | 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-Q-3 | 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 |

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-S-1 | multi-PDSCH DL grant for 120 kHz SCS in FR2-2 | 1. Support of scheduling up to 8 PDSCHs with a single DCI 1\_1 for 120kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-S-2 | multi-PDSCH DL grant for 480kHz SCS in FR2-2 | 1. Support of scheduling up to 8 PDSCHs with a single DCI 1\_1 for 480kHz SCS in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-S-3 | multi-PDSCH DL grant for 960kHz SCS in FR2-2 | 1. Support of scheduling up to 8 PDSCHs with a single DCI 1\_1 for 960kHz SCS in FR2-2
 |  | Optional |

Proposal: Add FGs for multi-PUSCH scheduling as follows

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-T-1 | multi-PUSCH UL grant for 120 kHz SCS in FR2-2 | 1. Support of scheduling up to 8 PUSCHs with a single DCI 0\_1 for 120kHz in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-T-2 | multi-PUSCH UL grant for 480kHz SCS in FR2-2 | 1. Support of scheduling up to 8 PUSCHs with a single DCI 0\_1 for 480kHz in FR2-2
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-T-3 | multi-PUSCH UL grant for 960kHz SCS in FR2-2 | 1. Support of scheduling up to 8 PUSCHs with a single DCI 0\_1 for 960kHz in FR2-2
 |  | Optional |

  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB based stand-alone support in FR2-2 | 1. Support 120KHz SSB for initial access in FR2-2 | 24-1 |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon  | According to the WID, there is a note saying “ Note: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)”. so FG24-2 should be a component of basic FR2-2 support (FG24-1)

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
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 |
| Nokia/Nokia Shanghai Bell  | • FG name mentions stand-alone support, but the functionality is relevat to PSCell operation as well.• It would be better to merge this FG with FG 24-1. |
| OPPO  |  |
| Ericsson  | In our view, it would be better to restructure the basic feature groups to support the following deployment scenarios for FR2-2 with 120 kHz SCS. We note that a similar approach was used for NR-U in Rel-16 for aligning basic feature groups with deployment scenarios.1. CA with PCell in FR1 (or FR2-1) + SCell (DL-only) in FR2-2
2. CA/DC with PCell in FR1 (or FR2-1) + (P)SCell (DL+UL) in FR2-2
3. Standalone operation in FR2-2, i.e., PCell in FR2-2

This means that FG 24-1 should contain only the components that are needed for Scenario #1 which is based on DL-only (non-standalone) operation in FR2-2. A separate basic FG should then be created to support UL non-standalone operation in FR2-2, with only the needed components to support Scenario #2. To support standalone operation in FR2-2 (Scenario #3), Component #3 in FG 24-1 related to long-sequence PRACH for initial access should be included in FG 24-2.**Proposal: Include component for long-sequence PRACH in FG 24-2 for stand-alone operation in FR2-2 with 120 kHz SCS.**According to the above proposals, the FG structure would look like the following assuming that FG 24-1 would be a pre-requisite for FG 24-1a, and both of these would be pre-requisites for FG 24-2:

|  |  |  |
| --- | --- | --- |
| 24-2 | 120KHz SSB based stand-alone support in FR2-2 | 1. Support 120KHz SSB for initial access in FR2-22. PRACH with 120KHz SCS and length 139/571/1151for initial access |

 |
| Intel Corporation  |  |
| Samsung  |  |
| Apple  | 1. For FG 24-s, given the agreements in the WID and in RAN1 #92-e, initial access (SSB) may be part of the basic FG and is mandated for FR2-2. Discussion is needed on if this FG is needed.
2. If kept, FG 24-2 should be a per-UE feature
 |
| vivo [9] |  |
| ZTE/Sanechips [10] | For “FG 24-2 120KHz SSB based stand-alone support in FR2-2”, we do not think this FG is necessary. According to WID [2] and the following agreement reached in RAN Plenary #92-e meeting, supporting 120KHz SSB for initial access and non-initial access is mandatory and it should be a basic feature. Thus FG 24-2 can be deleted and merged with FG 24-1.

|  |
| --- |
| From WID:* In addition to 120kHz, support 480 kHz SSB for initial access with support of CORESET#0/Type0-PDCCH configuration in the MIB with following constraints:
	+ Note: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)
 |

|  |
| --- |
| Agreement in RAN#92-e, June 14-18, 2021In addition to 120kHz, support **480** kHz SSB for initial access with support of CORESET0/Type0-PDCCH configuration in the MIB with following constraints:* Limited sync raster entry numbers
	+ It is assumed that RAN4 supports a channelization design which results in the total number of synchronization raster entries considering both licensed and unlicensed operation in a 52.6 – 71 GHz band no larger than **665** (Note: the total number of synchronization raster entries in FR2 for band n259 + n257 is 599). If the assumption cannot be satisfied, it’s up to RAN4 to decide its applicability to bands in 52.6 – 71 GHz.
* only 480kHz CORESTE#0/Type0-PDCCH SCS supported for 480 kHz SSB SCS.
* SSB time domain candidate resource pattern (within a slot or pair of slots) for 480 and 960kHz SSB are identical
* Prioritize support SSB-CORESET0 multiplexing pattern 1. Other patterns discussed on a best effort basis.
* 960 kHz numerology for the SSB is not supported by the UE for initial access in Rel-17.

Note: Strive to minimize specification impact by reusing tables for CORESET#0 and type0-PDCCH CSS set configuration defined for FR2 in Rel-15, as much as possibleNote: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)Note: Dependency or lack thereof for a UE supporting 480kHz and/or 960kHz numerology for data and control to also support 480kHz SSB numerology for initial access is to be tackled as part of UE capability discussion. |

**Proposal: “FG 24-2 120KHz SSB based stand-alone support in FR2-2” is not necessary, which can be deleted and merged with FG 24-1 in FR2-2.** |
| LG Electronics [11] |  |
| NTT DOCOMO, INC. [12] | Proposal: Regarding FG24-2 (to be a feature of initial access support with 120 kHz SCS)* It should be kept as it is, and the wording “initial/” within the bracket in component #1 of FG24-1 should be removed
 |
| MediaTek Inc. [13] | For FG24-2, the component should be “support 120kHz SSB for initial access” and we suggest to add FR2-2 notion to differentiate the support of 120kHz SSB in FR2-1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB based stand-alone support in FR2-2 | 1. Support ~~480~~120KHz SSB for initial access in FR2-2 |  | Optional |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB for initial access in FR2-2 | 1. Support 480KHz SSB for initial access in FR2-2 | 24-1[, 24-2, 24-4] | FFS |  |  | [per UE][per band] |  |  |  | From WID:* In addition to 120kHz, support 480 kHz SSB for initial access with support of CORESET#0/Type0-PDCCH configuration in the MIB with following constraints:
	+ Note: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)
	+ [only 480kHz CORESET#0/Type0-PDCCH SCS supported for 480 kHz SSB SCS]
 | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon  |  |
| Nokia/Nokia Shanghai Bell  | It would be better to merge this FG with FG 24-4.  |
| OPPO  |  |
| Ericsson  | We agree with the following text that was added in the Note column for FG 24-4 and 24-5:• Resolve the issues of wideband PRACH, multi-RB PUCCH format 0/1/4, and multi-PUSCH/PDSCH scheduling by single DCI, i.e., whether to have components of a single FG or separate FGs, for 120 kHz first, then use the same structure for 480 kHz• Resolve the issue of having separate capabilities for DL and UL (data and control channels as well as reference signals) for 120 kHz first, then use the same structure for 480 kHzFurthermore, we think that the FGs for 480/960 kHz SCS should follow the same structure as proposed above for 120 kHz to properly cover the 3 fundament deployment scenarios. These scenarios are equally applicable for 480/960 kHz as they are for 120 kHz. The only different aspect is that multi-slot PDCCH monitoring will be a component required for 480/960 kHz operation.**Proposal: For 480 and 960 kHz SCS operation, follow a similar structure as proposed above for 120 kHz to properly cover the 3 fundamental deployment scenarios, i.e., non-standalone DL-only, non-standalone DL+UL, and standalone.**According to this proposal, the FG structure would look like the following for the case of 480 kHz assuming that FG 24-4 would be a pre-requisite for FG 24-4a, and both of these would be pre-requisites for FG 24-3. A similar structure can be used for 960 kHz SCS.

|  |  |  |
| --- | --- | --- |
| 24-3 | 480KHz SSB based standalone support ~~for initial access~~ in FR2-2 | 1. Support 480KHz SSB for initial access in FR2-22. PRACH with 480 kHz and length 139/571 for initial access |

 |
| Intel Corporation  |  |
| Samsung  | Similarly, FG 24-4 and FG 24-5 should only include basic transmission and reception operations for 480 kHz and 960 kHz SCS, respectively, and enhancements regarding the SSB monitoring, multi-slot PDCCH monitoring, and PRACH should be separated out as new feature groups. It also needs to be clarified that FG 24-3, FG 24-4 and FG 24-5 are per band. Meanwhile, the FGs for SSB reception and data reception should be separated and may not need to be prerequisite from each other. **Proposal: For FG 24-3, FG 24-4 and FG 24-5:****• Separate DL and UL operations to be two FGs, for each of 480 kHz and 960 kHz;****• Separate out features other than basic DL/UL operation as new feature groups;****• “Type” of the FGs are “per band”;****• FG 24-3 doesn’t require FG 24-4 (after the separation) as perquisite FG.** |
| Apple  | 1. FG 24-3 should be a per-band feature |
| vivo [9] |  |
| ZTE/Sanechips [10] | For “FG 24-3 480KHz SSB for initial access in FR2-2”, so far, dependency or lack thereof for a UE supporting 480kHz numerology for data and control to also support 480kHz SSB numerology for initial access has not been decided. Thus, RAN1 should first agree that a UE supporting 480kHz SSB for initial access should also support 480kHz numerology for data and control, then FG 24-4 can be used as a prerequisite feature group for FG 24-3.**Observation 1: No agreements/conclusions to support that FG 24-4 can be used as a prerequisite feature group for FG 24-3.****Proposal 7: RAN1 should agree that a UE supporting 480KHz SSB for initial access also supports 480KHz numerology for data and control, and modify FG 24-3 as follows.**

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-3 | 480KHz SSB for initial access in FR2-2 | 1. Support 480KHz SSB for initial access in FR2-2 | 24-1~~[, 24-2~~, 24-4~~]~~ |

 |
| LG Electronics [11] |  |
| NTT DOCOMO, INC. [12] |  |
| MediaTek Inc. [13] | In the note of FG 24-3, it captures that 480 kHz is an optional SSB numerology for initial access. We suggest to add following description in the note based on one related sub-bullet in WID:* only 480kHz CORESET#0/Type0-PDCCH SCS is supported for 480 kHz SSB SCS.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB based stand-alone support in FR2-2 | 1. Support 480 KHz SSB for initial access in FR2-2 | From WID:- In addition to 120kHz, support 480 kHz SSB for initial access with support of CORESET#0/Type0-PDCCH configuration in the MIB with following constraints:* only 480kHz CORESET#0/Type0-PDCCH SCS supported for 480 kHz SSB SCS.

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

 |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support | 1. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-22. 480KH SCS for DL data and control channels and reference signal reception in FR2-23. 480KHz for SSB monitoring [for non-initial access]4. Multiple-slot PDCCH monitoring for 480KHz with X=[4] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]5. PRACH with 480KHz and length 139/[571]FFS: 6. Support multi-RB PUCCH format 0/1/4 for 480 kHzFFS: 7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-1 | Yes |  |  | [Per UE/band] |  |  |  | From WID:In addition to 120kHz SCS, specify new SCS, 480kHz and 960kHz, and define maximum bandwidth(s), for operation in this frequency range for data and control channels and reference signals, only NCP supported. [Agreement:A UE supporting 480 kHz SCS supports multi-slot PDCCH monitoring for 480 kHz SCS.Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH]Note:• Resolve the issues of wideband PRACH, multi-RB PUCCH format 0/1/4, and multi-PUSCH/PDSCH scheduling by single DCI, i.e., whether to have components of a single FG or separate FGs, for 120 kHz first, then use the same structure for 480 kHz• Resolve the issue of having separate capabilities for DL and UL (data and control channels as well as reference signals) for 120 kHz first, then use the same structure for 480 kHz | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon  | * **Component 3:** We support the remove the bracket on “for non-initial access”. The SSB monitoring for initial access is covered by FG24-3.
* **Component 5:** The support of wideband PRACH with length of 571 can be a component of the separate FG for wideband PRACH as it is only used in unlicensed band.
* **Component 6:** The multi RB PUCCH format 0/1/4 for 480 kHz SCS should be a component of the separate FG for multi RB PUCCH format 0/1/4 as it is only for unlicensed band.
* **Component 7:** We support to have the component of multi PDSCH/PUSCH scheduled by single DCI in the basic support of 480 kHz SCS. It allows schedule all slots in the X slot group for multi slot PDCCH monitoring which is one of the component of basic support of 480kHz SCS.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support | 1. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-22. 480KH SCS for DL data and control channels and reference signal reception in FR2-23. 480KHz for SSB monitoring for non-initial access4. Multiple-slot PDCCH monitoring for 480KHz with X=[4] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]5. PRACH with 480KHz and length 1397. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-1 | Yes |  |  | [per UE/band] |  |  |  | From WID:In addition to 120kHz SCS, specify new SCS, 480kHz and 960kHz, and define maximum bandwidth(s), for operation in this frequency range for data and control channels and reference signals, only NCP supported.[Agreement:A UE supporting 480 kHz SCS supports multi-slot PDCCH monitoring for 480 kHz SCS.Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH]Note:• Resolve the issues of wideband PRACH, multi-RB PUCCH format 0/1/4, and multi-PUSCH/PDSCH scheduling by single DCI, i.e., whether to have components of a single FG or separate FGs, for 120 kHz first, then use the same structure for 480 kHz• Resolve the issue of having separate capabilities for DL and UL (data and control channels as well as reference signals) for 120 kHz first, then use the same structure for 480 kHz | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell  |  |
| OPPO  |  |
| Ericsson  | We agree with the following text that was added in the Note column for FG 24-4 and 24-5:• Resolve the issues of wideband PRACH, multi-RB PUCCH format 0/1/4, and multi-PUSCH/PDSCH scheduling by single DCI, i.e., whether to have components of a single FG or separate FGs, for 120 kHz first, then use the same structure for 480 kHz• Resolve the issue of having separate capabilities for DL and UL (data and control channels as well as reference signals) for 120 kHz first, then use the same structure for 480 kHzFurthermore, we think that the FGs for 480/960 kHz SCS should follow the same structure as proposed above for 120 kHz to properly cover the 3 fundament deployment scenarios. These scenarios are equally applicable for 480/960 kHz as they are for 120 kHz. The only different aspect is that multi-slot PDCCH monitoring will be a component required for 480/960 kHz operation.**Proposal: For 480 and 960 kHz SCS operation, follow a similar structure as proposed above for 120 kHz to properly cover the 3 fundamental deployment scenarios, i.e., non-standalone DL-only, non-standalone DL+UL, and standalone.**According to this proposal, the FG structure would look like the following for the case of 480 kHz assuming that FG 24-4 would be a pre-requisite for FG 24-4a, and both of these would be pre-requisites for FG 24-3. A similar structure can be used for 960 kHz SCS.

|  |  |  |
| --- | --- | --- |
| 24-4 | Basic 480KHz SCS DL support | ~~1. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~2. 480 KHz SCS for DL data and control channels and reference signal reception in FR2-23. 480KHz for SSB monitoring ~~[~~for non-initial access~~]~~4. Multiple-slot PDCCH monitoring for 480 KHz with X=[4] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]~~5. PRACH with 480KHz and length 139/[571]~~~~FFS: 6. Support multi-RB PUCCH format 0/1/4 for 480 kHz~~~~FFS:~~ 7. Multi-~~PUSCH/~~PDSCH scheduling by single DCI for the operation with 480 kHz SCS |
| 24-4a | Basic 480KHz SCS UL support | 1. 480 kHz SCS for UL data and control channels and reference signal transmission in FR2-22. PRACH with 480 KHz and length 139/571 for non-initial access3. Multi-RB PUCCH format 0/1/4 for 480 kHz4. Multi-PUSCH scheduling by single DCI for operation with 480 kHz SCS |

 |
| Intel Corporation  |  |
| Samsung  | Similarly, FG 24-4 and FG 24-5 should only include basic transmission and reception operations for 480 kHz and 960 kHz SCS, respectively, and enhancements regarding the SSB monitoring, multi-slot PDCCH monitoring, and PRACH should be separated out as new feature groups. It also needs to be clarified that FG 24-3, FG 24-4 and FG 24-5 are per band. Meanwhile, the FGs for SSB reception and data reception should be separated and may not need to be prerequisite from each other. **Proposal: For FG 24-3, FG 24-4 and FG 24-5:****• Separate DL and UL operations to be two FGs, for each of 480 kHz and 960 kHz;****• Separate out features other than basic DL/UL operation as new feature groups;****• “Type” of the FGs are “per band”;****• FG 24-3 doesn’t require FG 24-4 (after the separation) as perquisite FG.** |
| Apple  | 1. In FG 24-4, consider splitting UL and DL similar to 120 kHz.
2. In FG 24-4 Item 5 “[5. PRACH with 480KHz and length 139/[571]]”, we should have a separate FG/component for length 571 for a UE supporting ‘480kHz SCS’.
	1. Support for L-139 is sufficient in FG 24-4 for supporting ‘480kHz SCS'.
3. In FG 24-4, remove FFS on item 7 “7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 480 kHz SCS”
4. In FG 24-4 , add item 8/9 on Type 1 / Type 2 Codebook for multi-PDSCH transmission in 480 kHz.
5. FG 24-4 should be a per-band feature
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| vivo [9] | On 24-4 and 24-5, support of PRACH and PUCCH may not be needed for certain non-standalone scenario similar with the discussion for 24-1. Thus, PRACH and PUCCH part should be listed as independent UE feature.

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** |
| 24-4 | 480KHz SCS support | 1. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-22. 480KH SCS for DL data and control channels and reference signal reception in FR2-23. 480KHz for SSB monitoring [for non-initial access]4. Multiple-slot PDCCH monitoring for 480KHz with X=[4] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]5. PRACH with 480KHz and length 139/[571]FFS: 6. Support multi-RB PUCCH format 0/1/4 for 480 kHzFFS: 7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 480 kHz SCS |  |

**Proposal: List PRACH and PUCCH part in 24-4 and 24-5 as independent UE feature.**On 24-4 and 24-5, SSB-based monitoring needs further clarification on what to be included in this bullet, e.g. SSB-based RLM, RRM, BFD and etc. It is better to make it clear using spec language.**Proposal: Further clarification of SSB-based monitoring in 24-4 and 24-5 is needed.**Beside the already listed UE features, it seems that certain issues are missing here, e.g. multi-PDSCH/PUSCH support, directional LBT, receiver-assisted LBT and etc. The details of these features may be still discussed currently but they should be considered after they are complete. |
| ZTE/Sanechips [10] | For FR 2-2, 480KHz SCS SSB can be supported both for initial access and non-initial access. FG 24-3 is defined for supporting 480KHz SSB for initial access in FR2-2. Thus for “FG 24-4 480KHz SCS support”, we think it is necessary to clarify that Component 3 “480KHz for SSB monitoring” is only used for non-initial access case. Brackets in Component 3 can be deleted.**Proposal: It is necessary to clarify that Component 3 “480KHz for SSB monitoring” in FG 24-4 is only used for non-initial access. Square brackets in Component 3 can be deleted.**In RAN1#106bis e-meeting, multi-slot PDCCH monitoring capability is still under discussion. Other values less than 4/8 for 480 kHz/960 kHz can be further discussed and determined after multi-slot PDCCH monitoring capability is supported for X=4/8 for 480 kHz/960 kHz. Thus, we propose to de-prioritize discussion other values less than X for the sake of progress and support at least one workable solution to define the multi-slot PDCCH monitoring capability. Therefore, square brackets of two sides 4 in Component 4 can be deleted.Moreover, if there is no consensus made in the upcoming meeting, per-slot PDCCH monitoring for 480KHz should be supported.**Proposal: De-prioritize discussion other values of X if multiple-slot monitoring capability is supported in FR2-2.****Proposal: Propose to support multiple-slot PDCCH monitoring for 480KHz with X=4 slots first if multiple-slot monitoring capability is supported in FR2-2.****Proposal: If multiple-slot monitoring capability is not introduced in FR2-2, it is recommended to support per-slot PDCCH monitoring for 480KHz.**It is agreed that L=571 is supported for 480kHz in RAN1 #106bis e-meeting, so square brackets in Component 5 can be deleted.

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| **Agreement**Additionally, support PRACH length L=571 for 480kHz |

**Proposal: “ PRACH with 480KHz and length 139/571” should be supported for FR2-2.** For PUCCH format 0/1/4 for 480kHz SCS, muti-RB is also supported, the processing is the same as 120 kHz SCS.The agreements are as follows:Agreement:The maximum configured number of RBs, N\_RB, for enhanced PF 0/1/4 is given by 16 RBs for 120 kHz SCSAgreement:The maximum configured number of RBs, N\_RB, for enhanced PF 0/1/4 is given by 16 RBs for 480 and 960 kHz SCS (same as for 120 kHz SCS).**Proposal: .Support component 6 and remove the FFS of component 6 in FG 24-4.**Single DCI scheduled multi-PDSCH/PUSCH has been approved in RAN1 #104-e meeting and the following agreement is as bellow:Agreement:* The maximum number of PDSCHs that can be scheduled with a single DCI in Rel-17 is 8 for SCS of 480 and 960 kHz.
	+ FFS: Further restrictions for 480 kHz to 4
	+ FFS: A UE capability to select between 4 and 8 for 480 kHz SCS
	+ Note: Multi-PDSCH scheduling for the case of 120 kHz SCS is still FFS as per prior agreement. This case can be addressed after this FFS has been decided.
* The maximum number of PUSCHs that can be scheduled with a single DCI in Rel-17 is 8.
	+ FFS: Further restrictions for 120 kHz and 480 kHz SCS
	+ FFS: A UE capability to select between different values for 120 kHz and 480 kHz SCS

Single DCI scheduled multi-PDSCH/PUSCH should be approved without FFS for SCS of 480 and 960 kHz.**Proposal: Support component 7 and remove the FFS of component 7 in FG 24-4.** |
| LG Electronics [11] |  |
| NTT DOCOMO, INC. [12] |  |
| MediaTek Inc. [13] | We view this optional FG as basic UE feature for operation in FR2-2 if UE supports 480kHz subcarrier spacing. Similar to FG 24-1, we suggest to follow the same principle as 120kHz to split the components into UL and DL basic features to enable operation in a cell not configured with uplink. We also suggest to separate multi-slot PDCCH monitoring, multi-RB PUCCH, multi-PDSCH/PUSCH scheduling, and wideband PRACH into other FGs as optional enhancements.

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

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|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support | 1. 960KHz SCS for UL data and control channels and reference signal transmission in FR2022. 960KHz SCS for DL data and control channels and reference signal reception in FR2-23. 960KHz for SSB monitoring4. Multiple-slot PDCCH monitoring for 960KHz with X=[8] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]5. PRACH with 960KHz and length 139FFS: 6. Support multi-RB PUCCH format 0/1/4 for 960 kHzFFS: 7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 960 kHz SCS | 24-1 | Yes |  |  | [Per UE/band] |  |  |  | From WID* In addition to 120kHz SCS, specify new SCS, 480kHz and 960kHz, and define maximum bandwidth(s), for operation in this frequency range for data and control channels and reference signals, only NCP supported.

[Agreement:A UE supporting 960 kHz SCS supports multi-slot PDCCH monitoring for 960 kHz SCS.Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH]Note:• Resolve the issues of wideband PRACH, multi-RB PUCCH format 0/1/4, and multi-PUSCH/PDSCH scheduling by single DCI, i.e., whether to have components of a single FG or separate FGs, for 120 kHz first, then use the same structure for 480 kHz• Resolve the issue of having separate capabilities for DL and UL (data and control channels as well as reference signals) for 120 kHz first, then use the same structure for 480 kHz | Optional with capability signalling |

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| Company | Summary |
| Huawei/HiSilicon  | * **Component 3:** The support of 960KHz for SSB monitoring should only be applied for non-initial access according to the WID.
* **Component 6:** The multi RB PUCCH format 0/1/4 for 480 kHz SCS should be a component of the separate FG for multi RB PUCCH format 0/1/4 as it is only for unlicensed band.
* **Component 7:** We support to have the component of multi PDSCH/PUSCH scheduled by single DCI in the basic support of 480 kHz SCS. It allows schedule all slots in the X slot group for multi slot PDCCH monitoring which is one of the component of basic support of 480kHz SCS.

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| 24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support | 1. 960KHz SCS for UL data and control channels and reference signal transmission in FR2022. 960KHz SCS for DL data and control channels and reference signal reception in FR2-23. 960KHz for SSB monitoring for non-initial access4. Multiple-slot PDCCH monitoring for 960KHz with X=[8] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]5. PRACH with 960KHz and length 1397. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 960 kHz SCS | 24-1 | Yes |  |  | [per UE/band ] |  |  |  | From WID* In addition to 120kHz SCS, specify new SCS, 480kHz and 960kHz, and define maximum bandwidth(s), for operation in this frequency range for data and control channels and reference signals, only NCP supported.

[Agreement:A UE supporting 960 kHz SCS supports multi-slot PDCCH monitoring for 960 kHz SCS.Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH]Note:• Resolve the issues of wideband PRACH, multi-RB PUCCH format 0/1/4, and multi-PUSCH/PDSCH scheduling by single DCI, i.e., whether to have components of a single FG or separate FGs, for 120 kHz first, then use the same structure for 480 kHz• Resolve the issue of having separate capabilities for DL and UL (data and control channels as well as reference signals) for 120 kHz first, then use the same structure for 480 kHz | Optional with capability signalling |

 |
| Nokia/Nokia Shanghai Bell  | • Confirm the FG, details to be defined later. |
| OPPO  |  |
| Ericsson  |  |
| Intel Corporation  |  |
| Samsung  | Similarly, FG 24-4 and FG 24-5 should only include basic transmission and reception operations for 480 kHz and 960 kHz SCS, respectively, and enhancements regarding the SSB monitoring, multi-slot PDCCH monitoring, and PRACH should be separated out as new feature groups. It also needs to be clarified that FG 24-3, FG 24-4 and FG 24-5 are per band. Meanwhile, the FGs for SSB reception and data reception should be separated and may not need to be prerequisite from each other. **Proposal: For FG 24-3, FG 24-4 and FG 24-5:****• Separate DL and UL operations to be two FGs, for each of 480 kHz and 960 kHz;****• Separate out features other than basic DL/UL operation as new feature groups;****• “Type” of the FGs are “per band”;****• FG 24-3 doesn’t require FG 24-4 (after the separation) as perquisite FG.** |
| Apple  | 1. In FG 24-5, consider splitting UL and DL similar to 120 kHz.
2. In FG 24-5 Item 5 “[5. PRACH with 480KHz and length 139/[571]]”, we should have a separate FG/component for length 571 for a UE supporting ‘480kHz SCS’.
	1. Support for L-139 is sufficient in FG 24-4 for supporting ‘480kHz SCS'.
3. In FG 24-5 remove FFS on item 6 “6. Support multi-RB PUCCH format 0/1/4 for 9600 kHz”.
4. In FG 24-5 remove FFS on item 7 “7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 960 kHz SCS”
5. In FG 24-5, add item 8/9 on Type 1 / Type 2 Codebook for multi-PDSCH transmission in 960 kHz.
6. FG 24-5 should be a per-band feature
 |
| vivo [9] | On 24-4 and 24-5, support of PRACH and PUCCH may not be needed for certain non-standalone scenario similar with the discussion for 24-1. Thus, PRACH and PUCCH part should be listed as independent UE feature.

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** |
| 24-5 | 960KHz SCS support | 1. 960KHz SCS for UL data and control channels and reference signal transmission in FR2022. 960KHz SCS for DL data and control channels and reference signal reception in FR2-23. 960KHz for SSB monitoring4. Multiple-slot PDCCH monitoring for 960KHz with X=[8] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]5. PRACH with 960KHz and length 139FFS: 6. Support multi-RB PUCCH format 0/1/4 for 960 kHzFFS: 7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 960 kHz SCS |  |

**Proposal: List PRACH and PUCCH part in 24-4 and 24-5 as independent UE feature.**On 24-4 and 24-5, SSB-based monitoring needs further clarification on what to be included in this bullet, e.g. SSB-based RLM, RRM, BFD and etc. It is better to make it clear using spec language.**Proposal: Further clarification of SSB-based monitoring in 24-4 and 24-5 is needed.**Beside the already listed UE features, it seems that certain issues are missing here, e.g. multi-PDSCH/PUSCH support, directional LBT, receiver-assisted LBT and etc. The details of these features may be still discussed currently but they should be considered after they are complete. |
| ZTE/Sanechips [10] | In regards to PDCCH monitoring enhancement for FR2-2, we propose to de-prioritize discussion other values less than X for the sake of progress and support at least one workable solution (X=4/8 for 960 kHz) to define the multi-slot PDCCH monitoring capability, and square brackets of two sides 8 in Component 4 can be deleted and X=4 slots for 960kHz should be added as an optional value according to the agreement made in RAN1#106bis e-meeting. Moreover, if there is no consensus made in the upcoming meeting, per-slot PDCCH monitoring for 480KHz should be supported.**Proposal: Same method as component 4 in FG 24-4 can be used for component 4 in FG 24-5, square brackets of two sides 8 in Component 4 can be deleted and X=4 slots for 960kHz should be added as an optional value.**For PUCCH format 0/1/4 for 960kHz SCS, muti-RB is also supported, the processing is the same as 120 kHz SCS.The agreements are as follows:Agreement:The maximum configured number of RBs, N\_RB, for enhanced PF 0/1/4 is given by 16 RBs for 120 kHz SCSAgreement:The maximum configured number of RBs, N\_RB, for enhanced PF 0/1/4 is given by 16 RBs for 480 and 960 kHz SCS (same as for 120 kHz SCS).**Proposal: Support component 6 and remove the FFS of component 6 in FG 24-5.**Similar with FG24-4, Single DCI scheduled multi-PDSCH/PUSCH should be approved without FFS for SCS 960 kHz.**Proposal: Support component 7 and remove the FFS of component 7 in FG 24-5.** |
| LG Electronics [11] |  |
| NTT DOCOMO, INC. [12] |  |
| MediaTek Inc. [13] |

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

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|  24. NR\_ext\_to\_71GHz | 24-6 | Uplink channel access procedure for FR2-2 unlicensed operation | 1. Cat 3 [or Cat 4] LBT support [(not agreed yet if CW is supported, so it can be either Cat 3 or Cat 4 LBT for now. Will update when we have agreement)]
2. [Support LBT performed per carrier/BWP bandwidth]
 | 24-1 |  |  |  | [per band] |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

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| Company | Summary |
| Huawei/HiSilicon  | * **Component 2:** the bracket on “Support LBT performed per carrier/BWP bandwidth” should be removed according to the following agreement in RAN1#106-e.

*Agreement:** *For LBT for single carrier transmission, gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth) (Alt SC.1. in earlier agreements)*
* *For LBT for multi-carrier transmission in intra-band CA, gNB/UE performs multiple LBT, one for each channel bandwidth separately (Alt CA.1. in earlier agreements)*
	+ *FFS: Additional support of performing single LBT over all CCs (Alt CA.2. in earlier agreements)*

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| 24. NR\_ext\_to\_71GHz | 24-6 | Uplink channel access procedure for FR2-2 unlicensed operation | 1. Cat 3 [or Cat 4] LBT support [(not agreed yet if CW is supported, so it can be either Cat 3 or Cat 4 LBT for now. Will update when we have agreement)]
2. Support LBT performed per carrier/BWP bandwidth
 | 24-1 |  |  |  | [per band] |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

 |
| Nokia/Nokia Shanghai Bell  |  |
| OPPO  | **A**ccording to the definition in [2], Cat 3 LBT is LBT with random back-off with a contention window of fixed size, Cat 4 LBT is LBT with random back-off with a contention window of variable size. The description for Cat 3 and Cat 4 LBT is not accurate. For now there is no consensus on how to adjust contention window, so we prefer to remove Cat 4 LBT and put Cat 3 LBT in brackets.

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| 24-6 | ~~Cat 3 or Cat 4 LBT support~~ Uplink channel access procedure for FR2-2 unlicensed operation | 1. [Cat 3] ~~[or Cat 4]~~ LBT support ~~[(not agreed yet if CW is supported, so it can be either Cat 3 or Cat 4 LBT for now. Will update when we have agreement)]~~
2. [Support LBT performed per carrier/BWP bandwidth]
 |

 |
| Ericsson  |  |
| Intel Corporation  |  |
| Samsung  |  |
| Apple  | 1. In FG 24-6, consider renaming as “Basic uplink channel access procedure …” to be similar in nomenclature to 24-7 i.e. “CAT 2 LBT support for uplink channel access procedure….”
2. In FG 24-6 we have the conclusion in 106bis-e, so CAT4 can be removed.
	1. There is no consensus to introduce CWS Adjustment for unlicensed operation in FR2-2
	2. There is no consensus to introduce CAPC for unlicensed operation in FR2-2
3. FG 24-6 should be a per-band feature
 |
| vivo [9] |  |
| ZTE/Sanechips [10] | In RAN1#106bis e-meeting, the following agreement on CWs adjustment was achieved, it means that Cat3 LBT is supported for above 52.6GHz, not Cat4 LBT. Hence, we propose to remove Cat 4 and related descriptions from components.

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| Conclusion:There is no consensus to introduce CWS Adjustment for unlicensed operation in FR2-2Conclusion:There is no consensus to introduce CAPC for unlicensed operation in FR2-2 |

Regarding LBT bandwidth, we think the conclusion on LBT bandwidth reached in RAN1 #106 e-meeting is only applied for per carrier, not per BWP since the functionality of accessing a carrier if there is interference in part of the carrier in frequency is not supported (conclusion is copied below). So we propose to remove BWP bandwidth from supporting LBT bandwidth.

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| Conclusion:There is no consensus in RAN1 to support the functionality of accessing a carrier if there is interference in part of the carrier in frequency.  |

**Proposal:** **Modify FG24-6 as follows:**

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| Index | Feature group | Components | Prerequisite feature groups | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** |
| 24-6 | Uplink channel access procedure for FR2-2 unlicensed operation | 1. Support Cat 3 ~~[or Cat 4]~~ LBT ~~[(not agreed yet if CW is supported, so it can be either Cat 3 or Cat 4 LBT for now. Will update when we have agreement)]~~
2. ~~[~~Support LBT performed per carrier~~/BWP bandwidth]~~
 | 24-1 | Per band |

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| LG Electronics [11] |

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| Conclusion:There is no consensus to introduce CWS Adjustment for unlicensed operation in FR2-2 |

Considering the above conclusion made in RAN1#106bis-e, the term “Cat 4” can be removed in FG 24-6 description.**Proposal: Remove “Cat 4” in FG 24-6 description, according to conclusion made in RAN1#106bis-e.** |
| NTT DOCOMO, INC. [12] | For FG24-6, LBT support was captured, while whether to include Cat-4 LBT was unclear. On this issue, RAN1 reached conclusions deciding no support of CWS adjustment and CAPC, which automatically means no support of Cat-4 LBT in our understanding. Thus, Cat-4 LBT should be removed from FG24-6. **Proposal: Regarding FG24-6 (to be a feature of LBT support)*** **Cat-4 LBT should be removed**
 |
| MediaTek Inc. [13] | Up to RAN1 #106 bis e meeting, COT sharing is the only agreed scenario for Cat2 LBT application and it is desirable to support such feature in additional to the support of Cat3 LBT which was agreed in RAN1 #106bis meeting. Therefore, we suggest to include the support of Cat3 LBT as the prerequisite features for the Cat2 LBT support.  Proposal: Modify FG 24-6 as follows

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| Features | Index | Feature group | Components | Prerequisite feature groups | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-~~?~~6 | ~~Cat 3 or Cat 4 LBT support~~ Uplink channel access procedure for FR2-2 unlicensed operation | 1. Cat 3 ~~[or Cat 4]~~ LBT support ~~[(not agreed yet if CW is supported, so it can be either Cat 3 or Cat 4 LBT for now. Will update when we have agreement)]~~

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

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

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| Company | Summary |
| Huawei/HiSilicon  |  |
| Nokia/Nokia Shanghai Bell  |  |
| OPPO  |  |
| Ericsson  |  |
| Intel Corporation  |  |
| Samsung  |  |
| Apple  |  |
| vivo [9] |  |
| ZTE/Sanechips [10] | So far, it was only agreed that Cat2 LBT can be supported for the responding device of COT sharing. But there is still no conclusion on whether other use cases can use Cat2 LBT. Hence, for COT sharing case, we propose to remove square brackets of FG 24-6, that is, FG 24-6 is a prerequisite for FG 24-7 until RAN1 concludes on Cat2 LBT support other use cases except COT sharing.**Proposal: Modify FG24-7 as follows:**

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| Index | Feature group | Components | Prerequisite feature groups | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** |
| 24-7 | Cat 2 LBT support for uplink channel access procedure for FR2-2 unlicensed operation | 1. Support Cat 2 LBT | 24-1, ~~[,~~ 24-6 ~~]~~ | Per band |

 |
| LG Electronics [11] |  |
| NTT DOCOMO, INC. [12] |  |
| MediaTek Inc. [13] | Up to RAN1 #106 bis e meeting, COT sharing is the only agreed scenario for Cat2 LBT application and it is desirable to support such feature in additional to the support of Cat3 LBT which was agreed in RAN1 #106bis meeting. Therefore, we suggest to include the support of Cat3 LBT as the prerequisite features for the Cat2 LBT support.  Proposal: Modify FG 24-7 as follows

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| --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Note | Mandatory/Optional |
|  24. NR\_ext\_to\_71GHz | 24-~~?~~7 | Cat 2 LBT support for uplink channel access procedure for FR2-2 unlicensed operation | 1. Support Cat 2 LBT | 24-1,24-6 |  | Optional with capability signalling~~[A UE that supports FR2-2 must indicate this FG is supported when required by regulation]~~ |

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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 480/960 kHz] |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

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| --- | --- |
| Company | Summary |
| Huawei/HiSilicon  | In RAN1#106-e, it is agreed that *Agreement:* *For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.** *Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.*
* *Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.*

According to the agreement, the support of such feature depends on UE capability. Considering NTN may only support FR1, it should be set a separate FG for FR2-2 with support 480 kHz and 960 kHz as prerequisite. So the brackets on [FR2-2] and [480/960kHz] can be removed

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

 |
| Nokia/Nokia Shanghai Bell  |  |
| OPPO  |  |
| Ericsson  |  |
| Intel Corporation  |  |
| Samsung  | It was agreed to support 32 DL and UL HARQ processes, using same solution as in NTN, but for UE features, the FGs of supporting 32 DL and UL HARQ processes should be separate from the corresponding FGs for NTN, since the type of UE to support those FGs can be different. Also, the supporting of FG 24-8 and 24-9 should be per FSPC. **Proposal: For FG 24-8 and FG 24-9:****• Keep the FGs for DL and UL separately;****• Keep the FGs separately from supporting 32 HARQ processes in NTN;****• “Type” of the FGs are per FSPC.** |
| Apple  | 1. In FG 24-8 remove brackets in “for FR2-2” as we have agreed for this only for NR operation above 52.6 GHz
2. FG 24-8 should be a per-UE feature
 |
| vivo [9] |  |
| ZTE/Sanechips [10] | According to the following agreement, support 32 as the maximum number of HARQ process for Rel-17 NTN and NR FR2-2 at least for 480/960 kHz SCS. However, NTN may only introduce the UE feature for FR1. Therefore, a separate FG 24-8 and 24-9 with restrict of FR2-2 and 480/960 kHz should be approved. Square brackets of two sides “for FR2-2” and “for 480/960kHz” in FG 24-8 and 24-9 should be deleted.Agreement:For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.* Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.
* Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.

**Proposal: Modify FG 24-8 and FG 24-9 as follows:**

|  |  |  |
| --- | --- | --- |
| Index | Feature group | Components |
| 24-8 | 32 DL HARQ processes ~~[~~for FR 2-2~~]~~ | Support 32 HARQ processes in DL ~~[~~for 480/960 kHz~~]~~ |

 |
| LG Electronics [11] |  |
| NTT DOCOMO, INC. [12] |  |
| MediaTek Inc. [13] | We suggest to add the notion of FR2-2 in the FGs and to specify the support of the FGs are only for 480kHz and 960kHz.Proposal: Update FGs for HARQ processes as follows

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 480/960 kHz |  | Optional |

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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 480/960 kHz] |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon  | In RAN1#106-e, it is agreed that *Agreement:* *For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.** *Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.*
* *Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.*

According to the agreement, the support of such feature depends on UE capability. Considering NTN may only support FR1, it should be set a separate FG for FR2-2 with support 480 kHz and 960 kHz as prerequisite. So the brackets on [FR2-2] and [480/960kHz] can be removed

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

 |
| Nokia/Nokia Shanghai Bell  |  |
| OPPO  |  |
| Ericsson  |  |
| Intel Corporation  |  |
| Samsung  | It was agreed to support 32 DL and UL HARQ processes, using same solution as in NTN, but for UE features, the FGs of supporting 32 DL and UL HARQ processes should be separate from the corresponding FGs for NTN, since the type of UE to support those FGs can be different. Also, the supporting of FG 24-8 and 24-9 should be per FSPC. **Proposal: For FG 24-8 and FG 24-9:****• Keep the FGs for DL and UL separately;****• Keep the FGs separately from supporting 32 HARQ processes in NTN;****• “Type” of the FGs are per FSPC.** |
| Apple  | 1. In FG 24-9 remove brackets in “for FR2-2” as we have agreed for this only for NR operation above 52.6 GHz
2. FG 24-9 should be a per-UE feature
 |
| vivo [9] |  |
| ZTE/Sanechips [10] | According to the following agreement, support 32 as the maximum number of HARQ process for Rel-17 NTN and NR FR2-2 at least for 480/960 kHz SCS. However, NTN may only introduce the UE feature for FR1. Therefore, a separate FG 24-8 and 24-9 with restrict of FR2-2 and 480/960 kHz should be approved. Square brackets of two sides “for FR2-2” and “for 480/960kHz” in FG 24-8 and 24-9 should be deleted.Agreement:For NR FR2-2 at least for 480/960 kHz SCS, support 32 as the maximum number of HARQ processes for DL and UL, subject to UE capability.* Note: Up to 32 maximal supported HARQ process number is already agreed in Rel-17 NTN WI.
* Working assumption: The same solution to support up to 32 HARQ process number in Rel-17 NTN WI is reused for NR FR2-2.

**Proposal: Modify FG 24-8 and FG 24-9 as follows:**

|  |  |  |
| --- | --- | --- |
| Index | Feature group | Components |
| 24-9 | 32 UL HARQ processes ~~[~~for FR 2-2~~]~~ | Support 32 HARQ processes in UL ~~[~~for 480/960 kHz~~]~~ |

 |
| LG Electronics [11] |  |
| NTT DOCOMO, INC. [12] |  |
| MediaTek Inc. [13] | We suggest to add the notion of FR2-2 in the FGs and to specify the support of the FGs are only for 480kHz and 960kHz.Proposal: Update FGs for HARQ processes as follows

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 480/960 kHz |  | Optional |

 |

**Other issues**

|  |  |
| --- | --- |
| Company | Summary |
| Huawei/HiSilicon  | In the WID, it is identified that the proximity of the frequency range of 52.6-71GHz to the original FR2 (24.25-52.6GHz) and the similar commercial opportunities for high data rate communications makes it possible to maximize the leverage of FR2 based implementation in Rel-15/16. During the discussion on FR definition, it is also agreed and reflected in the WID that FR2 is extended to cover the frequency range from 24.25GHz to 71GHz with FR2-1 and the frequency range from 52.6GHz to 71GHz with FR2-2. The commonality in specification between FR2-1 and FR2-2 at least in RAN1 and RAN2 is the main reason to define 52.6-71GHz as a frequency sub-range instead of a new frequency range. Although it is noted in the WID that “The related UE capabilities and their applicability to the frequency range 52.6 to 71 GHz will have to be analyzed on a case by case basis”, we observed that at least for 120 kHz SCS and licensed band operation, it is common understanding among companies to reuse the existing design in FR2-1. So in order to reduce the workload for UE feature discussion we have the following proposal. **Proposal: The R15/16 feature groups for FR2-1 should be supported by default at least for 120 kHz SCS and licensed band operation, except for those explicitly identified**In FR2-2, in addition to 120 kHz SCS with NCP, 480 kHz and 960 kHz SCS are optionally supported. Many of UE features agreed so far are either numerology agnostic or having trivial difference in parameters. For example, the support of channel access procedures, basic data/control channels and reference signals transmission/reception and multi PDSCH/PUSCH scheduling by single DCI are numerology agnostic. The capability of beam management may only differ in the values related to timeline. There are also UE features only supported by specific numerologies. For example, 120 kHz SSB for initial access will be supported for all UE while 480 kHz SSB is only optionally supported for initial access and 960 kHz SSB is not supported for initial access. In order to leave the flexibility while maintaining reasonable amount of UE capability report, we have the following proposal. **Proposal: The feature groups defined in Rel-17 for FR2-2 should be supported for all numerologies, except for those explicitly identified.** In NR-U Rel-16, it had been agreed that the feature groups designed for unlicensed band operation should be discussed case by case whether they are applicable to licensed band operation. Finally, there are several features also adopted by licensed band operation in Rel-16, such as PDSCH mapping Type B other than 2,4,7 OS, enhanced type 2 and type 3 HARQ codebook, SRS location other than last 6 OS and multiple PUSCH scheduling by single DCI. At same time, most of feature groups design for FR1 licensed band in NR Rel-15 is directly inherited. We meet a similar situation in Rel-17 for the feature groups for FR2-2. For example, multiple PDSCH scheduling and multi-slot PDCCH monitoring will be applied to both licensed and unlicensed band operation. While wideband PRACH and channel access procedure will only be valid for unlicensed band operation. Thus, we have the following proposal. **Proposal: It should be studied case by case for each feature group defined in Rel-17 for FR2-2 whether it can be applied only in unlicensed band or both unlicensed and licensed band operation. The feature group applicable to licensed or unlicensed band(s) should be explicitly captured in the table.**It is noted in WID after frequency sub-range FR2-2 is agreed that “The application of any of the UE feature introduced for 52.6-71 GHz to existing FR1/FR2 should be discussed case by case.” Most of feature group may only be used in FR2-2, e.g. the enhancements corresponding to the new SCS. On the other side, we do observe feature group can be applicable to FR2-1 or even FR1, such as multiple PDSCH scheduling by single DCI. **Proposal: It should be studied case by case for each feature group defined in Rel-17 for FR2-2 whether it can be extended to FR2-1. The applicable FR should be explicitly captured in the table.**There are some feature groups already existing in Rel-15. The values are extended for 480 kHz and 960 kHz SCS in FR2-2. These features includes:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] |
| 2-2 | PDSCH beam switching | 1) Time duration (definition follows clause 5.1.5 in TS 38.214), Xi, to determine and apply spatial QCL information for corresponding PDSCH reception.Time duration is defined counting from end of last symbol of PDCCH to beginning of the first symbol of PDSCH.Xi is the number of OFDM symbols, i is the index of SCS, l=1,2, corresponding to 60,120 kHz SCS. | 2-1 | *timeDurationForQCL* |
| 2-25 | Beam reporting timing | The number of symbols, Xi, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing beam report is at least RBi, wherei is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS. | 2-24 | *beamReportTiming* |
| 2-27 | Beam switching | Maximum number of Tx + Rx beam changes a UE can conduct during a slot across the whole band CC B\_(B\_Total,). This number is defined as per SCS | 2-24 | *maxNumberRxTxBeamSwitchDL* |
| 2-28 | A-CSI-RS beam switching timing | Minimum time between the DCI triggering of AP-CSI-RS and aperiodic CSI-RS transmission shall be at least KBi symbols. (Symbols measured from last symbol containing the indication to first symbol of CSI-RS), wherei is the index of SCS, l=1,2 corresponding to 60,120 kHz SCS. |  | *beamSwitchTiming* |

There is RAN2 agreement in RAN2#115e. The above 4 FGs satisfy the working assumption in bullet 4 and should be replicated for FR2-2. *No FRx diff**2: An existing UE capability applicable to FR2 is also applicable to FR2-2, unless otherwise stated (i.e. in the field description of the UE capability that it is not applicable to FR2-2) in TS38.306,**3: If a new UE capability introduced for FR2-2 is also applicable to FR2-1 and/or FR1 and the UE capability is per band, this can be expressed in the field description of the UE capability.**FRx diff**4: For an existing UE capability already requires FR1-FR2 Diff and further differentiation between FR2-1 and FR2-2 is needed, the existing UE capability is replicated for FR2-2.**5: For UE capability that has to be per UE, “FR1-FR2 Diff” column can be used to express the need of the FRx differentiation (via the ‘Yes/No’ and also whether it needs FR2-1 and FR2-2 differentiation).**Both 4 and 5 are taken as working assumption (can be revisited once we see the capabilities from RAN1/4)***Proposal: replicate the FGs of PDSCH beam switching, Beam reporting timing, Beam switching and A-CSI-RS beam switching timing for FR2-2.**  |
| Nokia/Nokia Shanghai Bell  |  |
| OPPO  |  |
| Ericsson  | As a general principle, feature group A should be listed as a pre-requisite for feature group B only if feature group B cannot functionally operate without feature group A. Hence, in order to apply this principle, it is first necessary to have stable, clear definitions for each feature group before deciding which FG is a pre-requisite for another. For example, FG 24-2 (120 kHz standalone support) does not strictly require multi-RB PUCCH and long sequence PRACH listed as components of FG 24-1, so it is not clear that 24-1 should be a pre-requisite for 24-2 given the current definition of 24-1. The components of 24-1 should be discussed first.Based on this we propose:**Proposal: Defer discussion on which FGs should be pre-requisites of other FGs until there are stable, clear definitions for each FG with agreements on which components should be included. For now, the pre-requisite column of the UE features table should be left as FFS to avoid complicating the UE feature discussion.** The first priority is to focus on defining clear descriptions of each feature group and agree on which components should be included. After that, then the signaling granularity (per UE, per band, etc.) and the optionality can be decided. In our view, unless there is a strong motivation to define the signaling granularity other than per-UE, the starting point is that a feature should be per-UE. As agreed in RAN, discussions on whether or not there is a need to differentiate between FR2-1 and FR2-2 is handled on a case-by-case (i.e., per FG) basis.**Proposal: Defer discussion on signaling type (Per UE, Per Band, etc.), optional/mandatory support, and potential FR2-1/2-2 differentiation until there are stable, clear definitions for each FG with agreements on which components should be included.** |
| Intel Corporation  | In previous RAN1 #106-bis-e meeting, there was a discussion around supporting a UE capability for time required for beam switching. Our basic understanding here is that a UE reports a certain amount of time it needs to switch a beam. Based on the reported value, the serving gNB decides whether it’s needed to configure a time gap for the UE between certain adjacent signals/channels based on one of *existing* frameworks (e.g., ZP-CSI-RS, RM resources, etc.). With this understanding, we support UE capability signaling for beam switching time. Typically, the exact values should be agreed based on the feedback from RAN4 and could be defined in absolute units, e.g., nanoseconds. However, if the response from RAN4 would not be available by RAN1 #107-e meeting, it is safe to allocate at least 1 symbol gap for beam switching for both 480 kHz and 960 kHz.Also, a discussion happened in [3] around an expected behavior of UE, which indicates a need for beam switching gap, in different cases depending on the assumptions on QCL Type-D source RS for adjacent signals/channels. In particular, the cases with different QCL Type-D source RS, same QCL Type-D source RS or without QCL Type-D source RS were considered. However, our understanding is that RAN1 efforts to define the UE behavior for all the cases listed above is a bit redundant since the serving gNB, after receiving the UE capability for beam switch time, is aware about the potentially needed gaps. In this case, a simple following to the rules of 3GPP TS 38.306, which state that “the network *needs* to respect the signalled UE radio access capabilities when configuring the UE and when scheduling the UE” [4], is enough.**Proposal 1:** Support UE capability signaling for beam switching time. The signaling may indicate a UE needs at least 1 symbol gap for both 480 kHz and 960 kHz.

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-X | Beam switching time indication | Indicates required time gap for Tx and Rx beam switching in number of symbols for 480 kHz SCS and 96 kHz SCS. |  |

For multi-slot PDCCH monitoring capability, the value X was agreed to support X=4 slots for SCS 480 kHz and X=8 slots for SCS 960 kHz. Other X value(s) were agreed as optional values for support. Therefore, we will need to update the UE feature to add an optional capability indicating support for X=2 and 4 for 480 kHz and 960 kHz, respectively. **Proposal 2:** * Propose to add new FG to indicate optional support of X = 2 and 4, for 480 kHz and 960 kHz, respectively.

|  |  |  |  |
| --- | --- | --- | --- |
| 24-X | Additionally supported multi-slot PDCCH monitoring group size  | Indicates UE supports multi-slot PDCCH monitoring slot group size of [2] for 480 kHz subcarrier spacing | 24-4 |
| 24-X | Additionally supported multi-slot PDCCH monitoring group size  | Indicates UE supports multi-slot PDCCH monitoring slot group size of 4 for 960 kHz subcarrier spacing | 24-5 |

From our companion contribution [4] it is evident that UE may not be able to support beyond specific MCS for a specific rank due to excessive phase noise, even with the most advanced phase noise compensation techniques that may be utilized by the UE. The support of advance phase noise compensation techniques should not be considered a norm for all UE. Therefore, the supported maximum MCS and for each transmission rank may need to indicate as capability signaling.It should be noted that existing capability signal does support indication of max number of MIMO layers, and supported modulation order for DL. However, gNB is allows to indicate higher modulator order than the reported values as long the maximum peak throughput is not exceeded. The following is the description for supportedModulationOrderDL.

|  |
| --- |
| ***supportedModulationOrderDL*** Indicates the maximum supported modulation order to be applied for downlink in the carrier in the max data rate calculation as defined in 4.1.2. If included, the network may use a modulation order on this serving cell which is higher than the value indicated in this field as long as UE supports the modulation of higher value for downlink. If not included: - for FR1, the network uses the modulation order signalled in *pdsch-256QAM-FR1*. - for FR2, the network uses the modulation order signalled per band i.e. *pdsch-256QAM-FR2* if signalled. If not signalled in a given band, the network shall use the modulation order 64QAM. In all the cases, it shall be ensured that the data rate does not exceed the max data rate (*DataRate*) and max data rate per CC (*DataRateCC*) according to TS 38.214 [12].  |

**Proposal 3:** * Support capability signaling to indicate the maximum MCS support for each transmission rank (among supported number of transmission layers). The actual minimum max-MCS value for each transmission rank (values in bracket) is FFS.

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-X | Supported maximum MCS in DL | Indicates the maximum MCS for DL supported by the UE for each transmission rank supported by the UE. Note that UE shall support MCS 29, 30, 31 of MCS table 1 and 3 regardless of indicated value.Values are indicated for each supported subcarrier spacing and each rank supported by the UE operating in FR2-2. [Note: numbers in brackets are FFS]For 120kHz:* For rank 1: max MCS of {[22], …, 28} of MCS table 1, max MCS of {[26], …, 28} of MCS table 3
* For rank 2: max MCS of {[17], …, 28} of MCS table 1, max MCS of {[21], …, 28} of MCS table 3
* For rank 3~8: max MCS of {[17], …, 28} of MCS table 1, max MCS of {[21], …, 28} of MCS table 3

For 480kHz:* For rank 1: max MCS of {[24], …, 28} of MCS table 1, max MCS of {27, …, 28} of MCS table 3
* For rank 2: max MCS of {[19], …, 28} of MCS table 1, max MCS of {[23], …, 28} of MCS table 3
* For rank 3~8: max MCS of {[19], …, 28} of MCS table 1, max MCS of {[23], …, 28} of MCS table 3

For 960kHz:* For rank 1: max MCS of {[26], …, 28} of MCS table 1, max MCS of {[28]} of MCS table 3
* For rank 2: max MCS of {[21], …, 28} of MCS table 1, max MCS of {[25], …, 28} of MCS table 3
* For rank 3~8: max MCS of {[21], …, 28} of MCS table 1, max MCS of {[25], …, 28} of MCS table 3
 |  |

As described in our companion document [5], among the four candidate schemes identified by RAN1 to support a receiver-aided LBT procedure so that to provide to the gNB a better assessment of the channel occupancy status of the UE, only scheme 1, which is based on L1-RSSI assistance, and scheme 2, which is based on CCA (a.k.a. CAT-2 LBT) or eCCA (a.k.a, Cat-4 LBT) based assistance, may be actually beneficial from a system level perspective, and may be feasible from a standardization point of view considering the amount of time left to work out the details. As highlighted in our contribution [5], the benefits of scheme 1 are strictly correlated with the timeline for L1-RSSI reporting, and they become more evident as this timeline is tightened. For this matter, while we believe this scheme may be beneficial and should be supported, it may need to be used only when the UE’s processing time for the L1-RSSI is tightened, therefore UE’s capability signaling is needed for this matter.As for scheme 2, as highlighted in our contribution [5], in order to reduce the LBT overhead, which otherwise would detrimentally impact the benefit of this scheme, only a CCA based receiver assistance should be supported. In this matter, given that Cat-2 is based on UE’s capability, and this scheme is based on the assumption that a UE can perform Cat-2, then this scheme could be only used up to UE’s capability. In this sense, we suggest to add a note into the CAT-2 capability signaling indicating that this signaling would also support the CCA based receiver assistance scheme.**Proposal 4:** * Support capability signaling to indicate whether or not a UE could support L1-RSSI based receiver assistance (scheme 1)
* CCA based receiver assistance scheme (scheme 2) is supported based on CAT-2 capability signaling.

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-X | L1-RSSI based receiver assistance | UE is able to perform L1-RSSI measurement and report as part of AP-CSI |  |
| 24-Y | Cat 2 LBT support for FR2-2 unlicensed operation | 1. Support Cat 2 LBT
2. Support CCA based receiver assistance
 | 24-1 |

In general, companies generally agree that LBT beams should have some correspondence (or strong correlation) with the Tx beams that are planned to be after successful LBT operation. In order for this operation to properly work beam correspondence at the UE is needed. Currently beam correspondence is mandatory UE capability with capability signaling. We suggest to change this such that for FR2-2, beam correspondence must be mandatorily supported.**Proposal 5:** * For UEs supporting bands in FR2-2, beamCorrespondenceWithoutUL-BeamSweeping must be supported.

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Feature group | Components | Prerequisite feature groups |
| 24-E | beamCorrespondenceWithoutUL-BeamSweeping | For existing capability beamCorrespondenceWithoutUL-BeamSweeping add the following text:For UEs supporting operation in FR2-2 band(s), UE shall indicate support of beamCorrespondenceWithoutUL-BeamSweeping for those band(s).  |  |

 |
| Samsung  |  |
| Apple  |  |
| vivo [9] | First, the organization structure of the UE features should consider different deployment scenarios as listed in TS 38.300 for operation with shared spectrum access:- Scenario A: Carrier aggregation between NR in licensed spectrum (SpCell) and NR in shared spectrum (SCell);- Scenario A.1: SCell is not configured with uplink (DL only);- Scenario A.2: SCell is configured with uplink (DL+UL).- Scenario B: Dual connectivity between LTE in licensed spectrum and NR in shared spectrum (PSCell);- Scenario C: NR in shared spectrum (PCell);- Scenario D: NR cell in shared spectrum and uplink in licensed spectrum;- Scenario E: Dual connectivity between NR in licensed spectrum (PCell) and NR in shared spectrum (PSCell).For NRU UE features, the basic features are defined for different scenarios, i.e. different deployment scenario may have different basic UE features. Similarly, the design framework could be reused for NR operation from 52.6GHz to 71GHz.**Proposal: Reuse NRU UE feature design framework, i.e. different deployment scenario corresponding to different basic UE features.**Second, in current listed UE features, DL reception and UL transmission are always bundled together in the same feature group. Actually, in Scenario A.1 listed above, there is no need to support UL transmission. Thus, separating DL reception and UL transmission into different feature groups is preferred.**Proposal5: Separate DL reception and UL transmission into different feature groups.**Third, since 52.6-71GHz may involve both licensed and unlicensed operation, the application band type for each feature group should be determined, i.e. licensed band only, unlicensed band only or both licensed and unlicensed band.**Proposal: The applicable band type (licensed or unlicensed) for each feature group should be determined.** |
| ZTE/Sanechips [10] | The WID [2] notes the applicability of the UE features introduced for FR 2-2 should be discussed case by case. Note 5: FR2 is extended to cover 24.25GHz to 71GHz with FR2-1 for 24.25-52.6GHz and FR2-2 for 52.6-71GHz. * + The related UE capabilities and their applicability to the frequency range 52.6 to 71 GHz will have to be analysed on a case by case basis
	+ The application of any of the UE feature introduced for 52.6-71 GHz to existing FR1/FR2 should be discussed case by case.

Firstly, as described in second bullet in Note 5, we should consider application band range (i.e. FR2-2 only, FR2, both FR2 and FR1) of any of the UE feature. In our opinion, at least we need to consider the possibility of extending the UE features newly introduced for 120KHz or all SCSs to FR2-1 even FR1, e.g. multi-PDSCH scheduling by a single DCI. In addition, since FR2-2 involve both licensed and unlicensed spectrum operation, the application band type (i.e. licensed band only, unlicensed band only or both licensed and unlicensed band) for each FG should be discussed case by case.**Proposal: The application band range (i.e. FR2-2 only, FR2, both FR2 and FR1) and application band type (i.e. licensed band only, unlicensed band only or both licensed and unlicensed band) for each FG introduced for FR2-2 should be discussed case by case.** |
| LG Electronics [11] | In RAN1#106bis-e meeting, the following agreement was made to introduce new UE capability signaling.

|  |
| --- |
| Agreement:For additional beam switching time delay d of 480 kHz, introduce UE capability signalling which indicates 56 symbols or 112 symbols. |

Therefore, the corresponding feature group should be introduced.**Proposal:** **Define new feature group on additional beam switching time delay *d* for 480 kHz SCS, where UE indicates 56 or 112 symbols.** |
| NTT DOCOMO, INC. [12] | A general issue would be how to consider FR-related differentiation. In this WI, companies discuss on various types of new features and enhancements of the existing NR functionalities to extend NR to 52.6 – 71 GHz frequency range. Any UE feature to be supported in this WI will then be applicable at least for 52.6 – 71 GHz. However, companies may or may not argue that some of the UE features to be specified in this WI could be technically beneficial even in another frequency range, and then desire to discuss whether/how to expand the applicability of such UE features to other frequency ranges. It may consume quite a lot of time in RAN1 to discuss the range of applicability one by one. Note that 52.6 – 71 GHz frequency range at least include unlicensed bands, while licensed bands may also be identified in the future. The WI also target the support for both licensed and unlicensed band in this frequency range. This fact may also make the discussion more complex. Also, frequency range notation itself should be carefully considered. In the latest WID for supporting NR from 52.6 GHz to 71 GHz [2], two important aspects on frequency range definition regarding beyond 24 GHz are captured; one is to extend the definition of FR2 up to 71GHz, and the other is to introduce new FR sub-labels, FR2-1 and FR2-2, to be used for differentiating 24.25 – 52.6 GHz and 52.6 – 71 GHz if needed. Therefore, as well as FR1/2 differentiation, FR2-1/2-2 differentiation may also need to be considered. With the consideration above, how to have FR-related differentiation would depend on each UE feature in our view. We see the following alternatives at this stage.* One potential approach to easily solve this issue could be to define all the UE features to be specified in this WI per-band (or per BC). With this, UE can report its capability regarding functionalities for 52.6 – 71 GHz operation per band that the UE supports, which means vendors have a freedom for its own implementation. However, it may increase the overhead for UE capability signalling depending on the number of bands/band combinations to be specified.
* For UE features which can be applied regardless of licensed or unlicensed band, extending per-FR capability signalling may be another possibility. For example, by enabling per-FR capability signalling to differentiate FR2-1 and FR2-2, it would be possible to indicate a certain UE feature is applicable for FR2-2 only if needed. Or, if a UE feature is applicable to both FR2-1 and FR2-2 without any difference, just to use the existing per-FR capability signalling would also be possible. By defining in this manner, vendors still have a freedom to implement a certain feature for a certain frequency range, while overhead for capability signalling can be suppressed.
* To decrease signalling overhead more, per-UE signalling with some Notes can also be considered. This approach, however, may be applicable to particular UE features only, for which the targeted FR is crystal clear. For example, if a UE feature is clearly applicable for FR2-2 unlicensed band only, it could be possible to define it as a UE feature with per-UE capability signalling with a Note saying i.e., “this is applicable only for unlicensed band in FR2-2”. While this approach achieves much less overhead on UE capability signalling, an issue may be less implementation flexibility.

Table 1. Comparison of FR differentiation approaches

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

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

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

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

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

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

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

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

The ones with per-FR capability signalling may not have any issue either since Rel-15/16 defines FR2 as a frequency range between 24.25 – 52.6 GHz. Also, even if FR2-2 is additionally considered, as well as FR1/2-1 differentiation which has already been done via per-FR capability signalling, FR2-2 will need to be differentiated from the other FRs in many cases. Given that, we have not analysed yet on the ones with per-FR capability signalling on the tables in Appendix.An issue which may be lying on the ones with per-FR capability signalling would be whether to be applicable when they are reported as applicable to FR2 if no differentiation between FR2-1 and FR2-2 is considered. Some could be applicable to FR2-2 in the same manner as to FR2-1, while some others may not. This issue may also need to be checked in a case-by-case basis. We think it should also be discussed in RAN1 in the future. **Proposal: For Rel-15/16 UE features with per-FR capability signalling, how to treat when it is reported as applicable to FR2 should be discussed*** **Option 1: Differentiation between FR2-1 and FR2-2 is introduced**
* **Option 2: All the UE features are treated as applicable or inapplicable to FR2-2 as well as FR2-1 when it is reported for FR2, while the ones for which such treatment cannot be appropriate are defined as exceptional cases via e.g., adding Note**
 |
| MediaTek Inc. [13] | For wideband PRACH enhancement, we suggest to introduce an FG to capture the agreement made in RAN1 #104e meetingAgreement:* For initial access and non-initial access use cases, support 120kHz PRACH SCS with sequence length L=571, 1151 (in addition to L=139) for PRACH Formats A1~A3, B1~B4, C0, and C2.

**Proposal: Add an FG for wideband PRACH enhancement for 120kHz SCS as follows**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-X | Wideband PRACH for 120kHz SCS in FR2-2 unlicensed operation | 1. Enhanced PRACH design for operation with shared spectrum channel access by adopting a single long ZC sequence, with ZC sequence = 571/1151 for 120kHz |  | Optional |

Although the multi-slot PDCCH monitoring feature details are still under discussion, we suggest to reserve FGs for the feature and revise the components with more details when the functionality is mature.Proposal: Add FGs for multi-slot PDCCH monitoring as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-Y-1 | Multi-slot PDCCH monitoring for 480kHz | 1. Support multi-slot PDCCH monitoring for 480KHz with X=4
 |  | Optional |
| 24. NR\_ext\_to\_71GHz | 24-Y-2 | Multi-slot PDCCH monitoring for 960kHz | 1. Support multi-slot PDCCH monitoring for 960KHz with X=8
 |  | Optional |

Based on the WID, both LBT and No-LBT related procedures can be supported in FR2-2 unlicensed spectrum. Therefore, we suggest to introduce a FG for UE to indicate support of only No-LBT mode transmission.Proposal: Add an FG for No-LBT mode transmission if FR2-2 unlicensed operation as follows

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-W | No-LBT mode transmission for FR2-2 unlicensed operation | 1. Support only No-LBT mode transmission for FR2-2 unlicensed operation |  | Optional |

Based on the conclusion made in RAN #92, indication of the UE features for FR2-2 only should be included in UE capability reporting, which is not allowed based on the current UE feature list structure. One way to address the issue could be to include the notion of “FR2-2” in the naming or components of the FG applied for FR2-2 only. Another way could be to include a column in the UE feature list table to indicate “FR1-FR2-1-FR2-2 differentiation” for FGs to allow UE to support different functionalities between FR1, FR2-1, and FR2-2. Proposal: How to report UE features applied to only FR2-1 or FR2-2 should be further discussed.

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

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

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

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

 |

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

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

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

# Issue 1: FG 24-1 and FG 24-2

After review of contributions submitted to RAN1 #107-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 red, including the definitions of new FGs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-1 | Basic FR2-2 ~~[~~DL~~]~~ support | 1. Support 120KHz SCS ~~[transmission and]~~ reception ~~[~~for ~~initial/~~non-initial access~~]~~~~[2. Support multi-RB PUCCH format 0/1/4 for 120 kHz]~~~~[3. PRACH with 120KHz SCS and length 139[/571/1151]]~~~~[~~4. Support 120kHz subcarrier spacing for DL data and control channels and reference signals in FR2-2~~]~~~~[5. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2]~~~~[6. Support multi-PUSCH[/PDSCH] scheduling by single DCI for the operation with 120 kHz SCS]~~ |  |  |  | FR2-2 is not supported | [per UE][per band] |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |
|  24. NR\_ext\_to\_71GHz | 24-1a | Basic FR2-2 UL support | 1. Support 120KHz SCS reception for non-initial access2. Support multi-RB PUCCH format 0/1 for 120 kHz3. PRACH with 120KHz SCS and length 1394. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | 24-1 |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH | Enhanced PRACH design for operation with shared spectrum channel access by adopting a single long ZC sequence, with ZC sequence = 1151 for 120kHz and ZC sequence = 571 for 120kHz /480kHz.  | 24-1a |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-1c | PUCCH format 4 for 120 kHz | Support multi-RB PUCCH format 4 for 120 kHz | 24-1a |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1 |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB based stand-alone support in FR2-2 | 1. Support 120KHz SSB for initial access in FR2-22. PRACH with 120KHz SCS and length 139 | 24-1, 24-1a | N/A | N/A | 120KHz SSB based stand-alone in FR2-2 is not supported | N/A | N/A | N/A | N/A | per band | Optional without capability signalling |

Note: FGs 24-3, 24-4, 24-5 can be addressed after FGs 24-1 and 24-2 have been stabilized

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| DOCOMO | For 24-1a and 24-1b, we are not sure why only wideband PRACH should be separated while multi-RB PUCCH format 0/1 is included in 24-1a. We believe it should be the unified approach between wideband PRACH and multi-RB PUCCH format 0/1, while we are open to discuss whether they should be basic feature or not. It is also unclear why multi-RB PUCCH format 4 for 120 kHz should be separated from multi-RB PUCCH format 0/.  |
| Ericsson | Comment #1: (FG 24-1b):According to the WID, wideband PRACH is not limited to operation with shared spectrum. The WID objective is as follows, and the intention of the "operation in shared spectrum" wording was to apply to RO configuration for non-consecutive RACH occasions, which was agreed not to be specified. The first part of the objective applies to both with/without shared spectrum.* + Specify support for PRACH sequence lengths (i.e. L=139, L=571 and L=1151) and study, if needed, specify support for RO configuration for non-consecutive RACH occasions (RO) in time domain for operation in shared spectrum

Hence we recommend the following change to the descriptionEnhanced PRACH design ~~for operation with shared spectrum channel access~~ by adopting a single long ZC sequence, with ZC sequence = 1151 for 120kHz and ZC sequence = 571 for 120kHz /480kHz."Comment #2 (FG 24-2):We think it warrants further discussion on whether or not a UE can support non-standalone operation only. If not, it seems there is a high bar for developing a device eco-system for use of the FR2-2 band. If this is agreed, then the FG24-2 would have to revert to "Optional with capability signaling".1. CA with PCell in FR1 (or FR2-1) + SCell (DL-only) in FR2-22. CA/DC with PCell in FR1 (or FR2-1) + (P)SCell (DL+UL) in FR2-2Comment #3:Regarding the pre-requisites, we think these can all be left in square brackets for now until the FG definitions + components have stabilized. We have the same view for the signaling granularity (per UE, per band). We should focus first on stabilizing the FGs definitions. |
| LG Electronics | For multi-RB PUCCH format 0/1, we have a different view with NTT DOCOMO. PUCCH format 0/1 and PRACH are related to initial access, and PRACH can occupy around 12 PRBs while PUCCH format 0/1 with single PRB occupies only 1 PRB, which can result in coverage issue. Therefore, we prefer to keep multi-RB PUCCH format 0/1 for 120 kHz in FG 24-1a.For FG 24-1b, there is one type: “Enhanced PRACH design for operation with shared spectrum channel access by adopting a single long ZC sequence, with ZC sequence = 1151 for 120kHz and ZC sequence = 571 for 120kHz ~~/480kHz~~” |
| OPPO | We share similar view with DOCOMO, and we think support multi-RB PUCCH format 0/1 for 120 kHz is kind of enhancement for support single-RB PUCCH format 0/1. So we prefer to remove “Support multi-RB PUCCH format 0/1 for 120 kHz” from FG24-1a to FG24-1c. |
| vivo | For 24-1a, agree with Docomo and OPPO that “Support multi-RB PUCCH format 0/1 for 120 kHz” is removed from 24-1a.Besides, there are two “PRACH with 120KHz SCS and length 139” in 24-1a and 24-2. We prefer to remove “PRACH with 120KHz SCS and length 139” from 24-1a since it may not be necessary for a UE supporting non-standalone operation only.  |
| ZTE, Sanechips | Comment on FG 24-1, 1. Component 1 and component 4 seem to overlap a little. In our view, component 4 lists specific channel/signal allowed to be received, which is contained in component 1.

Comments on FG 24-1a1. It seems to have a typo in component 1. that is, need to change “reception” to “transmission”
2. The same issue as FG24-1, that is, Component 1 and component 4 for UL overlap a little.
3. Regarding component 2, we have same view with DOCOMO, that is, why multi-RB PUCCH format 4 for 120 kHz is separated from multi-RB PUCCH format 0/1.
4. Regarding component 3, according to the agreement of previous meeting, we have no see any motivation to separate PRACH length = 571 and 1151 with length =139. could you please further clarify it?

Comment on FG 24-1b1. according to the agreement of previous meeting, we have no see any motivation to separate new FG to support PRACH length = 571 and 1151. besides, during the discussion of PRACH length, there is no any conclusion or provision that PRACH length 1151 and 571 is only for unlicensed band. In our understanding, it is applied for licensed and unlicensed band.

Comment on FG 24-21. Regarding “Optional without capability signalling” listed in the last column, could you please clarify why “with” is changed to “without”?
2. we can observe that FG 24-1a is a pre-requisit of FG 24-2 and component 3”PRACH with 120KHz SCS and length 139” has been contained in FG 24-1a, if it is added again in FG 24-2, the content is repeated and redundant. So propose to remove component 2 in FG 24-2.
3. If Component 2 in FG 24-2 is not removed, then the name of FG 24-2 does not match the description of the currently contained component 1 and 2. for example, the name of FG 24-2 is to describe SSB, while the contained component is for SSB and PRACH.
4. For SA scenario, whether other FGs also need to be supported such as muti-PDSCH/PUSCH, etc.
 |
| Samsung | In general, we support with moderator’s direction on splitting DL and UL for the basic FGs. Please find some further comments for fine tuning of the proposal: * For 24-1, seems the two bullets can be merged together, since they overlap. E.g. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2 for non-initial access.
* For 24-1a, a typo needs to be fixed: “1. Support 120KHz SCS ~~reception~~ transmission for non-initial access”
* For 24-1a, multi-RB PUCCH format 0/1 for 120 kHz should not be part of the basic FG, since it’s an enhancement particularly for FR2-2. We prefer to keep the basic FG close to FR2-1 as much as possible.
* For 24-2, the FG already uses 24-1a as prerequisite FG, which includes PRACH with 120KHz SCS and length 139 already.
 |
| Intel | While we don’t think separation of DL and UL is critical, we are ok to support the grouping 24-1 and 24-1a as suggested by moderator above.We agree with Docomo on 24-1c, we would like to better understand what is special about PUCCH format 4 that would be separated from PUCCH format 0/1. We think 41-1c should be included to 24-1a.For 24-1d and 24-1e, we think they should be part of basic operation. Without multi-PDSCH scheduling, not sure how specific throughputs are going to be achieved given that multi-slot PDCCH is expected to be norm of operation.Suggest merging 24-1d into 24-1, and 24-1e to 24-1a. |
| Apple | We are fine with the split of the basic UL and DL FGs.FG 24-1a: typo. * Should be “transmission” not “reception”.
* Clarification on why PF 0/1 is in the basic format while PF4 is separate in 24-1 c ? Also, why is it separate from 24-1c ? Is this because of initial access ? We would prefer it to be separate.

24-1b* Seems there is a typo with 480 kHz. Also, the wording can be tightened e.g. “with ZC sequence equal to 1151 and 571 for 120kHz”

FG 24-1d/1e* There needs to be a FG description of the enhanced HARQ. Do we need to couple this to the multi-PDSCH or will the enhanced HARQ be in separate FGs ?
 |
| Huawei, HiSilicon | For 24-1:* Component 1, it seems overlap with the component 4. Does it intend to cover the 120kHz SSB monitoring for non-initial access?

For 24-1a:* Component 1: is it 120kHz SCS transmission? Actually we are not sure what is transmit. It seems duplicate the rest of component.
* Component 2: we think it should be a separate FG. At least for licensed band operation, it is not needed as there is no PSD limitation. It can be together with 24-1c with general FG name as PUCCH with multiple RB.

For 24-2* Component 2: the PRACH with 139 sequence length is covered in FG24-1a.
 |
| MediaTek | We are generally agree with proposal with the following commentFG24-1: component 1 and 4 can be combined as mentioned by SamsungFG24-1a: multi-RB PUCCH should be separated into other FGs. Also, component 1 and 4 can be combined.FG24-1b: we suggest wideband PRACH for 480kHz should be a separate FG from wideband PRACH for 120kHz UE capability to align with the spirit of basic functionality under FG 24-1-X |
| Nokia, NSB | We do not agree with the proposed split of features. The validity of a DL-only in FR2-2 is itself questionable, and further splitting the support of PRACH and SSB-related functionalities make it even more difficult to manage deployments from network side. For the sake of progress and organization of the features themselves we can accept a separation of DL and UL features assuming that:1. The possibility of UL being a basic functionality for FR2-2 operation is still FFS
2. 24-1a/b/c and 24-2 are merged into a single FG
 |
| Qualcomm | We can accept the direction FL is heading, on splitting the FG to multiple smaller FGs, assuming there will be a follow up discussion on how to form basic feature groups.For 24-1. We also feel 1 and 4 are duplicatesFor 24-2, the component 2 seems to be already covered in 24-1 |

# Issue 2: FG 24-6 and FG 24-7

After review of contributions submitted to RAN1 #107-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 red**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-6 | Basic Uplink channel access procedure for FR2-2 unlicensed operation | 1. Cat 3 ~~[or Cat 4]~~ LBT support ~~[(not agreed yet if CW is supported, so it can be either Cat 3 or Cat 4 LBT for now. Will update when we have agreement)]~~
2. ~~[~~Support LBT performed per carrier~~/BWP bandwidth]~~
 | 24-1 |  |  |  | ~~[~~per band~~]~~ |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |
|  24. NR\_ext\_to\_71GHz | 24-7 | Cat 2 LBT support for uplink channel access procedure for FR2-2 unlicensed operation | 1. Support Cat 2 LBT | 24-1~~[~~, 24-6~~]~~ |  |  |  | ~~[~~per band~~]~~ |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| DOCOMO | For 24-6:* we do not see the need of a word “Basic” in 24-6. Our understanding is that both cat-3 and cat-2 are equally optional in this band.
* Our understanding is that the latest agreement on LBT just says “gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth)”, so why only BWP bandwidth is removed is not clear to us. Probably we should keep the bracket with keeping “BWP bandwidth”.
 |
| LG Electronics | For FG 24-6, RAN1 need further discussion between carrier and BWP bandwidth for LBT. Still, both interpretations seem valid, as captured agreement below. Hence, our suggestion is not to change component 2, i.e., “[Support LBT performed per carrier/BWP bandwidth]”Agreement:* For LBT for single carrier transmission, gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth) (Alt SC.1. in earlier agreements)
* For LBT for multi-carrier transmission in intra-band CA, gNB/UE performs multiple LBT, one for each channel bandwidth separately (Alt CA.1. in earlier agreements)
	+ FFS: Additional support of performing single LBT over all CCs (Alt CA.2. in earlier agreements)

more than one alternative for at least multi-carrier transmission in intra-band CA is not precluded. |
| OPPO | We agree with LGE, “BWP bandwidth” can be kept in FG24-6. |
| ZTE, Sanechips | According to the following agreement and conclusion, we think the conclusion on LBT bandwidth is only applied for per carrier, not per BWP since the functionality of accessing a carrier if there is interference in part of the carrier in frequency is not supported. So BWP bandwidth should be removed from current component 2 in FG 24-6.Agreement:* For LBT for single carrier transmission, gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth) (Alt SC.1. in earlier agreements)
* For LBT for multi-carrier transmission in intra-band CA, gNB/UE performs multiple LBT, one for each channel bandwidth separately (Alt CA.1. in earlier agreements)
	+ FFS: Additional support of performing single LBT over all CCs (Alt CA.2. in earlier agreements)

Conclusion:There is no consensus in RAN1 to support the functionality of accessing a carrier if there is interference in part of the carrier in frequency.  |
| Samsung | We are ok with the change for these two FGs.  |
| Intel | 24-6: we think “basic” should be removed. Not sure what “basic” refers to here. Usually basic should be reserved for set of features that should be supported if UE supports a band and all basic features should be compacted together. Since this feature is kept separate, the use of “basic” seems inappropriate. Also component (1) of 24-6 seems to require further discussions as Cat 3 LBT has not been discussed/agreed in RAN1. Therefore, suggest removing component (1) for now.24-7: ok |
| Apple | We are fine with the description change especially as 24-6 seems to be a pre-requisite for 24-7. If not, then (a) it should be renamed to “Cat 3 LBT support for uplink channel access procedure for FR2-2 unlicensed operation” and 24-7 should have a component 2On the removal of BWP bandwidth in component 2, either it should be kept or wording should be changed to ensure that it is clear that LBT is performed on a BWP in some cases as shown in the agreementAgreement:For LBT for single carrier transmission, gNB/UE performs LBT over the channel bandwidth (or BWP bandwidth)e.g. Support LBT performed per carrier or over BWP bandwidth |
| Huawei, HiSilicon | For 24-6, it seems there is confusion about per BWP bandwidth is supported, maybe a bracket can be added on “(or BWP bandwidth)”,  |
| Nokia, NSB | We agree with DOCOMO that the word “basic” is not needed in feature name for 24-6. This has no implication on confirmed the note in yellow highlight though.  |

# Issue 3: FG 24-8 and 24-9

After review of contributions submitted to RAN1 #107-e in this agenda item, the following is proposed by the moderator. Companies submitted the following views on the moderator’s proposals.

**Proposal:**

* **Confirm FGs 24-8 and 24-9 as separate rows**
* **Adopt the following changes highlighted in red**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes ~~[~~for FR 2-2~~]~~ | Support 32 HARQ processes in DL ~~[~~for 480/960 kHz~~]~~ |  |  |  |  | [Per UE/per FSPC] |  |  |  |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes ~~[~~for FR 2-2~~]~~ | Support 32 HARQ processes in UL ~~[~~for 480/960 kHz~~]~~ |  |  |  |  | [Per UE/per FSPC] |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| DOCOMO | To the proponent of “per FSPC”, could you clarify why should it be per FSPC? Our thinking is that it could be per UE, while wondering where per FSPC come from.  |
| Ericsson | We have the same question as DOCOMO. We think that the FFS should be a choice between "Per UE" and "Per Band". |
| LG Electronics | We prefer per UE for FG 24-8 and FG 24-9. |
| OPPO | We prefer per FSPC for FG24-8 and FG24-9, as we think 32 HARQ processes can be supported per CC per band combination. |
| vivo | We prefer per Band. One clarification: Per UE means it could be extended to other band? |
| ZTE, Sanechips | We have the same question as DOCOMO and Ericsson. |
| Samsung | We are ok with the changes. For the type of FG, we prefer “per FSPC”. Supporting 32 HARQ processes has higher impact to hardware change comparing to other features, so we prefer to allow the finest granularity to support such feature.  |
| Intel | We are ok with removing the brackets. We also suggest to add 120kHz to the FGs as well. We would be ok with per band or per UE. There is only 1 band defined for FR2-2, n263 so they would be equivalent in release 17. |
| Apple | Our understanding is that it can be per UE but for 480 kHz and 960 kHz only implying that it is for FR2-2 only.  |
| Huawei, HiSilicon | We support to remove [], maybe per band can be added as another candidate together with per UE/per FSPC |
| Nokia, NSB | We think that support should be per UE. We do not see any motivation to make it per FSPC, clarification is definitely needed here, as RAN1 is anyway supposed to provide clear justifications to RAN2 for anything defined as per FS or per FSPC.  |
| Qualcomm | For now, we would prefer to keep the FSPC. Depends on the physical memory available, an implementation may not be able to support all CCs in FR2-2 to have 32 HARQ processes. This will depend on some detailed evaluation. |

# Issue 4: New FGs

Please indicate which of the following proposed new FGs you support in principle.

|  |  |  |  |
| --- | --- | --- | --- |
| Features | Index | Feature group | Components |
| 24. NR\_ext\_to\_71GHz | 24-A | No-LBT mode transmission for FR2-2 unlicensed operation | 1. Support only No-LBT mode transmission for FR2-2 unlicensed operation
 |
| 24. NR\_ext\_to\_71GHz | 24-B | Multi-slot PDCCH monitoring for 480kHz | 1. Support multi-slot PDCCH monitoring for 480KHz with X=4
 |
| 24. NR\_ext\_to\_71GHz | 24-C | Multi-slot PDCCH monitoring for 960kHz | 1. Support multi-slot PDCCH monitoring for 960KHz with X=8
 |
| 24. NR\_ext\_to\_71GHz | 24-D | beamCorrespondenceWithoutUL-BeamSweeping | For existing capability beamCorrespondenceWithoutUL-BeamSweeping add the following text:For UEs supporting operation in FR2-2 band(s), UE shall indicate support of beamCorrespondenceWithoutUL-BeamSweeping for those band(s).  |
| 24. NR\_ext\_to\_71GHz | 24-E | L1-RSSI based receiver assistance | UE is able to perform L1-RSSI measurement and report as part of AP-CSI |
| 24. NR\_ext\_to\_71GHz | 24-F | Cat 2 LBT support for FR2-2 unlicensed operation | 1. Support Cat 2 LBT
2. Support CCA based receiver assistance
 |
| 24. NR\_ext\_to\_71GHz | 24-G | Supported maximum MCS in DL | Indicates the maximum MCS for DL supported by the UE for each transmission rank supported by the UE. Note that UE shall support MCS 29, 30, 31 of MCS table 1 and 3 regardless of indicated value.Values are indicated for each supported subcarrier spacing and each rank supported by the UE operating in FR2-2. [Note: numbers in brackets are FFS]For 120kHz:* For rank 1: max MCS of {[22], …, 28} of MCS table 1, max MCS of {[26], …, 28} of MCS table 3
* For rank 2: max MCS of {[17], …, 28} of MCS table 1, max MCS of {[21], …, 28} of MCS table 3
* For rank 3~8: max MCS of {[17], …, 28} of MCS table 1, max MCS of {[21], …, 28} of MCS table 3

For 480kHz:* For rank 1: max MCS of {[24], …, 28} of MCS table 1, max MCS of {27, …, 28} of MCS table 3
* For rank 2: max MCS of {[19], …, 28} of MCS table 1, max MCS of {[23], …, 28} of MCS table 3
* For rank 3~8: max MCS of {[19], …, 28} of MCS table 1, max MCS of {[23], …, 28} of MCS table 3

For 960kHz:* For rank 1: max MCS of {[26], …, 28} of MCS table 1, max MCS of {[28]} of MCS table 3
* For rank 2: max MCS of {[21], …, 28} of MCS table 1, max MCS of {[25], …, 28} of MCS table 3
* For rank 3~8: max MCS of {[21], …, 28} of MCS table 1, max MCS of {[25], …, 28} of MCS table 3
 |
| 24. NR\_ext\_to\_71GHz | 24-H | Beam switching time indication | Indicates required time gap for Tx and Rx beam switching in number of symbols for 480 kHz SCS and 96 kHz SCS. |
| 24. NR\_ext\_to\_71GHz | 24-J (2-2) | PDSCH beam switching | 1) Time duration (definition follows clause 5.1.5 in TS 38.214), Xi, to determine and apply spatial QCL information for corresponding PDSCH reception.Time duration is defined counting from end of last symbol of PDCCH to beginning of the first symbol of PDSCH.Xi is the number of OFDM symbols, i is the index of SCS, l=1,2, corresponding to 60,120 kHz SCS. |
| 24. NR\_ext\_to\_71GHz | 24-K (2-25) | Beam reporting timing | The number of symbols, Xi, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing beam report is at least RBi, wherei is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS. |
| 24. NR\_ext\_to\_71GHz | 24-L (2-27) | Beam switching | Maximum number of Tx + Rx beam changes a UE can conduct during a slot across the whole band CC B\_(B\_Total,). This number is defined as per SCS |
| 24. NR\_ext\_to\_71GHz | 24-M (2-28) | A-CSI-RS beam switching timing | Minimum time between the DCI triggering of AP-CSI-RS and aperiodic CSI-RS transmission shall be at least KBi symbols. (Symbols measured from last symbol containing the indication to first symbol of CSI-RS), wherei is the index of SCS, l=1,2 corresponding to 60,120 kHz SCS. |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| DOCOMO | * 24-A seems like a “incapability signaling”, which is generally not necessary in our view.
* 24-B and 24-C are agreed in WI already, while quite some details are FFS. We are ok to check the WI progress a bit later.
* 24-D is fine for us.
* 24-E should be revisited later. It needs another agreement in WI.
* While not preferable, we can live with having 24-G like MCS limitation per UE capability signaling if deemed necessary by majority.
* 24-H should be revisited later. It needs another agreement in WI.
* We understand that 24-J to 24-M is to extend existing UE capabilities as per the agreements in WI. Is it correct?
 |
| LG Electronics | * FG 24-A: Same view with NTT DOCOMO. We don’t see the necessity to have it.
* FG 24-D: Need more discussion. We prefer to reuse Rel-15 capability signaling for beam correspondence.
* FG 24-E: Need RAN1 agreement
* FG 24-F: Seems duplicated with FG 24-7
* FG 24-G: We don’t support to define such UE capability and it can be left up to RAN4.
* FG 24-H: Need RAN1 agreement

In addition, the following discussion in our Tdoc [11] needs to be reflected.In RAN1#106bis-e meeting, the following agreement was made to introduce new UE capability signaling.

|  |
| --- |
| Agreement:For additional beam switching time delay d of 480 kHz, introduce UE capability signalling which indicates 56 symbols or 112 symbols. |

Therefore, the corresponding feature group should be introduced.**Proposal: Define new feature group on additional beam switching time delay *d* for 480 kHz SCS, where UE indicates 56 or 112 symbols.** |
| ZTE, Sanechips | **FG 24-A, we think that it should be added in FG24-6****FG 24-B and C, it can be updated until relevant conclusions are reached****FG 24-D, we support to introduce this FG.****FG 24-E and F, it can be updated until relevant conclusions are reached****FG 24-G, the relevant issue is still under discussion in AI 8.2.5 and according to the view from the majority of companies, option 2 or 3 is preferred. For these two options, there is no need to introduce such UE capability.****FG 24-H, it can be updated until relevant conclusions are reached****FG 24-J to M, on whether these FG can be extended in FR2-2 will be discussed after all FR2-2 FGs are determined**  |
| Samsung | We believe all of these new FGs may need further RAN1 discussion and agreements to be included in the list.  |
| Intel | 24-A: not sure if not supporting LBT should be separate. We think this should be part of the basic feature set.24-B and 24-C: we assumed X=4/8 are part of the basic feature set, the optional values was 2/4 according to Ran1 agreement (see below)Agreement:* Multi-slot PDCCH monitoring is based on slots within a slot group
	+ Each slot group consists of X consecutive slots
		- Slot groups are consecutive and non-overlapping
		- The start of the first slot group in a subframe is aligned with the subframe boundary
		- The start of each slot group is aligned with a slot boundary
		- Reporting the BD/CCE budget for X=4/8 slots (for 480/960 kHz resp.) is mandatory (if UE supports the corresponding SCS), and is optional for X=[2]/4 slots (for 480/960 kHz resp.)

24-D : support24-E: support24-F: support24-G: support24-H: support24-J: support24-K: support24-L: support24-M: supportThere should be another new FG to reflect the following agreement made in RAN1#106-bis-e (also mentioned by LGE):Agreement:For additional beam switching time delay d of 480 kHz, introduce UE capability signalling which indicates 56 symbols or 112 symbols |
| Huawei, HiSilicon | 24-A, it is not needed. UE not report 24-6/7 automatically mean to support no LBT mode.24-B/C, they should be included as basic support of 480 and 960kHz SCS if RAN1 can finalize it in the WID.24-D/E/F/GH: we can discuss them when RAN1 have agreeemnt24-J/K/L/M: support according to RAN2 working assumption |
| Nokia, NSB | * 24-A is not a new feature itself, it could be added as component of another FG though, without specific on/off indication

Other FGs can be discussed after more progress in WI. |
| Qualcomm | 24-A: Not needed24-B/C: These should be part of FG 24-1 and 24-1a24-D: Existing FG should work24-E: Pending RAN1 agreement24-F: Isn’t this already in 24-7? Component 4 needs RAN1 agreement24-G: Needs RAN1 agreement24-H: Needs RAN4 agreement, but we feel it is needed.24-J/K/L/M: Reuse existing capability should work |

# Discussion/Approval Items during RAN1 #107-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**

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | For the agreed FGs from the GTW,We think at least for unlicensed operations that require uplink, we think wideband PRACH (24-1b) and wideband PUCCH (24-1c) should part of 24-1a. Whether they are a separate FG row or not could be discussed further, at the very least something like if the UE support n263 (unlicensed 60GHz) it must indicate support for 24-1b and 24-1c. The main reason is that wideband PRACH and wideband PUCCH is needed during initial access in some unlicensed regulatory domain, if they are capability that needs to be indicated during RRC setup, it means it will not be available during initial access, which is unacceptable as it will limit deployments for unlicensed operation. |
| DOCOMO | To confirm if we understand the procedure correctly, can we understand this on-going UE feature discussion as follows:* We focus on signaling impact, i.e. what kind of feature(s) need to be defined is the main topic
* Whether to define as basic feature or not can still be discussed, even for the ones related to FG24-1 and FG24-2 included in moderator’s note v01.
* Thus which FG include which component(s) can still be discussed, even for the ones related to FG24-1 and FG24-2 included in moderator’s note v01.
 |

# Issue 1: 24-3, 24-4, 24-5

**Proposal: Adopt the following changes highlighted in chromatic formatting, including the definitions of new FGs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB ~~for initial access~~ support for SA/DC in FR2-2 | 1. Support 480KHz SSB for SA/DC ~~initial access~~ in FR2-2 | 24-1[, 24-2, 24-4] | FFS |  |  | [per UE][per band] |  |  |  | ~~From WID:~~* ~~In addition to 120kHz, support 480 kHz SSB for initial access with support of CORESET#0/Type0-PDCCH configuration in the MIB with following constraints:~~
	+ ~~Note: 480 kHz is an optional SSB numerology for initial access for the UE. A UE supporting a band in 52.6-71 GHz must at least support 120 kHz SCS (for initial access and after initial access)~~
	+ ~~[only 480kHz CORESET#0/Type0-PDCCH SCS supported for 480 kHz SSB SCS]~~

FFS: whether to split this FG for SA and DC | Optional [with/without] capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | ~~1. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-2~~2. 480KH SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access~~3. 480KHz for SSB monitoring [for non-initial access]~~4. Multiple-slot PDCCH monitoring for 480KHz with X=[4] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]~~5. PRACH with 480KHz and length 139/[571]~~~~FFS: 6. Support multi-RB PUCCH format 0/1/4 for 480 kHz~~~~FFS: 7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 480 kHz SCS~~ | 24-1 | Yes |  |  | [Per UE/band] |  |  |  | ~~From WID:~~~~In addition to 120kHz SCS, specify new SCS, 480kHz and 960kHz, and define maximum bandwidth(s), for operation in this frequency range for data and control channels and reference signals, only NCP supported.~~ ~~[Agreement:~~~~A UE supporting 480 kHz SCS supports multi-slot PDCCH monitoring for 480 kHz SCS~~~~Agreement:~~~~Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH]~~~~Note:~~~~• Resolve the issues of wideband PRACH, multi-RB PUCCH format 0/1/4, and multi-PUSCH/PDSCH scheduling by single DCI, i.e., whether to have components of a single FG or separate FGs, for 120 kHz first, then use the same structure for 480 kHz~~~~• Resolve the issue of having separate capabilities for DL and UL (data and control channels as well as reference signals) for 120 kHz first, then use the same structure for 480 kHz~~ | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 1392. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz [with/without shared spectrum channel access] | PRACH with 480KHz and length 571  |  |  |  |  |  |  |  |  | FFS: whether to split this FG for SA and DC[Agreement:Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH] | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz [with/without shared spectrum channel access] | Support multi-RB PUCCH format 0/1/4 for 480 kHz |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-4d | Multiple PDSCH scheduling by single DCI for 480 kHz | 1. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS 2. HARQ enhancements |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-4e | Multiple PUSCH scheduling by single DCI for 480 kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | ~~1. 960KHz SCS for UL data and control channels and reference signal transmission in FR202~~2. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2~~3. 960KHz for SSB monitoring~~4. Multiple-slot PDCCH monitoring for 960KHz with X=[8] slots [FFS: Component description to be updated once further details of multi-slot monitoring capability are known, e.g., definition of Y]~~5. PRACH with 960KHz and length 139~~~~FFS: 6. Support multi-RB PUCCH format 0/1/4 for 960 kHz~~~~FFS: 7. Multi-PUSCH/PDSCH scheduling by single DCI for the operation with 960 kHz SCS~~ | 24-1 | Yes |  |  | [Per UE/band] |  |  |  | ~~From WID~~* ~~In addition to 120kHz SCS, specify new SCS, 480kHz and 960kHz, and define maximum bandwidth(s), for operation in this frequency range for data and control channels and reference signals, only NCP supported.~~

~~[Agreement:~~~~A UE supporting 960 kHz SCS supports multi-slot PDCCH monitoring for 960 kHz SCS~~~~Agreement:~~~~Do not support PRACH length L=571, 1151 for 960kHz PRACH and at least L =1151 for 480kHz PRACH]~~~~Note:~~~~• Resolve the issues of wideband PRACH, multi-RB PUCCH format 0/1/4, and multi-PUSCH/PDSCH scheduling by single DCI, i.e., whether to have components of a single FG or separate FGs, for 120 kHz first, then use the same structure for 480 kHz~~~~• Resolve the issue of having separate capabilities for DL and UL (data and control channels as well as reference signals) for 120 kHz first, then use the same structure for 480 kHz~~ | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 1392. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2 |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz [with/without shared spectrum channel access] | Support multi-RB PUCCH format 0/1/4 for 960 kHz |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-5d | Multiple PDSCH scheduling by single DCI for 960 kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 960 kHz SCS2. HARQ enhancements |  |  |  |  |  |  |  |  |  | Optional with capability signalling |
|  24. NR\_ext\_to\_71GHz | 24-5e | Multiple PUSCH scheduling by single DCI for 960 kHz | Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS |  |  |  |  |  |  |  |  |  | Optional with capability signalling |

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Nokia, NSB | * Support for consistency with 120kHz FG design. Same note as for 120kHz apply to these though: “Note: basic groups may be merged once they are determined “. For consistency, FG24-4b should be all in yellow though.
 |
| Intel | **For 24-4b, 24-4c:**Similarly with reason why we should merge 24-1b and 24-1c with 24-1a, we think 24-4b and 24-4c should be merged with 24-4a (at least for unlicensed operation).The reason is that in order to utilize wideband PRACH and PUCCH during initial access, it must be a capability that is supported by default as it needs to be available prior to UE capability exchange with the gNB.If they are placed in separate row, then we should put note that “UE that support n263 and support 24-4a must indicate support for 24-4b and 24-4c”.**For 24-5c:**Same comment for 24-5c and 25-5a. either merge 24-5a and 24-5c, or put a note ““UE that support n263 and support 24-5a must indicate support for 24-5c”.**For 24-4d/4e and 24-5d/5e:**Because multi-slot PDCCH monitor is the default mode of operation for 480 and 960kHz, we think multi-PxSCH scheduling should be a basic feature. Suggest merging24-4d with 24-4.Merging 24-4e with 24-4a.Merging 24-5d with 24-5.Merging 24-5e with 24-5a.New entry needed.Addition of new capability for multi-slot PDCCH monitoring capability for 480/960kHz with X = 2/4, respectively. It was agree that support of X=2/4 would be optional. Therefore, there needs to be a separate field for this.Agreement:* Multi-slot PDCCH monitoring is based on slots within a slot group
	+ Each slot group consists of X consecutive slots
		- Slot groups are consecutive and non-overlapping
		- The start of the first slot group in a subframe is aligned with the subframe boundary
		- The start of each slot group is aligned with a slot boundary
		- Reporting the BD/CCE budget for X=4/8 slots (for 480/960 kHz resp.) is mandatory (if UE supports the corresponding SCS), and is optional for X=[2]/4 slots (for 480/960 kHz resp.)
 |
| DOCOMO | Here we are wondering if merging a FG to another FG is allowed for basic group only. We appreciate moderator’s clarification. Besides, we are ok with each FG in general.  |
| Huawei, HiSilicon | For 24-4b, we think it should only be applied in unlicensed band because the motivation to introduce this feature to overcome the PSD limitation in unlicensed. In NRU, it had been discussed whether wideband PRACH can be extended to licensed band and finally no consensus on it. We think the situation is same for above 52.6 WI. So we suggest to remove “without” in the bracket in the FG name. Alternative, we can remove the whole text in bracket in FG name and add “the signaling is per band but is only expected for a band where shared spectrum channel access must be used” in the note column, similar as what we did for NRU.For 24-4c and 24-5c, these two FGs should only be applied in unlicensed band according to the WID. So we suggest to remove “without” in the bracket in the FG name. Alternative, we can remove the whole text in bracket in FG name and add “the signaling is per band but is only expected for a band where shared spectrum channel access must be used” in the note column, similar as what we did for NRU.For 24-5, the red text should be added for the component of “2. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access” |

# Issue 2: FG 24-6 and FG 24-7

**Proposed Agreement: Adopt the following changes highlighted in chromatic formatting**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-6 | Uplink channel access procedure for FR2-2 unlicensed operation | 1. Cat 3 [or Cat 4] LBT support [(not agreed yet if CW is supported, so it can be either Cat 3 or Cat 4 LBT for now. Will update when we have agreement)]
2. [Support LBT performed per carrier/BWP bandwidth]
 | 24-1 |  |  |  | ~~[~~per band~~]~~ |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |
|  24. NR\_ext\_to\_71GHz | 24-7 | Cat 2 LBT support for uplink channel access procedure for FR2-2 unlicensed operation | 1. Support Cat 2 LBT | 24-1~~[~~, 24-6~~]~~ |  |  |  | ~~[~~per band~~]~~ |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported when required by regulation] |

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

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Nokia, NSB | Support |
| Intel | **FG 24-6:**As commented in section 3, Cat 3 aspect require further discussion and therefore, we think the component should be in brackets. We think there might have been some confusion between Cat-3 LBT and TYpe-3 LBT, which are very different things. It would be good to clarify whether Cat 3 above refers to Type-3 LBT or Cat-3 LBT.So changes are ok but we should put the whole component 1 in brackets. |
| DOCOMO | For FG24-6, we believe we can remove [or Cat 4] given that we will not have CAPC and CWS adjustment in FR2-2 per the WI agreements. Also, if LBT BW is per carrier or per BWP is up to implementation, we can also simply remove “per carrier/BWP bandwidth. If the wording Cat-3 is confusing for some companies, we are fine with putting them in bracket.  |
| LG Electronics | To align terminologies with 37.213 specification, it would better to replace Cat 3 and Cat 2 LBT with Type 1 and Type 2 channel access procedures.We agree with DOCOMO that Cat 4 can be removed. So, our suggestion is as follows.

|  |  |  |
| --- | --- | --- |
| 24-6 | Uplink channel access procedure for FR2-2 unlicensed operation | 1. Support Type 1 channel access procedure
2. [Support LBT performed per carrier/BWP bandwidth]
 |
| 24-7 | Support of Type 2 channel access procedure for uplink channel access procedure for FR2-2 unlicensed operation | 1. Support Type 2 channel access procedure |

 |
| Huawei, HiSilicon | For 24-6, CAT4 can be removed according to agreement. Either CAT3 (in HS) or type 1 channel access (in 3GPP spec) is fine. The bracket on component 2 can be removed according to RAN1 agreement. |

# Issue 3: FG 24-8 and 24-9

**Proposed Agreement:**

* **Confirm FGs 24-8 and 24-9 as separate rows**
* **Adopt the following changes highlighted in chromatic formatting**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes ~~[~~for FR 2-2~~]~~ | Support 32 HARQ processes in DL ~~[~~for 480/960 kHz~~]~~ |  |  |  |  | [Per UE/per FSPC/per band] |  |  |  | FFS: 120 kHz | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes ~~[~~for FR 2-2~~]~~ | Support 32 HARQ processes in UL ~~[~~for 480/960 kHz~~]~~ |  |  |  |  | [Per UE/per FSPC/per band] |  |  |  | FFS: 120 kHz | Optional with capability signalling |

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

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Huawei, HiSilicon | In NRU, we had FG developed for unlicensed and extended to licensed band and even other FR. We are not sure when such discussion will happen? At least for these two FGs, we think they can be extended. The current description including text in the bracket reflects the agreement in the WI. And we would suggest to leave some flexibility for future extension. e.g. together with FFS:120kHz, we suggest to further add “FFS: FR1/FR2-1”  |

# Issue 4: New FGs

Among the new FGs proposed in Section 3, no row had more than three supporters while the majority had a single company supporting the introduction of the new row. At the same time, all rows had at least 5 companies with concerns, most of them had six or more companies with concerns. Hence, further discussions are postponed until the work item has progressed more on these issues.

The following new FG/row was proposed by two companies in Section 3.

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

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

|  |  |
| --- | --- |
| Company | Comments/Questions/Suggestions |
| Intel | Support |
| LG Electronics | Support |
| Huawei, HiSilicon |  Support  |

# Conclusion

After further discussion on the RAN1 email reflector and during official GTW conference calls, the following was agreed as part of this email discussion:

**Agreement: Adopt the following changes highlighted in red and blue, including the definitions of new FGs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 24. NR\_ext\_to\_71GHz | 24-1 | Basic FR2-2 ~~[~~DL~~]~~ support | ~~1. Support 120KHz SCS [transmission and] reception [for initial/non-initial access]~~~~[2. Support multi-RB PUCCH format 0/1/4 for 120 kHz]~~~~[3. PRACH with 120KHz SCS and length 139[/571/1151]]~~~~[~~4. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2~~]~~ for non-initial access~~[5. Support 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2]~~~~[6. Support multi-PUSCH[/PDSCH] scheduling by single DCI for the operation with 120 kHz SCS]~~ |  |  |  | FR2-2 is not supported | [per UE][per band] |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |
|  24. NR\_ext\_to\_71GHz | 24-1a | Basic FR2-2 UL support | ~~1. Support 120KHz SCS reception for non-initial access~~~~2. Support multi-RB PUCCH format 0/1 for 120 kHz~~3. PRACH with 120KHz SCS and length 1394. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | [24-1] |  |  |  |  |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |
|  24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH [with/without shared spectrum channel access] | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz ~~/480kHz~~.  | [24-1a] |  |  |  |  |  |  |  | FFS: whether to split this FG for SA and DC | Optional [with/without]capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |
|  24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB PUCCH format 0/1/4 for 120 kHz [with/without shared spectrum channel access] | 1. Support multi-RB PUCCH format 4 for 120 kHz 2. Support multi-RB PUCCH format 0/1 for 120 kHz | [24-1a] |  |  |  |  |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |
|  24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS2. HARQ enhancements | [24-1] |  |  |  |  |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |
|  24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | [24-1a] |  |  |  |  |  |  |  |  | Optional with capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |
|  24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB ~~based stand-alone~~ support for SA/DC in FR2-2 | 1. Support 120KHz SSB for SA/DC ~~initial access~~ in FR2-2~~2. PRACH with 120KHz SCS and length 139~~ | [24-1, 24-1a] |  |  | 120KHz SSB based stand-alone in FR2-2 is not supported |  |  |  |  | per bandFFS: whether to split this FG for SA and DC | Optional [with/without] capability signalling[A UE that supports FR2-2 must indicate this FG is supported] |

* Note: basic groups may be merged once they are determined

# References

1. R1-2110587, Updated RAN1 UE features list for Rel-17 NR after RAN1 #106bis-e, Moderators (AT&T, NTT DOCOMO, INC.)
2. R1-2110833, Rel-17 UE features for extension to 71 GHz, Huawei/HiSilicon
3. R1-2111153, On UE features for supporting NR from 52.6 GHz to 71 GHz, Nokia/Nokia Shanghai Bell
4. R1-2111313, Discussion on UE features for FR2-2, OPPO
5. R1-2111471, UE features for extending current NR operation to 71 GHz, Ericsson
6. R1-2111526, Discussion on UE capability for extending NR up to 71 GHz, Intel Corporation
7. R1-2111770, UE features for supporting NR from 52.6 GHz to 71 GHz, Samsung
8. R1-2111907, Views on Rel-17 Above 52.6 GHz  UE features, Apple
9. R1-2111051, Discussions on UE features for NR operation from 52.6GHz to 71GHz, vivo
10. R1-2111081, Discussion on UE features for 52.6 to 71GHz, ZTE/Sanechips
11. R1-2112070, Discussion on UE features for NR above 52.6 GHz, LG Electronics
12. R1-2112133, Views on UE features for supporting NR from 52.6 GHz to 71 GHz, NTT DOCOMO, INC.
13. R1-2112304, Views on UE features for supporting NR from 52.6 GHz to 71 GHz, MediaTek Inc.