**3GPP TSG RAN WG1 #101 R1-20xxxxx**

**e-Meeting, May 25th – June 5th, 2020**

**Source: Moderator (NTT DOCOMO, INC.)**

**Title:** **Summary on [101-e-NR-UEFeatures-NRU-02]**

**Agenda Item:** **7.2.11.2**

**Document for:** **Discussion and Decision**

1. Introduction

This contribution summarizes the following email discussion/approval regarding UE features for NR-U.

[101-e-NR-UEFeatures-NRU-02] Email discussion/approval on capability signaling design for existing FGs for NR-U (25th May – 2nd June) – (DCM, Hiroki)

* Discuss and decide capability signaling design (including components, candidate values, reporting type, xDD/FRx differentiations) for existing FGs
* Discuss and decide any other necessary update for the UE features list for NR-U based on identified issues/proposals in R1-2004403

1. Discussion on UE features for NR-U

## 2.1 FG10-1/1a

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-1 | UL channel access for dynamic channel access mode | 1. Type 1 channel access  2. Type 2A channel access  3. Type 2B channel access  4. Type 2C channel access  5. 20MHz LBT bandwidth  6. CP extension up to 1 symbol for PUSCH/PUCCH transmission |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-1a | UL channel access for semi-static channel access mode | 1. Type 2C channel access  2. Single sensing slot of 9us channel access  3. 20MHz LBT bandwidth | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **Component of FG10-1**
  + **Include contention window size adjustment under the first component (i.e., Type 1 channel access) or as a separate component: [6]**
* **Component of FG10-1a**
  + **Add “FFS: CP extension up to 1 symbol for PUSCH/PUCCH transmission” as one of its components: [4]**
* **Prerequisite feature groups for FG10-1a**
  + **No prerequisite feature groups: [12]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

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| [4] | For FG10-1a, since Type 2C is one of its components, CP extension should be, too.  **Proposal 3: In FG10-1a, add “FFS: CP extension up to 1 symbol for PUSCH/PUCCH transmission” as one of its components.** |
| [6] | For FG 10-1, it is generic FG for dynamic channel access including various types of channel access mode. For Type 1 channel access, contention window size adjustment procedure should be required. However, it is not clearly stated in FG 10-1. During e-mail discussion, it was proposed to include contention window size adjustment procedure as a component in FG 10-1. Although Type 1 channel access in the component includes contention window size adjustment procedure, in our view, explicit description to avoid miss-leading of FG 10-1 is desirable. Therefore, it is proposed to include contention window size adjustment under the first component (i.e., Type 1 channel access) or as a separate component in FG 10-1.  **Proposal 1: Include contention window size adjustment under the first component (i.e., Type 1 channel access) or as a separate component in FG 10-1** |
| [12] | |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-1 | UL channel access for dynamic channel access mode | 1. Type 1 channel access  2. Type 2A channel access  3. Type 2B channel access  4. Type 2C channel access  5. 20MHz LBT bandwidth  6. CP extension up to 1 symbol for PUSCH/PUCCH transmission |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | | 10. NR-unlicensed | 10-1a | UL channel access for semi-static channel access mode | 1. Type 2C channel access  2. Single sensing slot of 9us channel access  3. 20MHz LBT bandwidth |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | |

Based on above, following FL proposals are made.

### **FL proposal 1:**

* **Add “and contention window size adjustment” to component 1 of FG10-1**

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| 10. NR-unlicensed | 10-1 | UL channel access for dynamic channel access mode | 1. Type 1 channel access and contention window size adjustment  2. Type 2A channel access  3. Type 2B channel access  4. Type 2C channel access  5. 20MHz LBT bandwidth  6. CP extension up to 1 symbol for PUSCH/PUCCH transmission |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

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### **FL proposal 2:**

* **Add “CP extension up to 1 symbol for PUSCH/PUCCH transmission” as component 4 of FG10-1a**
* **“TBD” is removed from prerequisite feature groups for FG10-1a**

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| 10. NR-unlicensed | 10-1a | UL channel access for semi-static channel access mode | 1. Type 2C channel access  2. Single sensing slot of 9us channel access  3. 20MHz LBT bandwidth  4. CP extension up to 1 symbol for PUSCH/PUCCH transmission |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

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## 2.2 FG10-2/2a/2b/2c/2d/2e/2f

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-2 | SSB-based RRM [for dynamic channel access mode] | 1. SSB-based RRM with Q [for dynamic channel access mode] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2a | SSB-based RRM [for semi-static channel access mode] | 1. SSB-based RRM with Q [for semi-static channel access mode] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2b | MIB reading on unlicensed cell | 1. MIB reading on unlicensed cell | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2c | SSB-based RLM [for dynamic channel access mode] | 1. SSB-based RLM with Q [for dynamic channel access mode] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2d | SSB-based RLM [for semi-static channel access mode] | 1. SSB-based RLM with Q [for semi-static channel access mode] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2e | SIB1 reception on unlicensed cell | 1. SIB1 reception on unlicensed cell | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2f | Support monitoring of extended RAR window | 1. Support of RAR extension from 10ms to [40ms] by decoding of the 2-bit SFN indication in DCI 1\_0 | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **Component of FG10-2b**
  + **Modify the component of FG 10-2b from “MIB reading on unlicensed cell” to “MIB reading on unlicensed cell for PCell and PSCell”: [10]**
* **Component of FG10-2e**
  + **Modify the component of FG 10-2e from “SIB1 reception on unlicensed cell” to “SIB1 reception on unlicensed cell for PCell”: [10]**
* **Component of FG10-2f**
  + **Remove the brackets of [40ms]: [9], [12], [13]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

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| [4] | For downlink features, there is no need to distinguish FBE from LBE. Hence, FGs 10-2a and 10-2d are not necessary.  **Proposal 4: Remove FG10-2a and FG10-2d.** |
| [5] | It does not seem necessary to have separate FGs defined for dynamic and semi-static channel access mode for RLM and RRM. It seems like 2/2a can be merged and 2c/2d can be merged. It can be further discussed if there is a need to introduce a range of values for various configurable parameters to allow a UE to report its capability.  **Proposal 2 FG 2a/2b can be merged. FG 2c/2d can be merged.**  FG 10-2f “Support of RAR extension from 10ms to [40ms] by decoding of the 2-bit SFN indication in DCI 1\_0” in our view, it is not critical if NR-U capable UEs do not support the extended RAR window. Collisions do not happen frequently, and if there is a collision, a UE can retry to access the channel again. It is true that the gNB does not know the UE’s capability if the RACH procedure is initiated by the IDLE/INACTIVE UE. However, if support of extended RAR is a separate FG with its own an capability bit, this can be used to collect statistics on UE capabilities, and the gNB may decide based on the penetration and use case whether to configure the extended RAR window or not. If considered useful, this can be implemented in the initial phase. Otherwise, UEs may also be upgraded with this capability if enhancements are considered needed.  **Proposal 3 FG 10-2f for support of RAR extension from 10ms to [40ms] by decoding of the 2-bit SFN indication in DCI 1\_0 does not need to be part of basic operation.** |
| [7] | In RAN1#100-e meeting, the following conclusion was made.   |  | | --- | | Conclusion:  For semi-static channel access, SSBs that (partially) fall in the idle region of a fixed frame period should be considered as invalid. No PDSCH rate matching and no RLM/RRM measurement will be done for those candidate SSB positions. |   The above conclusion implies that, for FBE case, if location of a candidate SS/PBCH block is (partially) overlapped with idle region of a fixed frame period, UE shall not perform RRM/RLM/BFD/CBD operation for the SS/PBCH block. Therefore, based on this observation, we can remove brackets of FG 10-2/2a/2c/2d.  **Proposal #5: Keep FG 10-2/2a/2c/2d separate feature groups as is, and remove brackets for FG 10-2/2a/2c/2d.** |
| [9] | |  |  |  | | --- | --- | --- | | 10-2 | SSB-based RRM [for dynamic channel access mode] | 1. SSB-based RRM with Q [for dynamic channel access mode] | | 10-2a | SSB-based RRM [for semi-static channel access mode] | 1. SSB-based RRM with Q [for semi-static channel access mode] |   Proposal: keep the two FGs separate. There is no reason that a FBE UE should have to support measurements for LBE, and vice-versa.   |  |  |  | | --- | --- | --- | | 10-2c | SSB-based RLM [for dynamic channel access mode] | 1. SSB-based RLM with Q [for dynamic channel access mode] | | 10-2d | SSB-based RLM [for semi-static channel access mode] | 1. SSB-based RLM with Q [for semi-static channel access mode] |   Proposal: keep the two FGs separate. There is no reason that a FBE UE should have to support measurements for LBE, and vice-versa.   |  |  |  | | --- | --- | --- | | 10-2f | Support of RAR extension from 10ms to [40ms] by decoding of the 2-bit SFN indication in DCI 1\_0 | 1. Support of RAR extension from 10ms to [40ms] by decoding of the 2-bit SFN indication in DCI 1\_0 |   Proposal: remove the brackets. |
| [10] | **On FG 10-2b and 10-2e**  We would like to add “PCell and PSCell” to the FG10-2b to scope the intended use case of this FG. For PSCell, reading MIB is still needed to acquire the SFN timing of the SCG (which maybe different from the MCG). This modification is important to provide desirable flexibility so that UE that only supports NR-U deployment scenario A together with FG 10-23 (reportCGI for neighbour) does not necessarily support this feature. In other words, this modification gets rid of the overlapping part (i.e. MIB/SIB1 decoding) between FG 10-2b (PCell/PSCell) and FG 10-23 (neighbour cells).   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 10-2b | MIB reading on unlicensed cell | 1. MIB reading on unlicensed cell for PCell and PSCell |  |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |   For SIB-1 reading i.e. FG 10-2e, we propose to update the component to include “for PCell”. It should be noted that, according to TS 38.331 section 5.2.1, SIB-1 information for SCell, including PSCell, is provided by dedicated RRC signaling in SCell addition procedure or SCG addition procedure and therefore no need to read SIB1 for any SCell.   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 10-2e | SIB1 reception on unlicensed cell | 1. SIB1 reception on unlicensed cell for PCell |  |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |   **Proposal 2:**   * *Modify the component of FG 10-2b to be “MIB reading on unlicensed cell for PCell and PSCell”* * *Modify the component of FG 10-2e to be “SIB1 reception on unlicensed cell for PCell”*   **On FG 10-2c/10-2d**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | 10-2c | SSB-based RLM [for dynamic channel access mode] | 1. SSB-based RLM with Q [for dynamic channel access mode] |  | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | | 10-2d | SSB-based RLM [for semi-static channel access mode] | 1. SSB-based RLM with Q [for semi-static channel access mode] |  | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |   As shown in Table above, the current FG 10-2c/10-2d only includes SSB-based RLM functionality. RAN1 needs to discuss how to handle other SSB-based functionalities, e.g. BFD (Beam Failure Detection) and CBD (Candidate Beam Detection) for NR-U operation, i.e. either adding them into 10-2c and 10-2d as components (Alt.1) or creating new FGs e.g. FG 10-2g/2h/2I/2J (Alt.2)  **Proposal 3:**   * *RAN1 to discuss how to handle SSB-based BFD and CBD capabilities support by considering two alternatives below:*    + *Alt.1: Adding SSB-based BFD/CBD with Q as additional components in FG 10-2c/2d.*      - *FG-10-2c: SSB-based RLM/BFD/CBD with Q [for dynamic channel access mode]*     - *FG-10-2d: SSB-based RLM/BFD/CBD with Q [for semi-static channel access mode]*   + *Alt.2: Create four new FGs*     - *FG 10-2g: SSB-based BFD with Q [for dynamic channel access mode]*     - *FG 10-2h: SSB-based BFD with Q [for semi-static channel access mode]*     - *FG 10-2I: SSB-based CBD with Q [for dynamic channel access mode]*     - *FG 10-2J: SSB-based CBD with Q [for semi-static channel access mode]* |
| [11] | * FG 10-2: SSB-based RRM [for dynamic channel access mode]   1. As commented to 10-2a, we don’t see the necessity to separate FGs for LBE and FBE. 10-2 and 10-2a should be combined into a single FG. * FG 10-2a: SSB-based RRM [for semi-static channel access mode]   1. Considering RRM for measurement cell, FFP of the measurement cell may not be always the same FFP of the serving cell. In that case, UE may perform several RRM for the measurement cell and has to support SSB-based RRM with an arbitrary FFP. In that sense, we don’t see the necessity to separate FGs for LBE and FBE. 10-2 and 10-2a should be combined into a single FG. As there was a discussion in the last RAN1 meeting that measurement cells would have the same FFP as the serving cells in some cases since they are deployed by the same operator, we would like to know whether this assumption can be the baseline to define the FG. * FG 10-2c: SSB-based RLM with Q [for dynamic channel access mode]   1. As commented to 10-2d, we are OK to separate SSB-based RLM for LBE and FBE. * FG 10-2d: SSB-based RLM with Q [for semi-static channel access mode]   1. We think the motivation to separate the capability of SSB-based RLM for LBE and that for FBE comes from reducing the number of RLM within DRS half slot for FFP of 5/10ms (e.g. UE only perform RLM for candidate SSB index from #0 to #7 within DRS half slot for FFP of 5ms). In that sense, we are OK to separate SSB-based RLM for LBE and FBE. |
| [12] | * We do prefer to keep 10-2 and 10-2a separate, and keep 10-2c and 10-2d separate, i.e., remove square brackets, consider the SSB transmission patterns are different between LBE and FBE systems at least during the idle period. * As discussed in the previous round of email discussion, for 10-2a and 10-2c, we would like to only keep SMTC window or DRS window length shorter or equal to the fixed frame period as the component, consider the UE behavior can be different if the SSB burst can be spreaded across multiple FFPs. We can introduce separate capability for SMTC window or DRS window longer than FFP if necessary.  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-2 | SSB-based RRM for dynamic channel access mode | 1. SSB-based RRM with Q for dynamic channel access mode | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | | 10. NR-unlicensed | 10-2a | SSB-based RRM for semi-static channel access mode | 1. SSB-based RRM with Q for semi-static channel access mode, when SMTC window is no longer than the fixed frame period | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | | 10. NR-unlicensed | 10-2b | MIB reading on unlicensed cell | 1. MIB reading on unlicensed cell | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | | 10. NR-unlicensed | 10-2c | SSB-based RLM for dynamic channel access mode | 1. SSB-based RLM with Q for dynamic channel access mode | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | | 10. NR-unlicensed | 10-2d | SSB-based RLM for semi-static channel access mode | 1. SSB-based RLM with Q for semi-static channel access mode, when DRS window is no longer than the fixed frame period | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | | 10. NR-unlicensed | 10-2e | SIB1 reception on unlicensed cell | 1. SIB1 reception on unlicensed cell | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | | 10. NR-unlicensed | 10-2f | Support monitoring of extended RAR window | 1. Support of RAR extension from 10ms to 40ms by decoding of the 2-bit SFN indication in DCI 1\_0 | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | |
| [13] | * 10-2/2a/2c/2d: it is OK to keep the differentiation depending on dynamic/static access modes. * 10-2f: RAN2 has agreed already that 40ms is mandatory. |

Based on above, following FL proposals are made.

### **FL proposal 3:**

* **Modify the component of FG 10-2b from “MIB reading on unlicensed cell” to “MIB reading on unlicensed cell for PCell and PSCell”**
* **Modify the component of FG 10-2e from “SIB1 reception on unlicensed cell” to “SIB1 reception on unlicensed cell for PCell”**
* **“TBD” is removed from prerequisite feature groups for FG10-2b/2e**

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| 10. NR-unlicensed | 10-2b | MIB reading on unlicensed cell | 1. MIB reading on unlicensed cell for PCell and PSCell |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2e | SIB1 reception on unlicensed cell | 1. SIB1 reception on unlicensed cell for PCell |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

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### **FL proposal 4:**

* **Modify the component of FG 10-2f to “Support of RAR extension from 10ms to 40ms by decoding of the 2-bit SFN indication in DCI 1\_0”**
* **“TBD” is removed from prerequisite feature groups for FG10-2f**

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| 10. NR-unlicensed | 10-2f | Support monitoring of extended RAR window | 1. Support of RAR extension from 10ms to 40ms by decoding of the 2-bit SFN indication in DCI 1\_0 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.3 FG10-7

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-7 | UL channel access for 10 MHz SCell | 1. 10 MHz LBT bandwidth | one of {10-1, 10-1a} | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **No remaining issues or proposals are identified for FG10-7**

## 2.4 FG10-10

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-10 | RSSI and channel occupancy measurement and reporting | 1. RSSI measurement 2. Channel occupancy reporting | TBD | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **Reporting type of FG10-10**
  + **Per UE: [5]**
  + **Per band: [9], [10], [11], [12]**
* **Whether FG10-10 can be extended to licensed band**
  + **Not support: [4], [6], [9], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.** |
| [5] | It is not clear why RSSI channel occupancy measurement and reporting needs to be per band instead of being per UE as it was in the case of LTE-LAA. It is simpler to make this per UE, especially considering there are at least two bands already (5 and 6 GHz) and there may potentially also be other unlicensed bands that may open up in the future.  Proposal 6 FG 10-10 should be per UE |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant***   ***10-28 Configured grant enhanced resource configuration*** |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**   * *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | 1. We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later. |
| [12] | * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-10 | RSSI and channel occupancy measurement and reporting | 1. RSSI measurement   Channel occupancy reporting | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | |

Based on above, following FL proposals are made.

### **FL proposal 5:**

* **Type of FG10-10 is “Per band”**
* **“TBD” is removed from prerequisite feature groups for FG10-10**
* **FG10-10 is only for unlicensed bands**

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| 10. NR-unlicensed | 10-10 | RSSI and channel occupancy measurement and reporting | 1. RSSI measurement 2. Channel occupancy reporting |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.5 FG10-11

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-11 | SRS starting position at any OFDM symbol in a slot | 1. Support transmitting SRS starting in all symbols (0,…,13) of a slot | TBD | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **Reporting type of FG10-11**
  + **Per UE: [2], [5], [9]**
  + **Per band: [10], [11], [12]**
* **Whether FG10-11 can be extended to licensed band**
  + **Support: [2], [3], [5], [6], [9], [14]**
  + **Not support: [4], [6], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
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| [2] | * For SRS starting position at any OFDM symbol in a slot (10-11), it offers more flexibility on the placement of SRS which will also benefit the licensed band.   **Proposal 1: SS group switching related features (10-9, 10-9b, 10-9c, 10-9d) and SRS starting position at any OFDM symbol in a slot (10-11) could be extended to licensed use and adopt “Per UE” type.** |
| [3] | * TypeB PDSCH length & SRS starting position: including FG 10-8 and FG 10-11 * CORESET/SS: including FG 10-9/9b/9c, 10-20/20a. * HARQ enhancements: including FG 10-14 ~ 10-17.   In general, the above enhancements on PDSCH, SRS, CORESET/SS, and HARQ could be beneficial to licensed spectrum in terms of enhanced flexibility and reliability. On the other hand, it may introduce implementation complexity for NR UEs. Probably they can be considered as optional features to be applied to NR licensed spectrum.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.*** * ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.** |
| [5] | The ability to configure an SRS resource to start at any OFDM symbol in a slot is generally useful, regardless of the band. For example, it can enable 1T4R antenna switching in the same slot (currently 2-slots are needed), it can be useful for positioning, and also URLLC. Hence this FG should be per UE.  Proposal 7 FG 10-11 should be per UE |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant***   ***10-28 Configured grant enhanced resource configuration*** |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**   * *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later. |
| [12] | * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-11 | SRS starting position at any OFDM symbol in a slot | Support transmitting SRS starting in all symbols (0,…,13) of a slot | TBD | Yes | N/A |  | Per UE | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario | |
| [14] | ***Observation 1: Support of SRS starting position at any symbol in a slot will alleviate the shortage of SRS capacity and is beneficial for licensed bands as well.***  ***Observation 2: Support of SRS starting position at any symbol in a slot for licensed bands will lead to NO additional standardization efforts.***  Based on the above discussions and observations, we have the following proposal  ***Proposal 1: Support SRS resource starting at any symbol in a slot for licensed bands in Rel-16, i.e., UE feature 10-11 is also applicable to licensed bands.*** |

Based on above, following FL proposals are made.

### **FL proposal 6:**

* **Type of FG10-11 is “Per UE”**
  + **Need of xDD/FRx differentiations are “No”**
* **“TBD” is removed from prerequisite feature groups for FG10-11**
* **Add a note “This FG is also applicable to licensed bands”**

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| 10. NR-unlicensed | 10-11 | SRS starting position at any OFDM symbol in a slot | 1. Support transmitting SRS starting in all symbols (0,…,13) of a slot |  | Yes | N/A |  | Per UE | No | No | N/A | This FG is also applicable to licensed bands | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.6 FG10-20/20a

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-20 | Support search space set configuration with freqMonitorLocation-r16 | 1. Support search space set configuration with freqMonitorLocations-r16 | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-20a | Support coreset configuration with rb-Offset | 1. Support coreset configuration with rb-Offset | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **Component of FG10-20**
  + **Modify the component of FG10-20 from “Support search space set configuration with freqMonitorLocations-r16” to “Maximum number of frequency domain locations for a search space set configuration with freqMonitorLocations-r16”: [4]**
* **Whether FG10-20/20a can be extended to licensed band**
  + **Support: [3]**
  + **Not support: [4], [6]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

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| --- | --- |
| [3] | * TypeB PDSCH length & SRS starting position: including FG 10-8 and FG 10-11 * CORESET/SS: including FG 10-9/9b/9c, 10-20/20a. * HARQ enhancements: including FG 10-14 ~ 10-17.   In general, the above enhancements on PDSCH, SRS, CORESET/SS, and HARQ could be beneficial to licensed spectrum in terms of enhanced flexibility and reliability. On the other hand, it may introduce implementation complexity for NR UEs. Probably they can be considered as optional features to be applied to NR licensed spectrum.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.*** * ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.**  For 10-20, the number of PDCCH search space sets/CORESETs/candidates that UE can monitor is highly related to UE’s complexity. The more cost a UE is willing to pay, the more candidates/search spaces sets/CORESETs the UE is able to process. Therefore, 10-20 should not be just a “whether or not” indication. Instead, it should be a “how many” indication.  **Proposal 10: For FG10-20, change the component to “Maximum number of frequency domain locations for a search space set configuration with *freqMonitorLocations-r16*”** |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |

Based on above, following FL proposals are made.

### **FL proposal 7:**

* **Modify component 1 of FG10-20 to “Maximum number of frequency domain locations for a search space set configuration with freqMonitorLocations-r16”**
* **“TBD” is removed from prerequisite feature groups for FG10-20/20a**
* **FG10-20/20a are only for unlicensed band**

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| 10. NR-unlicensed | 10-20 | Support search space set configuration with freqMonitorLocation-r16 | 1. Maximum number of frequency domain locations for a search space set configuration with freqMonitorLocations-r16 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-20a | Support coreset configuration with rb-Offset | 1. Support coreset configuration with rb-Offset |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.7 FG10-23

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-23 | CGI reading on unlicensed cell [based on off-sync raster SSB] for ANR functionality | 1. Support acquisition of relevant information from a neighbouring NR unlicensed cell in an unlicensed carrier by reading the RMSI of the neighbouring unlicensed cell and reporting the acquired information to the network | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Support reading RMSI from an unlicensed cell [with an off-sync raster SSB] for ANR | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **FG name of FG10-23**
  + **Change FG name from “CGI reading on unlicensed cell [based on off-sync raster SSB] for ANR functionality” to “CGI reading on unlicensed cell for ANR functionality”: [4], [7], [11]**
  + **Remove the brackets of [based on off-sync raster SSB]: [9]**
* **Prerequisite feature groups for FG10-23**
  + **Add FG 4-5: [10]**
* **Note of FG10-23**
  + **Remove “[based on off-sync raster SSB]”: [4], [7], [11]**
  + **Remove the brackets of [based on off-sync raster SSB]: [9]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [4] | With the introduction of discovery burst transmission windows, the number of SSB positions that UE has to monitor for measurements and PBCH reading is increased dramatically especially for small Q values. In addition, PCI collision is no new issue in NR-U. LTE-LAA has the same issue. However, it is resolved by eNB without mandating UE to read and report CGI. Hence, we think the CGI reading of an unlicensed cell for ANR functionality should be an optional feature.  **Proposal 11: CGI reading of an unlicensed cell for ANR functionality should be UE capability regardless whether its SSB is on or off sync rater.**  **Proposal 12: For FG10-23, change FG name from “CGI reading on unlicensed cell [based on off-sync raster SSB] for ANR functionality” to “CGI reading on unlicensed cell for ANR functionality”.** |
| [7] | In our opinion, it would be preferable that CGI reading for ANR purpose is an optional feature regardless of whether the corresponding SSB is located in sync raster or not. Therefore, “[based on off-sync raster SSB]” can be removed for FG 10-23.  **Proposal #6: Remove “[based on off-sync raster SSB]” for FG 10-23.** |
| [9] | |  |  |  | | --- | --- | --- | | 10-23 | CGI reading on unlicensed cell [based on off-sync raster SSB] for ANR functionality | 1. Support acquisition of relevant information from a neighbouring NR unlicensed cell in an unlicensed carrier by reading the RMSI of the neighbouring unlicensed cell and reporting the acquired information to the network |   Proposal: remove the brackets. |
| [10] | ***Proposal 4:***   * *Adding the FG 4-5 as prerequisite feature groups for FG 10-23.* * *Modify the “cat4” in FG 10-21a to “Type 1” to align with TS 37.213 specification.* |
| [11] | * FG 10-23: CGI reading on unlicensed cell [based on off-sync raster SSB] for ANR functionality   1. Since CGI reading for both on and off sync raster are defined for unlicensed band, the capability including both cases may be sufficient, i.e., the sentence in the bracket in the columns of Feature group and Note should be removed. |

Based on above, following FL proposals are made.

### **FL proposal 8:**

* **Remove “[based on off-sync raster SSB]” from FG name**
* **Remove “[with an off-sync raster SSB]” from Note**
* **Prerequisite feature groups for FG10-23 is “4-5”**

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| 10. NR-unlicensed | 10-23 | CGI reading on unlicensed cell for ANR functionality | 1. Support acquisition of relevant information from a neighbouring NR unlicensed cell in an unlicensed carrier by reading the RMSI of the neighbouring unlicensed cell and reporting the acquired information to the network | 4-5 | Yes | N/A |  | Per band | N/A | N/A | N/A | Support reading RMSI from an unlicensed cell for ANR | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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| Company | Comment |
| LG Electronics | FG 4-5 corresponds to PUCCH format 4 over 4 – 14 OFDM symbols once per slot with frequency hopping as “enabled”, which seems to have nothing to do with FG 10-23. I guess 4-5 is a typo? |
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## 2.8 FG10-25

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-25 | Enable configured UL transmissions when DCI 2\_0 is configured but not detected | 1. Support configuration of enableConfiguredUL-r16 and enable transmission of higher-layer configured UL \*SRS, PUCCH, CG-PUSCH etc) when DCI 2\_0 is configured but not detected | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **Components of FG10-25**
  + **Change “DCI 2\_0” to “SFI”: [2]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

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| [2] | * On **10-25** (*Enable configured UL transmission out of COT*), to be more accurate, we suggest to change “DCI 2\_0” to “SFI” since DCI 2\_0 is not SFI only in NRU Rel-16.  |  |  |  |  | | --- | --- | --- | --- | | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | | 10-25 | Enable configured UL transmission out of COT | 1. Support configuration of enableConfiguredUL-r16 and enable Cat 4 LBT based transmission of RRC configured UL \*SRS, PUCCH, CG-PUSCH etc) out of COT when DCI 2\_0 is configured but not detected | 10-1 |   **Proposal 5: Change “DCI 2\_0” to “SFI” in the component of 10-25.** |

Based on above, following FL proposals are made.

### **FL proposal 9:**

* **Change from “DCI 2\_0” to “SFI” in FG name and Components of FG10-25**
* **“TBD” is removed from prerequisite feature groups for FG10-25**

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| 10. NR-unlicensed | 10-25 | Enable configured UL transmissions when SFI is configured but not detected | 1. Support configuration of enableConfiguredUL-r16 and enable transmission of higher-layer configured UL \*SRS, PUCCH, CG-PUSCH etc) when SFI is configured but not detected |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| LG Electronics | Removal of TBD in pre-requisite column is OK.  In [101-e-NR-unlic-NRU-DL\_Signals\_and\_Channels-02], “whether R16 supports the case where UE is not configured with SFI-index field but configured with any of the following: CO-duration, SS-switching trigger and RB-sets indication in DCI format 2\_0” is currently discussed. Depending on the outcome of this discussion, if we conclude that DCI 2\_0 at least includes SFI, we don’t need to change from DCI 2\_0 to SFI. Therefore, we can decide whether to change from DCI 2\_0 to SFI or not, after we obtain outcome of [101-e-NR-unlic-NRU-DL\_Signals\_and\_Channels-02]. |
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## 2.9 FG10-27

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-27 | Wideband PRACH | 1. Enhanced PRACH design for NR-U by adopting a single long ZC sequence, with ZC sequence = 1151 for 15kHz and ZC sequence = 571 for 30kHz | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **No remaining issues or proposals are identified for FG10-27**

Based on above, following FL proposals are made.

### **FL proposal 10:**

* **“TBD” is removed from prerequisite feature groups for FG10-27**

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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| Company | Comment |
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## 2.10 FG10-29

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-29 | Support available RB set indicator field in DCI 2\_0 | 1. Support monitoring DCI 2\_0 to read availableRB-Sets-r16 | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **No remaining issues or proposals are identified for FG10-29**

Based on above, following FL proposals are made.

### **FL proposal 11:**

* **“TBD” is removed from prerequisite feature groups for FG10-29**

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

|  |  |
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| Company | Comment |
| LG Electronics | This is also related to [101-e-NR-unlic-NRU-DL\_Signals\_and\_Channels-02]. To be specific, in order to configure available RB set indicator, at least SFI (or CO-duration) field may need to be configured with DCI format 2\_0. In this case, we may need FG 3-6 (or FG 10-30) as a pre-requeiste. |
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## 2.11 FG10-30

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-30 | Support channel occupancy duration indicator field in DCI 2\_0 | 1. Support monitoring DCI 2\_0 to read COT duration | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

* **No remaining issues or proposals are identified for FG10-30**

Based on above, following FL proposals are made.

### **FL proposal 12:**

* **“TBD” is removed from prerequisite feature groups for FG10-30**

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

|  |  |
| --- | --- |
| Company | Comment |
| LG Electronics | This is also related to [101-e-NR-unlic-NRU-DL\_Signals\_and\_Channels-02]. To be specific, in order to configure CO-duration field, at least SFI field may need to be configured with DCI format 2\_0. In this case, we may need FG 3-6 as a pre-requeiste. |
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## 2.12 FG10-8

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-8 | Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | 1. Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | 5-6a | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A | Note length 9/10 with DMRS shift due to CRS collision are already covered by 14-3 | Optional with capability signalling |

* **FG name of FG10-8**
  + **Remove the brackets of [9, 10,]: [9], [11], [13]**
* **Components of FG10-8**
  + **Remove the brackets of [9, 10,]: [9], [11], [13]**
* **Reporting type of FG10-8**
  + **Per UE: [5], [9]**
  + **Per band: [10], [11], [12]**
* **Whether FG10-8 can be extended to licensed band**
  + **Support: [3], [5], [6], [8], [9]**
  + **Not support: [4], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [3] | * TypeB PDSCH length & SRS starting position: including FG 10-8 and FG 10-11 * CORESET/SS: including FG 10-9/9b/9c, 10-20/20a. * HARQ enhancements: including FG 10-14 ~ 10-17.   In general, the above enhancements on PDSCH, SRS, CORESET/SS, and HARQ could be beneficial to licensed spectrum in terms of enhanced flexibility and reliability. On the other hand, it may introduce implementation complexity for NR UEs. Probably they can be considered as optional features to be applied to NR licensed spectrum.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.*** * ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.** |
| [5] | Since the PDSCH mapping lengths are generally useful, regardless of the band, in our view this feature should be per UE.  **Proposal 4 FG 10-8 should be per UE.** |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant*** * ***10-28 Configured grant enhanced resource configuration***  |  |  |  | | --- | --- | --- | | 10-8 | Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | 1. Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision |   Proposal: remove the brackets. |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**  *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later.   * FG 10-8: Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision   1. We are OK to remove the bracket on PDSCH length [9, 10] for supporting them without DMRS shift due to CRS collision. |
| [12] | * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-8 | Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | 5-6a | Yes | N/A |  | Per band | N/A | N/A | N/A | Note length 9/10 with DMRS shift due to CRS collision are already covered by 14-3 | Optional with capability signalling | |
| [13] | * 10-8: We are OK to remove brackets from [9,10]. |

Based on above, following FL proposals are made.

### **FL proposal 13:**

* **Remove bracket from “[9, 10,]” in FG name and Components of FG10-8**
* **Type of FG10-8 is “Per band”**
* **Add a note “This FG is also applicable to licensed bands”**

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| 10. NR-unlicensed | 10-8 | Type B PDSCH length {3, 5, 6, 8, 9, 10, 11, 12, 13} without DMRS shift due to CRS collision | 1. Type B PDSCH length {3, 5, 6, 8, 9, 10, 11, 12, 13} without DMRS shift due to CRS collision | 5-6a | Yes | N/A |  | Per band | N/A | N/A | N/A | Note length 9/10 with DMRS shift due to CRS collision are already covered by 14-3  This FG is also applicable to licensed bands | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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| Company | Comment |
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## 2.13 FG10-9/9b/9c/9d

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-9 | Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Monitor DCI 2\_0 with a search space set switching field  3. Support switching the search space set group with PDCCH decoding in group 1  4. Support a timer to switch back to original search space set group  5. Monitor DCI 2\_0 for channel occupancy time and use the end of channel occupancy time to switch back to the original search space set group | TBD | Yes | N/A |  | FFS: Per UE or per band or per BC | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups. | Optional with capability signalling |
| 10. NR-unlicensed | 10-9b | Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Support switching the search space set group with PDCCH decoding in group 1  3. Support a timer to switch back to original search space set group | TBD | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups. | Optional with capability signalling |
| 10. NR-unlicensed | 10-9c | Joint search space group switching across multiple cells | 1. Configured with a group of cells and switch search space set group jointly over these cells | one of {10-9, 10-9b} | Yes | N/A |  | FFS: Per UE or per band or per BC | N/A | N/A | N/A | Without this capability, the UE will switch search space set groups for different cells independently | Optional with capability signalling |
| 10. NR-unlicensed | 10-9d | Support Search space set group switching capability 2 | 1. Search space set group switching Capability-2: P=10/12/22 symbols for µ = 0/1/2 SCS | one of {10-9, 10-9b} | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A | Without this capability, the UE supports search space set group switching capability-1: P=25/25/25 symbols for µ=0/1/2 | Optional with capability signalling |

* **FG name of FG10-9**
  + **Change from “Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring” to “Search space set group switching with DCI 2\_0 monitoring”: [4]**
* **Reporting type of FG10-9/9b/9d**
  + **Per UE: [2], [5]**
  + **Per band: [4], [6], [9], [10], [11], [12]**
* **Reporting type of FG10-9c**
  + **Per UE: [2], [5]**
  + **Per band: [4], [6], [10], [11]**
  + **Per BC: [9], [12]**
* **Whether FG10-9/9b/9c/9d can be extended to licensed band**
  + **Support: [2], [3], [5]**
  + **Not support: [4], [6], [9], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [2] | * For search space set (SS) group switching related features (10-9, 10-9b, 10-9c, 10-9d), it is beneficial for power saving purpose in licensed band, i.e. one SS with sparse PDCCH monitoring in power saving mode and switch to another SS with frequent PDCCH monitoring when traffic arrives.   **Proposal 1: SS group switching related features (10-9, 10-9b, 10-9c, 10-9d) and SRS starting position at any OFDM symbol in a slot (10-11) could be extended to licensed use and adopt “Per UE” type.** |
| [3] | * TypeB PDSCH length & SRS starting position: including FG 10-8 and FG 10-11 * CORESET/SS: including FG 10-9/9b/9c, 10-20/20a. * HARQ enhancements: including FG 10-14 ~ 10-17.   In general, the above enhancements on PDSCH, SRS, CORESET/SS, and HARQ could be beneficial to licensed spectrum in terms of enhanced flexibility and reliability. On the other hand, it may introduce implementation complexity for NR UEs. Probably they can be considered as optional features to be applied to NR licensed spectrum.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.*** * ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.**  For FG10-9, we suggest to change from “Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring” to “Search space set group switching without DCI 2\_0 monitoring.”  **Proposal 5: For FG10-9, change from “Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring” to “Search space set group switching without DCI 2\_0 monitoring.”** |
| [5] | In our view, this feature is useful for UE power saving, regardless of the operating band. Hence this feature should be per UE. Please note that we previously commented that 10-9c should be FFS Per UE or Per Band to be consistent with 10-9,-9b,-9d.  Proposal 5 FGs 10-9/9b/9c/9d should be per UE. |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant***   ***10-28 Configured grant enhanced resource configuration*** |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**  *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later. |
| [12] | * For 10-9c, consider this is CA related, may need to consider this is “per band” or “per BC” * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-9 | Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Monitor DCI 2\_0 with a search space set switching field  3. Support switching the search space set group with PDCCH decoding in group 1  4. Support a timer to switch back to original search space set group  5. Monitor DCI 2\_0 for channel occupancy time and use the end of channel occupancy time to switch back to the original search space set group | TBD | Yes | N/A |  | per band | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups. | Optional with capability signalling | | 10. NR-unlicensed | 10-9b | Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Support switching the search space set group with PDCCH decoding in group 1  3. Support a timer to switch back to original search space set group | TBD | Yes | N/A |  | per band | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups. | Optional with capability signalling | | 10. NR-unlicensed | 10-9c | Joint search space group switching across multiple cells | Configured with a group of cells and switch search space set group jointly over these cells | one of {10-9, 10-9b} | Yes | N/A |  | per BC | N/A | N/A | N/A | Without this capability, the UE will switch search space set groups for different cells independently | Optional with capability signalling | | 10. NR-unlicensed | 10-9d | Support Search space set group switching capability 2 | Search space set group switching Capability-2: P=10/12/22 symbols for µ = 0/1/2 SCS | one of {10-9, 10-9b} | Yes | N/A |  | per band | N/A | N/A | N/A | Without this capability, the UE supports search space set group switching capability-1: P=25/25/25 symbols for µ=0/1/2 | Optional with capability signalling | |

Based on above, following FL proposals are made.

### **FL proposal 14:**

* **Modify FG name of FG10-9 to “Search space set group switching with DCI 2\_0 monitoring”**
* **Type of FG10-9/9b/9c/9d is “Per band”**
* **FG10-9/9b/9c/9d are only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-9/9b**

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| 10. NR-unlicensed | 10-9 | Search space set group switching with DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Monitor DCI 2\_0 with a search space set switching field  3. Support switching the search space set group with PDCCH decoding in group 1  4. Support a timer to switch back to original search space set group  5. Monitor DCI 2\_0 for channel occupancy time and use the end of channel occupancy time to switch back to the original search space set group |  | Yes | N/A |  | per band | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups. | Optional with capability signalling |
| 10. NR-unlicensed | 10-9b | Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Support switching the search space set group with PDCCH decoding in group 1  3. Support a timer to switch back to original search space set group |  | Yes | N/A |  | per band | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups. | Optional with capability signalling |
| 10. NR-unlicensed | 10-9c | Joint search space group switching across multiple cells | 1. Configured with a group of cells and switch search space set group jointly over these cells | one of {10-9, 10-9b} | Yes | N/A |  | per band | N/A | N/A | N/A | Without this capability, the UE will switch search space set groups for different cells independently | Optional with capability signalling |
| 10. NR-unlicensed | 10-9d | Support Search space set group switching capability 2 | 1. Search space set group switching Capability-2: P=10/12/22 symbols for µ = 0/1/2 SCS | one of {10-9, 10-9b} | Yes | N/A |  | per band | N/A | N/A | N/A | Without this capability, the UE supports search space set group switching capability-1: P=25/25/25 symbols for µ=0/1/2 | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.14 FG10-14

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-14 | Non-numerical PDSCH to HARQ-ACK timing | 1. Support configuration of a value for dl-DataToUL-ACK indicating an inapplicable time to report HARQ ACK | TBD | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A | If non-numerical K1 value is supported | Optional with capability signalling |

* **Reporting type of FG10-14**
  + **Per UE: [9]**
  + **Per band: [10], [11], [12]**
  + **Per unlicensed band: [2]**
* **Whether FG10-14 can be extended to licensed band**
  + **Support: [3], [9]**
  + **Not support: [2], [4], [6], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [2] | * For other UE features, we do not see the need of extension to licensed band since it is introduced due to LBT requirement on unlicensed band which doesn’t exist in licensed band and no benefit is   **Proposal 2: For UE features that are not agreed to be extended to licensed use, update “per band” to “per unlicensed band”.** |
| [3] | * TypeB PDSCH length & SRS starting position: including FG 10-8 and FG 10-11 * CORESET/SS: including FG 10-9/9b/9c, 10-20/20a. * HARQ enhancements: including FG 10-14 ~ 10-17.   In general, the above enhancements on PDSCH, SRS, CORESET/SS, and HARQ could be beneficial to licensed spectrum in terms of enhanced flexibility and reliability. On the other hand, it may introduce implementation complexity for NR UEs. Probably they can be considered as optional features to be applied to NR licensed spectrum.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.***   ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.** |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant***   ***10-28 Configured grant enhanced resource configuration*** |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**  *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later. |
| [12] | * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-14 | Non-numerical PDSCH to HARQ-ACK timing | Support configuration of a value for dl-DataToUL-ACK indicating an inapplicable time to report HARQ ACK | TBD | Yes | N/A |  | per band | N/A | N/A | N/A | If non-numerical K1 value is supported | Optional with capability signalling | |

Based on above, following FL proposals are made.

### **FL proposal 15:**

* **Type of FG10-14 is “Per band”**
* **FG10-14 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-14**

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| 10. NR-unlicensed | 10-14 | Non-numerical PDSCH to HARQ-ACK timing | 1. Support configuration of a value for dl-DataToUL-ACK indicating an inapplicable time to report HARQ ACK |  | Yes | N/A |  | per band | N/A | N/A | N/A | If non-numerical K1 value is supported | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.15 FG10-15

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-15 | Enhanced dynamic HARQ codebook | 1. Support of bit fields signalling PDSCH HARQ group index and NFI in DCI 1\_1 (configuration of nfi-TotalDAI-Included)  2. Support of bit field in DCI 0\_1 for other group total DAI if configured. (configuration of ul-TotalDAI-Included)  3. Support the retransmission of HARQ ACK (pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16) | TBD | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A | Enhanced dynamic HARQ codebook supporting grouping of HARQ ACK and triggering the retransmission of HARQ ACK in each groups | Optional with capability signalling |

* **Reporting type of FG10-15**
  + **Per UE: [9]**
  + **Per band: [10], [11], [12]**
  + **Per unlicensed band: [2]**
* **Whether FG10-15 can be extended to licensed band**
  + **Support: [3], [9]**
  + **Not support: [2], [4], [6], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [2] | * For other UE features, we do not see the need of extension to licensed band since it is introduced due to LBT requirement on unlicensed band which doesn’t exist in licensed band and no benefit is   **Proposal 2: For UE features that are not agreed to be extended to licensed use, update “per band” to “per unlicensed band”.** |
| [3] | * TypeB PDSCH length & SRS starting position: including FG 10-8 and FG 10-11 * CORESET/SS: including FG 10-9/9b/9c, 10-20/20a. * HARQ enhancements: including FG 10-14 ~ 10-17.   In general, the above enhancements on PDSCH, SRS, CORESET/SS, and HARQ could be beneficial to licensed spectrum in terms of enhanced flexibility and reliability. On the other hand, it may introduce implementation complexity for NR UEs. Probably they can be considered as optional features to be applied to NR licensed spectrum.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.***   ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.** |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant***   ***10-28 Configured grant enhanced resource configuration*** |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**  *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later. |
| [12] | * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-15 | Enhanced dynamic HARQ codebook | 1. Support of bit fields signalling PDSCH HARQ group index and NFI in DCI 1\_1 (configuration of nfi-TotalDAI-Included)  2. Support of bit field in DCI 0\_1 for other group total DAI if configured. (configuration of ul-TotalDAI-Included)  3. Support the retransmission of HARQ ACK (pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16) | TBD | Yes | N/A |  | per band | N/A | N/A | N/A | Enhanced dynamic HARQ codebook supporting grouping of HARQ ACK and triggering the retransmission of HARQ ACK in each groups | Optional with capability signalling | |

Based on above, following FL proposals are made.

### **FL proposal 16:**

* **Type of FG10-15 is “Per band”**
* **FG10-15 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-15**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10. NR-unlicensed | 10-15 | Enhanced dynamic HARQ codebook | 1. Support of bit fields signalling PDSCH HARQ group index and NFI in DCI 1\_1 (configuration of nfi-TotalDAI-Included)  2. Support of bit field in DCI 0\_1 for other group total DAI if configured. (configuration of ul-TotalDAI-Included)  3. Support the retransmission of HARQ ACK (pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16) |  | Yes | N/A |  | per band | N/A | N/A | N/A | Enhanced dynamic HARQ codebook supporting grouping of HARQ ACK and triggering the retransmission of HARQ ACK in each groups | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.16 FG10-16

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-16 | One-shot HARQ ACK feedback | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 scheduling a PDSCH 2. Support feedback of type 3 HARQ-ACK codebook , triggered by a DCI 1\_1 without scheduling a PDSCH using a reserved FDRA value | TBD | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A | Upon triggering, UE reports A/N for all HARQ processes and all CCs in a PUCCH group. | Optional with capability signalling |

* **Reporting type of FG10-16**
  + **Per UE: [5]**
  + **Per band: [10], [11], [12]**
  + **Per unlicensed band: [2]**
* **Whether FG10-16 can be extended to licensed band**
  + **Support: [3]**
  + **Not support: [2], [4], [6], [9], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [2] | * For other UE features, we do not see the need of extension to licensed band since it is introduced due to LBT requirement on unlicensed band which doesn’t exist in licensed band and no benefit is   **Proposal 2: For UE features that are not agreed to be extended to licensed use, update “per band” to “per unlicensed band”.** |
| [3] | * TypeB PDSCH length & SRS starting position: including FG 10-8 and FG 10-11 * CORESET/SS: including FG 10-9/9b/9c, 10-20/20a. * HARQ enhancements: including FG 10-14 ~ 10-17.   In general, the above enhancements on PDSCH, SRS, CORESET/SS, and HARQ could be beneficial to licensed spectrum in terms of enhanced flexibility and reliability. On the other hand, it may introduce implementation complexity for NR UEs. Probably they can be considered as optional features to be applied to NR licensed spectrum.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.***   ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.** |
| [5] | Proposal 8 FG 10-16 should be per UE |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant***   ***10-28 Configured grant enhanced resource configuration*** |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**  *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later. |
| [12] | * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-16 | One-shot HARQ ACK feedback | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 scheduling a PDSCH   Support feedback of type 3 HARQ-ACK codebook , triggered by a DCI 1\_1 without scheduling a PDSCH using a reserved FDRA value | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Upon triggering, UE reports A/N for all HARQ processes and all CCs in a PUCCH group. | Optional with capability signalling | |

Based on above, following FL proposals are made.

### **FL proposal 17:**

* **Type of FG10-16 is “Per band”**
* **FG10-16 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-16**

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| 10. NR-unlicensed | 10-16 | One-shot HARQ ACK feedback | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 scheduling a PDSCH 2. Support feedback of type 3 HARQ-ACK codebook , triggered by a DCI 1\_1 without scheduling a PDSCH using a reserved FDRA value |  | Yes | N/A |  | Per band | N/A | N/A | N/A | Upon triggering, UE reports A/N for all HARQ processes and all CCs in a PUCCH group. | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.17 FG10-17

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-17 | Multi-PUSCH UL grant | 1. Support of scheduling up to 8 PUSCH with a single DCI 0\_1 | TBD | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A |  | Optional with capability signalling |

* **Reporting type of FG10-17**
  + **Per UE: [5], [9]**
  + **Per band: [10], [11], [12]**
  + **Per unlicensed band: [2]**
* **Whether FG10-17 can be extended to licensed band**
  + **Support: [3], [5], [9]**
  + **Not support: [2], [4], [6], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [2] | * For other UE features, we do not see the need of extension to licensed band since it is introduced due to LBT requirement on unlicensed band which doesn’t exist in licensed band and no benefit is   **Proposal 2: For UE features that are not agreed to be extended to licensed use, update “per band” to “per unlicensed band”.** |
| [3] | * TypeB PDSCH length & SRS starting position: including FG 10-8 and FG 10-11 * CORESET/SS: including FG 10-9/9b/9c, 10-20/20a. * HARQ enhancements: including FG 10-14 ~ 10-17.   In general, the above enhancements on PDSCH, SRS, CORESET/SS, and HARQ could be beneficial to licensed spectrum in terms of enhanced flexibility and reliability. On the other hand, it may introduce implementation complexity for NR UEs. Probably they can be considered as optional features to be applied to NR licensed spectrum.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.*** * ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.** |
| [5] | Multi-PUSCH UL grants should be per UE instead of per band. Firstly, the functionality will be very useful in any band where PDCCH capacity can be constrained. Secondly, it is functionality that once implemented is fundamentally not related to the band of operation.  Proposal 9 FG 10-17 should be per UE |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant***   ***10-28 Configured grant enhanced resource configuration*** |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**  *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later. |
| [12] | * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-17 | Multi-PUSCH UL grant | 1. Support of scheduling up to 8 PUSCH with a single DCI 0\_1 | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling | |

Based on above, following FL proposals are made.

### **FL proposal 18:**

* **Type of FG10-17 is “Per band”**
* **FG10-17 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-17**

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| 10. NR-unlicensed | 10-17 | Multi-PUSCH UL grant | 1. Support of scheduling up to 8 PUSCH with a single DCI 0\_1 |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.18 FG10-26/26a

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-26 | CSI-RS based RLM for NR-U | [CSI-RS based RLM for NR-U] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 10. NR-unlicensed | 10-26a | CSI-RS based RRM for NR-U | [CSI-RS based RRM for NR-U] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

* **No remaining issues or proposals are identified for FG10-26/26a**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [11] | * FG 10-26: CSI-RS based RLM for NR-U   1. As this FG is related to the discussion on the validation of periodic CSI-RS, which wasn’t agreed in the last RAN1 meeting, it would be better to discuss the definition of this FG after the agreement on the validation of periodic CSI-RS is made in NR-U agenda. * FG 10-26a: CSI-RS based RRM for NR-U   1. As this FG is related to the discussion on the validation of periodic CSI-RS, which wasn’t agreed in the last RAN1 meeting, it would be better to discuss the definition of this FG after the agreement on the validation of periodic CSI-RS is made in NR-U agenda. |

Based on above, following FL proposals are made.

### **FL proposal 19:**

* **Remove brackets from components of 10-26/26a**
* **“TBD” is removed from prerequisite feature groups for FG10-26/26a**

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| 10. NR-unlicensed | 10-26 | CSI-RS based RLM for NR-U | CSI-RS based RLM for NR-U |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 10. NR-unlicensed | 10-26a | CSI-RS based RRM for NR-U | CSI-RS based RRM for NR-U |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.19 FG10-3/3a

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-3 | PRB interlace mapping for PUSCH | 1. PRB interlace frequency domain resource allocation for PUSCH | TBD  One of {10-1, 10-1a} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support of PRB interlace PUSCH | Optional with capability signalling |
| 10. NR-unlicensed | 10-3a | PRB interlace mapping for PUCCH | 1. PRB interlace frequency domain resource allocation for PUCCH format 0 and format 1 2. PRB interlace frequency domain resource allocation for PUCCH format 2 3. PRB interlace frequency domain resource allocation for PUCCH format 3 | TBD  One of {10-1, 10-1a} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support of PRB interlace PUCCH format 0/1 | Optional with capability signalling |

* **No remaining issues or proposals are identified for FG10-3/3a**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [3] | * Interlaced mapping including FG 10-3/3a.   The interlaced mapping is proposed to simplify the signalling of the FDRA of interlace in order to satisfy the OCB requirement from ESTI. There is no such OCB requirement for NR licensed spectrum, so we do not think there is a need to extend the application range for this feature.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.*** * ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |

Based on above, following FL proposals are made.

### **FL proposal 20:**

* **“TBD” is removed from prerequisite feature groups for FG10-3/3a**

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| 10. NR-unlicensed | 10-3 | PRB interlace mapping for PUSCH | 1. PRB interlace frequency domain resource allocation for PUSCH | One of {10-1, 10-1a} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support of PRB interlace PUSCH | Optional with capability signalling |
| 10. NR-unlicensed | 10-3a | PRB interlace mapping for PUCCH | 1. PRB interlace frequency domain resource allocation for PUCCH format 0 and format 1 2. PRB interlace frequency domain resource allocation for PUCCH format 2 3. PRB interlace frequency domain resource allocation for PUCCH format 3 | One of {10-1, 10-1a} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support of PRB interlace PUCCH format 0/1 | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.20 FG10-12

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-12 | OCC for PRB interlace mapping for PF2 and PF3 | 1. OCC2  2. OCC4 | 10-3a | Yes | N/A |  | Per band | N/A | N/A | N/A | UE OCC capability for EPF2/EFP3 | Optional with capability signalling |

* **No remaining issues or proposals are identified for FG10-12**

## 2.21 FG10-13a

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-13a | Extended CP range of more than one symbol for CG-PUSCH | 1. UE supports generating a CP extension of length longer than 1 symbol for Configured Grant PUSCH transmission | TBD  One of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | How long a UE can generate the CP extension beyond 1 symbol for CG-PUSCH | Optional with capability signalling |

* **No remaining issues or proposals are identified for FG10-13a**

Based on above, following FL proposals are made.

### **FL proposal 21:**

* **“TBD” is removed from prerequisite feature groups for FG10-13a**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10. NR-unlicensed | 10-13a | Extended CP range of more than one symbol for CG-PUSCH | 1. UE supports generating a CP extension of length longer than 1 symbol for Configured Grant PUSCH transmission | One of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | How long a UE can generate the CP extension beyond 1 symbol for CG-PUSCH | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.22 FG10-18

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-18 | Configured grant with retransmission in CG resources | 1. Support retransmission in CG resources  2. Support configured grant retransmission timer  3. Support DFI monitoring  4. Support CG-UCI in CG-PUSCH | TBD  One of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support configured grant with retransmission in configured grant resource | Optional with capability signalling |

* **No remaining issues or proposals are identified for FG10-18**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [3] | * CG enhancement: FG 10-18, 10-24, and 10-28.   The enhancement on the configured grant, for example the CG-UCI and retransmission on CG resources have been discussed in Rel-15, but not agreed at that moment. And then in Rel-16 URLLC WI, the configured grant has been enhanced with different approaches. If the enhancements in NR-U are applied to licensed spectrum, there will be two ways to do configured grant which are not compatible. It is not clear on the configurations and UE behavior for the operation of configured grant. So we think the CG enhancement shall not be applied to licensed spectrum at least in Rel-16. We can further discuss how to optimize the URLLC for NR-U in Rel-17.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.*** * ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |

Based on above, following FL proposals are made.

### **FL proposal 22:**

* **“TBD” is removed from prerequisite feature groups for FG10-18**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10. NR-unlicensed | 10-18 | Configured grant with retransmission in CG resources | 1. Support retransmission in CG resources  2. Support configured grant retransmission timer  3. Support DFI monitoring  4. Support CG-UCI in CG-PUSCH | One of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support configured grant with retransmission in configured grant resource | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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| Company | Comment |
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## 2.23 FG10-21a

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-21a | Support using ED threshold given by gNB for UL to DL COT sharing | 1. Use ULtoDL-CO-SharingED-Threshold-r16 for cat 4 LBT for scheduled UL to share COT with gNB for DL  2. Use ULtoDL-CO-SharingED-Threshold-r16 for cat 4 LBT for CG-PUSCH to share COT with gNB for DL  3. Indicate in CG-UCI the COT sharing information | TBD  10-1 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

* **Components of FG10-21a**
  + **Modify the “cat4” in FG 10-21a to “Type 1” to align with TS 37.213 specification: [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| [8] | **UL to DL COT sharing**  **FG10-21a, FG10-21b** should be kept as is, in last RAN1 meeting there was an agreement that if a UE is provided with ULtoDL-CO-SharingED-Threshold-r16 the UE can select if the UE uses the configured ED threshold or not. If the UE chooses to not use this threshold, the UE shall not share the COT with the gNB.   |  | | --- | | Agreement:  For at least PUSCH transmissions with configured grants, a UE is allowed to choose between the ED threshold given by ul-toDL-CO-SharingED-Threshold-r16 and the default one. Whether a spec change is required needs further discussion. Discuss and decide the possible TPs in the next meeting. |   In this case, FG10-21b is necessary, because if the UE only supports the COT sharing without ULtoDL-CO-SharingED-Threshold-r16, it must be informed to the gNB, otherwise, the gNB might configure ULtoDL-CO-SharingED-Threshold-r16, but the UE does not implement this threshold so that the UE cannot share the COT.  Keeping FG10-21b, it allows the UE to continue sharing its COT without using ULtoDL-CO-SharingED-Threshold-r16.   |  |  |  | | --- | --- | --- | | 10-21a | Support using ED threshold for UL to DL COT sharing | 1. Use ULtoDL-CO-SharingED-Threshold-r16 for cat 4 LBT for scheduled UL to share COT with gNB for DL  2. Use ULtoDL-CO-SharingED-Threshold-r16 for cat 4 LBT for CG-PUSCH to share COT with gNB for DL  3. Indicate in CG-UCI the COT sharing information as configured in cg-COT-Sharing-r16 | | 10-21b | Support UL to DL COT sharing | 1. Support cat 4 LBT for scheduled UL to share COT with gNB for DL without ULtoDL-CO-SharingED-Threshold-r16  2. Support cat 4 LBT for CG-PUSCH to share COT with gNB for DL without ULtoDL-CO-SharingED-Threshold-r16  3. Indicate in CG-UCI the COT sharing information |   ***Proposal 1: keeping FG10-21a and FG10-21b separately to allow UE COT sharing without using ULtoDL-CO-SharingED-Threshold-r16.*** |
| [10] | ***Proposal 4:***   * *Adding the FG 4-5 as prerequisite feature groups for FG 10-23.* * *Modify the “cat4” in FG 10-21a to “Type 1” to align with TS 37.213 specification.* |
| [11] | * FG 10-21a: Support using ED threshold given by gNB for UL to DL COT sharing   1. In addition to this FG, 10-21b which was discussed in the last RAN1 meeting can be added as follows:  |  |  |  | | --- | --- | --- | | 10-21b | Support UL to DL COT sharing | 1. Support cat 4 LBT for CG-PUSCH to share COT with gNB for DL without ULtoDL-CO-SharingED-Threshold-r16  2. Indicate in CG-UCI the COT sharing information | |

Based on above, following FL proposals are made.

### **FL proposal 23:**

* **Modify the “cat4” in FG 10-21a to “Type 1”**
* **“TBD” is removed from prerequisite feature groups for FG10-21a**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10. NR-unlicensed | 10-21a | Support using ED threshold given by gNB for UL to DL COT sharing | 1. Use ULtoDL-CO-SharingED-Threshold-r16 for Type 1 LBT for scheduled UL to share COT with gNB for DL  2. Use ULtoDL-CO-SharingED-Threshold-r16 for Type 1 LBT for CG-PUSCH to share COT with gNB for DL  3. Indicate in CG-UCI the COT sharing information | 10-1 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

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## 2.24 FG10-24

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-24 | CG-UCI multiplexing with HARQ ACK | 1. Support multiplexing CG-UCI with HARQ ACK | 10-18 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |

* **No remaining issues or proposals are identified for FG10-24**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [3] | * CG enhancement: FG 10-18, 10-24, and 10-28.   The enhancement on the configured grant, for example the CG-UCI and retransmission on CG resources have been discussed in Rel-15, but not agreed at that moment. And then in Rel-16 URLLC WI, the configured grant has been enhanced with different approaches. If the enhancements in NR-U are applied to licensed spectrum, there will be two ways to do configured grant which are not compatible. It is not clear on the configurations and UE behavior for the operation of configured grant. So we think the CG enhancement shall not be applied to licensed spectrum at least in Rel-16. We can further discuss how to optimize the URLLC for NR-U in Rel-17.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.***   ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |

## 2.25 FG10-28

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-28 | Configured grant with Rel-16 enhanced resource configuration | 1. Support configuration of resources with cg-nrofSlots-r16 and cg-nrofPUSCH-InSlot-r16, | TBD  One of {5-19, 5-20} | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A |  | Optional with capability signalling |

* **Reporting type of FG10-28**
  + **Per UE: [9]**
  + **Per band: [10], [11], [12]**
* **Whether FG10-28 can be extended to licensed band**
  + **Support: [3], [5], [9]**
  + **Not support: [3], [4], [6], [10]**

Above remaining issues and proposals are identified based on following feedbacks provided in contributions for the RAN1#101-e meeting.

|  |  |
| --- | --- |
| [3] | * CG enhancement: FG 10-18, 10-24, and 10-28.   The enhancement on the configured grant, for example the CG-UCI and retransmission on CG resources have been discussed in Rel-15, but not agreed at that moment. And then in Rel-16 URLLC WI, the configured grant has been enhanced with different approaches. If the enhancements in NR-U are applied to licensed spectrum, there will be two ways to do configured grant which are not compatible. It is not clear on the configurations and UE behavior for the operation of configured grant. So we think the CG enhancement shall not be applied to licensed spectrum at least in Rel-16. We can further discuss how to optimize the URLLC for NR-U in Rel-17.  ***Proposal 2:***   * ***The interlace structure and enhancement on configured grant shall not be applied to NR licensed spectrum.***   ***Enhancements on TypeB PDSCH length, SRS starting position, HARQ and CORESET/SS can be considered to be applied to NR licensed spectrum as optional features.*** |
| [4] | During the previous email discussion, a question was raised about the extension of NR-U features to licensed operation. In principle, we do not think NR-U features should be applied for licensed operation unless the use cases and benefits are well justified. The reason is that NR-U features are introduced to mitigate the impact of LBT and/or to meet regional regulations such as OCB or PSD. In contrast, these regulations are not required for licensed spectrum access. We hence do not see the need to apply NR-U features to licensed operation.  **Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified.** |
| [6] | NR-U functions have been introduced to handle inherit problem of unlicensed band such as LBT failure and regulation. Hence, in our view, except FG-8 and FG-11 which are general function for licensed band, applicability of NR-U feature groups should be restricted to unlicensed band. If some of NR-U feature groups are identified to be beneficial for licensed band operation, we will be able to make an agreement for each.  **Proposal 3: UE features for NR-U should be used only for unlicensed band.** |
| [9] | |  |  |  | | --- | --- | --- | | **Functionality** | **FGs** | **Need for licensed band operation** | | Type B PDSCH length | **10-8** Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | Per UE  The additional scheduling flexibility could be exploited by the network. | | Search space set group switching | **10-9** Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring  **10-9b** Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring  **10-9c** Joint search space group switching across multiple cells  **10-9d** Support Search space set group switching capability 2 | 10-9/9b/9d: per band  10-9c: per BC  It is unclear what benefit could be obtained for operation on a licensed carrier since the monitoring periodicity of PDCCH search spaces would generally not need to change frequently nor depend on implicit rules. | | RSSI and channel occupancy measurement and reporting | **10-10** RSSI and channel occupancy measurement and reporting | Per band  Unclear what additional information those measurements could bring in case of licensed band operation. | | SRS starting position at any OFDM symbol in a slot | **10-11** SRS starting position at any OFDM symbol in a slot | Per UE  It is well-known that SRS capacity is always an issue even in licensed bands. | | HARQ enhancements | **10-14** Non-numerical PDSCH to HARQ-ACK timing  **10-15** Enhanced dynamic HARQ codebook  **10-16** One-shot HARQ ACK feedback | 10-14 & 10-15: per UE  10-16: per band  It is unclear why many instances of HARQ feedback from a UE would fail simultaneously in licensed operation, requiring that all the HARQ processes are reported by a UE in one-shot | | Multi-PUSCH UL grant | **10-17** Multi-PUSCH UL grant | Per UE  This feature is beneficial for reducing control overhead on licensed bands. To avoid additional complexity, we suggest no further optimization for this feature in Rel-16, so it should be limited to time-consecutive PUSCHs even on licensed bands. | | Configured grant enhanced resource configuration | **10-28** Configured grant with Rel-16 enhanced resource configuration | Per UE |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-8 Type B PDSCH length*** * ***10-11 SRS starting position at any OFDM symbol in a slot*** * ***10-14 and 10-15 HARQ enhancements*** * ***10-17 Multi-PUSCH UL grant***   ***10-28 Configured grant enhanced resource configuration*** |
| [10] | In general, our view is that the features developed under NR-U WI should be limited to unlicensed operation by default and exceptions should be discussed case by case with strong justifications. This is important to avoid unnecessary complications/impacts on the operation of licensed band operation. To be more specific, in our view the features listed with “FFS: Per band or Per UE” should be put “per band” to provide the flexibility in implementation and IOT testing  **Proposal 1:**  *The features listed with “FFS: Per band or Per UE” should be put “per band”* |
| [11] | We think the type of all FGs in NR-U should be “per band” and whether a FG can be applied to licensed band as well can be discussed later. |
| [12] | * For all the features listed as “FFS:Per band or Per UE”, to allow the most flexibility in implementation and IOT testing, we would like to make them “per band”  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10. NR-unlicensed | 10-28 | Configured grant with Rel-16 enhanced resource configuration | 1. Support configuration of resources with cg-nrofSlots-r16 and cg-nrofPUSCH-InSlot-r16, | TBD  One of {5-19, 5-20} | Yes | N/A |  | per band | N/A | N/A | N/A |  | Optional with capability signalling | |

Based on above, following FL proposals are made.

### **FL proposal 24:**

* **Type of FG10-28 is “Per band”**
* **FG10-28 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-28**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 10. NR-unlicensed | 10-28 | Configured grant with Rel-16 enhanced resource configuration | 1. Support configuration of resources with cg-nrofSlots-r16 and cg-nrofPUSCH-InSlot-r16, | One of {5-19, 5-20} | Yes | N/A |  | per band | N/A | N/A | N/A |  | Optional with capability signalling |

Companies are encouraged to check above FL proposals and to provide feedback if any in below. If you cannot accept the FL proposals, please put your company name after “Cannot accept the proposals” below and please provide your alternative proposal (in your comment) which could be acceptable to all in your consideration.

Cannot accept the proposals:

|  |  |
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| Company | Comment |
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1. Conclusion

**FL proposal 1:**

* **Add “and contention window size adjustment” to component 1 of FG10-1**

**FL proposal 2:**

* **Add “CP extension up to 1 symbol for PUSCH/PUCCH transmission” as component 4 of FG10-1a**
* **“TBD” is removed from prerequisite feature groups for FG10-1a**

**FL proposal 3:**

* **Modify the component of FG 10-2b from “MIB reading on unlicensed cell” to “MIB reading on unlicensed cell for PCell and PSCell”**
* **Modify the component of FG 10-2e from “SIB1 reception on unlicensed cell” to “SIB1 reception on unlicensed cell for PCell”**
* **“TBD” is removed from prerequisite feature groups for FG10-2b/2e**

**FL proposal 4:**

* **Modify the component of FG 10-2f to “Support of RAR extension from 10ms to 40ms by decoding of the 2-bit SFN indication in DCI 1\_0”**
* **“TBD” is removed from prerequisite feature groups for FG10-2f**

**FL proposal 5:**

* **Type of FG10-10 is “Per band”**
* **“TBD” is removed from prerequisite feature groups for FG10-10**
* **FG10-10 is only for unlicensed bands**

**FL proposal 6:**

* **Type of FG10-11 is “Per UE”**
  + **Need of xDD/FRx differentiations are “No”**
* **“TBD” is removed from prerequisite feature groups for FG10-11**
* **Add a note “This FG is also applicable to licensed bands”**

**FL proposal 7:**

* **Modify component 1 of FG10-20 to “Maximum number of frequency domain locations for a search space set configuration with freqMonitorLocations-r16”**
* **“TBD” is removed from prerequisite feature groups for FG10-20/20a**
* **FG10-20/20a are only for unlicensed bands**

**FL proposal 8:**

* **Remove “[based on off-sync raster SSB]” from FG name**
* **Remove “[with an off-sync raster SSB]” from Note**
* **Prerequisite feature groups for FG10-23 is “4-5”**

**FL proposal 9:**

* **Change from “DCI 2\_0” to “SFI” in FG name and Components of FG10-25**
* **“TBD” is removed from prerequisite feature groups for FG10-25**

**FL proposal 10:**

* **“TBD” is removed from prerequisite feature groups for FG10-27**

**FL proposal 11:**

* **“TBD” is removed from prerequisite feature groups for FG10-29**

**FL proposal 12:**

* **“TBD” is removed from prerequisite feature groups for FG10-30**

**FL proposal 13:**

* **Remove bracket from “[9, 10,]” in FG name and Components of FG10-8**
* **Type of FG10-8 is “Per band”**
* **Add a note “This FG is also applicable to licensed bands”**

**FL proposal 14:**

* **Modify FG name of FG10-9 to “Search space set group switching with DCI 2\_0 monitoring”**
* **Type of FG10-9/9b/9c/9d is “Per band”**
* **FG10-9/9b/9c/9d are only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-9/9b**

**FL proposal 15:**

* **Type of FG10-14 is “Per band”**
* **FG10-14 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-14**

**FL proposal 16:**

* **Type of FG10-15 is “Per band”**
* **FG10-15 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-15**

**FL proposal 17:**

* **Type of FG10-16 is “Per band”**
* **FG10-16 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-16**

**FL proposal 18:**

* **Type of FG10-17 is “Per band”**
* **FG10-17 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-17**

**FL proposal 19:**

* **Remove brackets from components of 10-26/26a**
* **“TBD” is removed from prerequisite feature groups for FG10-26/26a**

**FL proposal 20:**

* **“TBD” is removed from prerequisite feature groups for FG10-3/3a**

**FL proposal 21:**

* **“TBD” is removed from prerequisite feature groups for FG10-13a**

**FL proposal 22:**

* **“TBD” is removed from prerequisite feature groups for FG10-18**

**FL proposal 23:**

* **Modify the “cat4” in FG 10-21a to “Type 1”**
* **“TBD” is removed from prerequisite feature groups for FG10-21a**

**FL proposal 24:**

* **Type of FG10-28 is “Per band”**
* **FG10-28 is only for unlicensed bands**
* **“TBD” is removed from prerequisite feature groups for FG10-28**

Reference

[1] R1-2003198 Summary on email discussion [100b-e-NR-UEFeatures-Remaining] NR-unlicensed Moderator (NTT DOCOMO, INC.)

[2] R1-2003416 Discussion on UE features for NRU vivo

[3] R1-2003460 Discussion on the remaining issues of the UE features for NR-U ZTE, Sanechips

[4] R1-2003694 Views on Rel-16 UE features for NR-U MediaTek Inc.

[5] R1-2003848 UE features for NR-U Ericsson

[6] R1-2003894 UE features for NR-U Samsung

[7] R1-2004019 Discussion on UE features for NR-U LG Electronics

[8] R1-2004091 Discussion on UE feature for NRU OPPO

[9] R1-2004152 Rel-16 UE features for NR-U Huawei, HiSilicon

[10] R1-2004241 Discussions on NR-U UE features Apple

[11] R1-2004402 UE features for NR-U NTT DOCOMO, INC

[12] R1-2004477 Discussion on NR-U UE features Qualcomm Incorporated

[13] R1-2004560 On UE features NR Unlicensed Nokia, Nokia Shanghai Bell

[14] R1-2004062 Discussion on the support of SRS transmission in all symbols of a slot OPPO

Appendix: latest version of UE features list for NR-U [1]

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | **Consequence if the feature is not supported by the UE** | **Type**  **( 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 10. NR-unlicensed | 10-1 | UL channel access for dynamic channel access mode | 1. Type 1 channel access  2. Type 2A channel access  3. Type 2B channel access  4. Type 2C channel access  5. 20MHz LBT bandwidth  6. CP extension up to 1 symbol for PUSCH/PUCCH transmission |  | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-1a | UL channel access for semi-static channel access mode | 1. Type 2C channel access  2. Single sensing slot of 9us channel access  3. 20MHz LBT bandwidth | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2 | SSB-based RRM [for dynamic channel access mode] | 1. SSB-based RRM with Q [for dynamic channel access mode] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2a | SSB-based RRM [for semi-static channel access mode] | 1. SSB-based RRM with Q [for semi-static channel access mode] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2b | MIB reading on unlicensed cell | 1. MIB reading on unlicensed cell | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2c | SSB-based RLM [for dynamic channel access mode] | 1. SSB-based RLM with Q [for dynamic channel access mode] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2d | SSB-based RLM [for semi-static channel access mode] | 1. SSB-based RLM with Q [for semi-static channel access mode] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Q indicates the value of RAN1 parameter | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2e | SIB1 reception on unlicensed cell | 1. SIB1 reception on unlicensed cell | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-2f | Support monitoring of extended RAR window | 1. Support of RAR extension from 10ms to [40ms] by decoding of the 2-bit SFN indication in DCI 1\_0 | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-7 | UL channel access for 10 MHz SCell | 1. 10 MHz LBT bandwidth | one of {10-1, 10-1a} | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-10 | RSSI and channel occupancy measurement and reporting | 1. RSSI measurement 2. Channel occupancy reporting | TBD | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-11 | SRS starting position at any OFDM symbol in a slot | 1. Support transmitting SRS starting in all symbols (0,…,13) of a slot | TBD | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-20 | Support search space set configuration with freqMonitorLocation-r16 | 1. Support search space set configuration with freqMonitorLocations-r16 | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-20a | Support coreset configuration with rb-Offset | 1. Support coreset configuration with rb-Offset | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-23 | CGI reading on unlicensed cell [based on off-sync raster SSB] for ANR functionality | 1. Support acquisition of relevant information from a neighbouring NR unlicensed cell in an unlicensed carrier by reading the RMSI of the neighbouring unlicensed cell and reporting the acquired information to the network | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A | Support reading RMSI from an unlicensed cell [with an off-sync raster SSB] for ANR | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-25 | Enable configured UL transmissions when DCI 2\_0 is configured but not detected | 1. Support configuration of enableConfiguredUL-r16 and enable transmission of higher-layer configured UL \*SRS, PUCCH, CG-PUSCH etc) when DCI 2\_0 is configured but not detected | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-27 | Wideband PRACH | 1. Enhanced PRACH design for NR-U by adopting a single long ZC sequence, with ZC sequence = 1151 for 15kHz and ZC sequence = 571 for 30kHz | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-29 | Support available RB set indicator field in DCI 2\_0 | 1. Support monitoring DCI 2\_0 to read availableRB-Sets-r16 | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-30 | Support channel occupancy duration indicator field in DCI 2\_0 | 1. Support monitoring DCI 2\_0 to read COT duration | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |
| 10. NR-unlicensed | 10-8 | Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | 1. Type B PDSCH length {3, 5, 6, 8, [9, 10,] 11, 12, 13} without DMRS shift due to CRS collision | 5-6a | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A | Note length 9/10 with DMRS shift due to CRS collision are already covered by 14-3 | Optional with capability signalling |
| 10. NR-unlicensed | 10-9 | Search space set group switching with explicit DCI 2\_0 bit field trigger or with implicit PDCCH decoding with DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Monitor DCI 2\_0 with a search space set switching field  3. Support switching the search space set group with PDCCH decoding in group 1  4. Support a timer to switch back to original search space set group  5. Monitor DCI 2\_0 for channel occupancy time and use the end of channel occupancy time to switch back to the original search space set group | TBD | Yes | N/A |  | FFS: Per UE or per band or per BC | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups. | Optional with capability signalling |
| 10. NR-unlicensed | 10-9b | Search space set group switching with implicit PDCCH decoding without DCI 2\_0 monitoring | 1. Two groups of search space sets  2. Support switching the search space set group with PDCCH decoding in group 1  3. Support a timer to switch back to original search space set group | TBD | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A | Being configured with two groups of search spaces, and switch between them. Some search space sets can be configured in both groups. | Optional with capability signalling |
| 10. NR-unlicensed | 10-9c | Joint search space group switching across multiple cells | 1. Configured with a group of cells and switch search space set group jointly over these cells | one of {10-9, 10-9b} | Yes | N/A |  | FFS: Per UE or per band or per BC | N/A | N/A | N/A | Without this capability, the UE will switch search space set groups for different cells independently | Optional with capability signalling |
| 10. NR-unlicensed | 10-9d | Support Search space set group switching capability 2 | 1. Search space set group switching Capability-2: P=10/12/22 symbols for µ = 0/1/2 SCS | one of {10-9, 10-9b} | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A | Without this capability, the UE supports search space set group switching capability-1: P=25/25/25 symbols for µ=0/1/2 | Optional with capability signalling |
| 10. NR-unlicensed | 10-14 | Non-numerical PDSCH to HARQ-ACK timing | 1. Support configuration of a value for dl-DataToUL-ACK indicating an inapplicable time to report HARQ ACK | TBD | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A | If non-numerical K1 value is supported | Optional with capability signalling |
| 10. NR-unlicensed | 10-15 | Enhanced dynamic HARQ codebook | 1. Support of bit fields signalling PDSCH HARQ group index and NFI in DCI 1\_1 (configuration of nfi-TotalDAI-Included)  2. Support of bit field in DCI 0\_1 for other group total DAI if configured. (configuration of ul-TotalDAI-Included)  3. Support the retransmission of HARQ ACK (pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16) | TBD | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A | Enhanced dynamic HARQ codebook supporting grouping of HARQ ACK and triggering the retransmission of HARQ ACK in each groups | Optional with capability signalling |
| 10. NR-unlicensed | 10-16 | One-shot HARQ ACK feedback | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 scheduling a PDSCH 2. Support feedback of type 3 HARQ-ACK codebook , triggered by a DCI 1\_1 without scheduling a PDSCH using a reserved FDRA value | TBD | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A | Upon triggering, UE reports A/N for all HARQ processes and all CCs in a PUCCH group. | Optional with capability signalling |
| 10. NR-unlicensed | 10-17 | Multi-PUSCH UL grant | 1. Support of scheduling up to 8 PUSCH with a single DCI 0\_1 | TBD | Yes | N/A |  | FFS: Per band or Per UE | N/A | N/A | N/A |  | Optional with capability signalling |
| 10. NR-unlicensed | [10-19a] | [Support DL reception in a carrier with intra-cell guard-bands] | 1. [When DL BWP has multiple RB sets, support using the available RB set bitmap in DCI 2\_0 to validate the periodic CSI-RS transmission if the CSI-RS is over multiple RB-sets] | TBD | Yes | N/A |  | Per band | N/A | N/A |  | Without this capability, UE will assume all RB sets in the DL BWP are all transmitted or none of them are transmitted | Optional with capability signalling |
| 10. NR-unlicensed | [10-19b] | [Support UL transmission with subset of RB sets passing LBT] | 1. [When UL BWP has multiple RB sets, support transmission of UL signal or channels when LBT passes for only the RB sets the UL signals or channels are located] | TBD | Yes | N/A |  | Per band | N/A | N/A |  | Without this capability, UE will transmit UL when all RB sets in the UL BWP pass LBT | Optional with capability signalling |
| 10. NR-unlicensed | 10-26 | CSI-RS based RLM for NR-U | [CSI-RS based RLM for NR-U] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 10. NR-unlicensed | 10-26a | CSI-RS based RRM for NR-U | [CSI-RS based RRM for NR-U] | TBD | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 10. NR-unlicensed | [10-31] | [Support of CSI-RS measurements for CSI reporting and tracking without COT duration from DCI 2\_0] | [· Perform CSI measurements for reporting and tracking using CSI-RS resources that are not within a COT duration indicated by DCI 2\_0  · Note: This includes the cases when DCI 2\_0 is not configured and when DCI 2\_0 is configured but COT duration is not provided by either CO duration field or SFI.] | TBD | Yes | N/A |  | [Per band] | N/A | N/A |  |  | Optional with capability signaling |
| 10. NR-unlicensed | 10-3 | PRB interlace mapping for PUSCH | 1. PRB interlace frequency domain resource allocation for PUSCH | TBD  One of {10-1, 10-1a} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support of PRB interlace PUSCH | Optional with capability signalling |
| 10. NR-unlicensed | 10-3a | PRB interlace mapping for PUCCH | 1. PRB interlace frequency domain resource allocation for PUCCH format 0 and format 1 2. PRB interlace frequency domain resource allocation for PUCCH format 2 3. PRB interlace frequency domain resource allocation for PUCCH format 3 | TBD  One of {10-1, 10-1a} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support of PRB interlace PUCCH format 0/1 | Optional with capability signalling |
| 10. NR-unlicensed | 10-12 | OCC for PRB interlace mapping for PF2 and PF3 | 1. OCC2  2. OCC4 | 10-3a | Yes | N/A |  | Per band | N/A | N/A | N/A | UE OCC capability for EPF2/EFP3 | Optional with capability signalling |
| 10. NR-unlicensed | 10-13a | Extended CP range of more than one symbol for CG-PUSCH | 1. UE supports generating a CP extension of length longer than 1 symbol for Configured Grant PUSCH transmission | TBD  One of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | How long a UE can generate the CP extension beyond 1 symbol for CG-PUSCH | Optional with capability signalling |
| 10. NR-unlicensed | 10-18 | Configured grant with retransmission in CG resources | 1. Support retransmission in CG resources  2. Support configured grant retransmission timer  3. Support DFI monitoring  4. Support CG-UCI in CG-PUSCH | TBD  One of {5-19, 5-20} | Yes | N/A |  | Per band | N/A | N/A | N/A | Support configured grant with retransmission in configured grant resource | Optional with capability signalling |
| 10. NR-unlicensed | 10-21a | Support using ED threshold given by gNB for UL to DL COT sharing | 1. Use ULtoDL-CO-SharingED-Threshold-r16 for cat 4 LBT for scheduled UL to share COT with gNB for DL  2. Use ULtoDL-CO-SharingED-Threshold-r16 for cat 4 LBT for CG-PUSCH to share COT with gNB for DL  3. Indicate in CG-UCI the COT sharing information | TBD  10-1 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 10. NR-unlicensed | 10-24 | CG-UCI multiplexing with HARQ ACK | 1. Support multiplexing CG-UCI with HARQ ACK | 10-18 | Yes | N/A |  | Per band | N/A | N/A | N/A |  | Optional with capability signalling |
| 10. NR-unlicensed | 10-28 | Configured grant with Rel-16 enhanced resource configuration | 1. Support configuration of resources with cg-nrofSlots-r16 and cg-nrofPUSCH-InSlot-r16, | TBD  One of {5-19, 5-20} | Yes | N/A |  | FFS: Per UE or per band | N/A | N/A | N/A |  | Optional with capability signalling |