**3GPP TSG RAN WG1 #100bis-e R1-2002865**

e-Meeting, April 20th – 30th, 2020

Source: NTT DOCOMO, INC.

Title: Summary on Email discussion [100b-e-NR-UEFeatures-NRU-04]

Agenda Item: 7.2.11.2

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

# **Introduction**

This contribution summarizes the following email discussion in AI 7.2.11.2 regarding UE features for NR-U.

[100b-e-NR-UEFeatures-NRU-04] Email discussion/approval on issues with capability signaling impacts on basic FGs for NR-U (24th-29th April) – Hiroki (DCM)

* Discuss on component(s) of each FG that need to be reported and candidate values for the component(s)
* Discuss on reporting type of each FG
* Discuss on the need of xDD and/or FRx differentiation for each FG of per-UE type
* Note that discussed FGs in this email discussion are derived by outcome of high priority email discussion in FL proposal 1

In the email discussion [100b-e-NR-UEFeatures-NRU-01], following agreements were made.

**Agreements:**

* Define new basic FGs with components that have tightly related functionality to replace current basic FGs
  + In “mandatory/optional” column for the possible basic FGs, it should be clarified that the FG may be a part of basic operation for a particular scenario
    - If the FG is decided as a basic FG, the note will be updated to clarify that the FG is “optional with capability signaling and is required to be supported for the scenario”
  + Note: each basic FG will have capability bit
* [Working assumption] Take either one of following alternatives

Alt.1:

* Define a table to capture the basic FGs required for a certain NR-U deployment scenario in specification
  + Note: the table does not have impact on capability signaling
  + Note: the grouping of FGs in the table does not have impact on “prerequisite FGs” column in features list

Alt.2:

* Capture an association between the basic FGs required to be supported and a certain NR-U deployment scenario in the UE features list

**Agreements:**

* Replace FG10-1/1a/2/2a/2b by following FGs
  + UL channel access for dynamic channel access mode
  + UL channel access for semi-static channel access mode
  + SSB-based RRM [for dynamic channel access mode]
  + SSB-based RRM [for semi-static channel access mode]
  + MIB reading
  + SSB-based RLM [for dynamic channel access mode]
  + SSB-based RLM [for semi-static channel access mode]
  + SIB1 reception
* Introducing the separated FG for “Support of RAR extension from 10ms to [40ms] by decoding of the 2-bit SFN indication in DCI 1\_0”
* Not introducing the separate FG for “Type 2B channel access”, i.e., it is merged with new basic FG for “UL channel access for dynamic channel access mode”
* FG10-11 is kept for “SRS starting position at any OFDM symbol in a slot”
* FG10-20 is kept for “Support search space set configuration with freqMonitorLocation-r16”
* FG10-20a is kept for “Support coreset configuration with rb-Offset”
* FG10-25 is kept for “Enable configured UL transmission out of COT”
* FG10-29 is kept for “Support available RB set indicator field in DCI 2\_0”
* FG10-30 is kept for “Support channel occupancy duration indicator field in DCI 2\_0”
* FG10-7 is kept for “UL channel access for 10 MHz SCell”
* FG10-10 is kept for “RSSI and channel occupancy measurement and reporting”
* FG10-23 is kept for “CGI reading on unlicensed cell [based on off-sync raster SSB] for ANR functionality”
* FG10-27 is kept for “Wideband PRACH”

# **10-1: UL channel access for dynamic channel access mode**

Based on agreements and proposal in [8], FG10-1 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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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. Contention window adjustment  7. CP extension up to 1 symbol for PUSCH/PUCCH transmission | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-1a: UL channel access for semi-static channel access mode**

Based on agreements and proposal in [8], FG10-1a can be defined as below.

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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 | 10-1a | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-2: SSB-based RRM [for dynamic channel access mode]**

Based on agreements and proposal in [8], FG10-2 can be defined as below.

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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 | 10-2 | SSB-based RRM [for dynamic channel access mode] | 1. SSB-based RRM [for dynamic channel access mode] | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-2a: SSB-based RRM [for semi-static channel access mode]**

Based on agreements and proposal in [8], FG10-2a can be defined as below.

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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 | 10-2a | SSB-based RRM [for semi-static channel access mode] | 1. SSB-based RRM [for semi-static channel access mode] | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-2b: MIB reading on unlicensed cell**

Based on agreements and proposal in [8], FG10-2b can be defined as below.

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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 | 10-2b | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-2c: SSB-based RLM [for dynamic channel access mode]**

Based on agreements and proposal in [8], FG10-2c can be defined as below.

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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 | 10-2c | SSB-based RLM [for dynamic channel access mode] | 1. SSB-based RLM [for dynamic channel access mode] | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-2d: SSB-based RLM [for semi-static channel access mode]**

Based on agreements and proposal in [8], FG10-2d can be defined as below.

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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 | 10-2d | SSB-based RLM [for semi-static channel access mode] | 1. SSB-based RLM [for semi-static channel access mode] | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-2e: SIB1 reception on unlicensed cell**

Based on agreements and proposal in [8], FG10-2e can be defined as below.

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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 | 10-2e | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-2f: Support of RAR extension from 10ms to [40ms] by decoding of the 2-bit SFN indication in DCI 1\_0**

Based on agreements and proposal in [8], FG10-2f can be defined as below.

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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 | 10-2f | 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 | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-7: LBT bandwidth size of 10MHz**

Based on agreements and [1], FG10-7 can be defined as below.

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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 | 10-7 | LBT bandwidth size of 10MHz | 1. LBT bandwidth size of 10MHz | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| [8] | Ericsson | 10 MHz LBT bandwidth is only needed for the special case of configuring an SCell only on one of two specific ARFCNs in one specific geographic region in the world (India), and only if UL is enabled. Hence the capability should be restructured as shown below. This FG can have FG 10-1 in our Proposal 3 as a pre-requisite.   1. Rename FG 10-7 as follows. This FG can have FG 10-1 in our Proposal 3 as a pre-requisite.  |  |  |  | | --- | --- | --- | | 10-7 | ~~LBT bandwidth size of 10MHz~~  UL channel access for 10 MHz SCell | ~~FFS the components~~  1. 10 MHz LBT bandwidth | |

# **10-10: RSSI and channel occupancy measurement and reporting**

Based on agreements and [1], FG10-10 can be defined as below.

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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 | 10-10 | RSSI and channel occupancy measurement and reporting | 1. RSSI measurement 2. 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| [8] | Ericsson | 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.   1. FG 10-10 should be per UE |

# **10-11: SRS starting position at any OFDM symbol in a slot**

Based on agreements and [1], FG10-11 can be defined as below.

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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 | 10-11 | SRS starting position at any OFDM symbol in a slot | 1. SRS starting position at any OFDM symbol in a slot | TBD | Yes | N/A |  | Per band or per UE | N/A | N/A | N/A | Support transmitting SRS starting in all symbols (0,…,13) of a slot | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| [2] | ZTE, Sanechips | * SRS starting position: including FG 10-11   In general, the above enhancements on SRS 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. |
| [5] | MediaTek Inc. | Proposal 1: NR-U features can only be extended to licensed operation when uses cases and benefits are well justified. |
| [7] | Intel Corporation | We support that some of feature groups are used for licensed use, including 10-8 and 10-11. And also some of HARQ features seem beneficial for licensed use as well including enhanced dynamic HARQ codebook, one-shot HARQ ACK, and multi-PUSCH UL grant.  **Proposal 5:**  **Let 10-8/10-11/10-14/10-15/10-16/10-16a/10-17 be used for licensed band** |
| [8] | Ericsson | 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.   1. FG 10-11 should be per UE |
| [9] | Samsung | 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 2: UE features for NR-U should be used only for unlicensed band.** |
| [13] | Qualcomm Incorporated | |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 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 band or per UE | N/A | N/A |  |  | Optional with capability signalling | |
| [14] | Huawei, HiSilicon | |  |  |  | | --- | --- | --- | | Functionality | FGs | Need for 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 |   ***Proposal 2: The following FGs could be extended to licensed bands, i.e. reported “per UE”:***   * ***10-11 SRS starting position at any OFDM symbol in a slot*** |

# **10-20: Support search space set configuration with freqMonitorLocation-r16**

Based on agreements and [1], FG10-20 can be defined as below.

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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 | 10-20 | Support search space set configuration with freqMonitorLocation-r16 | 1. Support search space set configuration with freqMonitorLocations-r16 | TBD  Need discussion for licensed use | 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 provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| [2] | ZTE, Sanechips | * CORESET/SS: including FG 10-9/9a/9b/9c, 10-20/20a.   In general, the above enhancements on CORESET/SS 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. |
| [3] | vivo | For other UE features, the extension to licensed band could be considered if the benefit is identified in certain licensed scenario.  **Proposal 2: For UE features that are not agreed to be extended to licensed use, update “per band” to “per unlicensed band”.** |
| [5] | MediaTek Inc. | 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 13: For 10-20, change the component to “Maximum number of frequency domain locations for a search space set configuration with *freqMonitorLocations-r16*”** |
| [7] | Intel Corporation | However, do not see any motivation to let the features for search space set group switching and search space/CORESET configuration in wideband to be used for licensed band. Those features were introduced to overcome the limitation of unlicensed band and we do not see any benefits when used for licensed operation.  **Proposal 6:**  **Do not open 10-9/10-9a/10-9b/10-20/10-20a for licensed use.** |
| [9] | Samsung | 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 2: UE features for NR-U should be used only for unlicensed band.** |
| [12] | Nokia, Nokia Shanghai Bell | * 10-20a: It is OK to support it for licensed use as well. |
| [14] | Huawei, HiSilicon | |  |  |  | | --- | --- | --- | | Functionality | FGs | Need for licensed band operation | | Support search space set configuration with freqMonitorLocation-r16 | 10-20 Support search space set configuration with freqMonitorLocation-r16 | Per band  The motivation of this feature is to save RRC signaling overhead and complexity to configure too many CORESETs when UE is expect to monitor PDCCH on multiple RB sets in case gNB may fail to transmit PDCCH on RB set where LBT fail. In licensed band, there is no LBT failure and UE can be configured with exact CORESET location in the BWP. | | Support coreset configuration with rb-Offset | 10-20a Support coreset configuration with rb-Offset | Per band  The motivation of this feature is to increase usable CCE in a CORESET confined in fixed LBT bandwidth. In licensed band, there is no such restriction from LBT bandwidth. |   **FG 10-20 (Support search space set configuration with freqMonitorLocation-r16**  FG10-20a and 10-19a should be prerequisites for FG10-20. |

# **10-20a: Support search space set configuration with freqMonitorLocation-r16**

Based on agreements and [1], FG10-20a can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 10-20a | Support coreset configuration with rb-Offset | 1. Support coreset configuration with rb-Offset | TBD  Need discussion for licensed use | 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 provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-23: CGI reading on unlicensed cell [based on off-sync raster SSB] for ANR functionality**

Based on agreements and [1], FG10-23 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 10-23 | 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 SCell from an off-sync raster SSB for ANR | Optional with capability signaling  This FG may be a part of basic operation for a particular scenario |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| [5] | MediaTek Inc. | 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.  **Proposal 7: CGI reading of an unlicensed cell for ANR functionality should be UE capability regardless whether its SSB is on or off sync rater.**   |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 10-23 | CGI reading ~~based on off-sync raster SSB~~of an 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 | 10-1, 10-1a, 10-2, or 10-2a | Yes | N/A |  | Per band | N/A | N/A |  | Support reading RMSI from SCell from an off-sync raster SSB for ANR | Optional with capability signalling | |

# **10-25: Enable configured UL transmission out of COT**

Based on agreements and [1], FG10-25 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 10-25 | 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\_0is 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| [3] | vivo | 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.  **Proposal 6: Change “DCI 2\_0” to “SFI” in the component of 10-25.** |
| [5] | MediaTek Inc. | For 10-25, change “RRC configured UL” to “higher-layer configured UL” to be aligned with the specification. And remove Cat 4 LBT from the description. We did not make the agreement only for LBE. It is applicable to FBE as well.  **Proposal 16: In 10-25, change “RRC configured UL” to “higher-layer configured UL” to be aligned with the specification.**  **Proposal 17: Remove Cat 4 LBT from the description of 10-25.** |
| [8] | Ericsson | The description of the feature group and its components is erroneous. The ability to use the configuration of *enableConfiguredUL-r16* has nothing to do with whether the configured UL transmission happens inside or outside the COT. This parameter applies to both cases and the type of UL channel access method used is conditioned on whether the transmission happens within or outside the COT based on another parameter. Hence “Cat 4 LBT” and “out of COT” should be removed from the description of the feature group and its components.   1. Modify the FG name and description as follows:  |  |  |  | | --- | --- | --- | | 10-25 | Enable configured UL transmissions when DCI 2\_0 is configured but not detected ~~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 | |
| [14] | Huawei, HiSilicon | **FG10-25 (enable configured UL transmission out of COT)**  It is not clear whether it is gNB acquired COT or UE acquired COT. |

# **10-27: Wideband PRACH**

Based on agreements and [1], FG10-27 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 10-27 | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **10-29: Support available RB set indicator field in DCI 2\_0**

Based on agreements and [1], FG10-29 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 10-29 | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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Following feedbacks are provided in contributions for the RAN1#100bis-e meeting.

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| --- | --- | --- |
| [5] | MediaTek Inc. | Without any agreements on “the initial signal” design and any guaranteed DL transmissions (e.g. (GC-) PDCCH) in the beginning of a COT, it is challenging to UE to adjust AGC and conduct periodic/semi-persistent DL reception. We hence propose the following.  **Proposal 8: Components 10-29 and 10-30 should be mandatory for UE. Merge 10-29 and 10-30 to 10-1, 10-2, 10-1x, and 10-2x.** |
| [6] | LG Electronics | FG 10-29 and FG-30 seem to be essential for NR-U since they enable to   * Increase UE’s channel access probability within channel occupancy by allowing to change LBT type * Reduce UE’s power consumption by skipping PDCCH monitoring for unavailable RB set(s) and adapting PDCCH monitoring frequency   **Proposal #7: FG 10-29 and FG 10-30 are to be the component of basic feature groups such as 10-1, 10-1a, 10-2, and 10-2a.** |
| [10] | Apple | |  |  | | --- | --- | | Question | Comments | | Can we merge 10-29 to 10-1, 10-1a, and 10-2 as components, instead of separate feature? | Yes.  We think it is beneficial and important to merge these two into basic feature group 10-1, 10-1a and 10-2. It should be noted that many NR-U functionalities, especially for wideband operation as well as periodic/SP-CSI-RS processing, are specified assuming DCI 2\_0 is available. As Qualcomm said, many UE behaviors are not defined if the UE cannot detect this DCI format to know the COT structure, we therefore prefer to merge these two features to basic feature groups. | | Can we merge 10-30 to 10-1 and 10-1a as components, instead of separate feature? For 10-2, I guess we will need further discussion separately on how necessary the COT duration needs to be indicated. | Yes.  COT duration is essential and needed to support COT sharing information. | |
| [11] | Sharp | FG 10-29 requires Support of COT indication since the availability of the RB-sets continues until the end of the COT. Thus, this feature requires COT indication reception or dynamic SFI in DCI format 2\_0.  **Proposal 3: Set “10-30 or 3-6” as pre-requisite feature for FG 10-29.** |

# **10-30: Support channel occupancy duration indicator field in DCI 2\_0**

Based on agreements and [1], FG10-30 can be defined as below.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 | 10-30 | 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 |

**Companies are encouraged to provide feedbacks focusing on signaling design aspects (e.g., components with candidate values for reporting, Type, Need of xDD/FRx differentiation).**

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# **Conclusion**

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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. Contention window adjustment  7. CP extension up to 1 symbol for PUSCH/PUCCH transmission | 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 | 10-1a | 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 [for dynamic channel access mode] | 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 | 10-2a | SSB-based RRM [for semi-static channel access mode] | 1. SSB-based RRM [for semi-static channel access mode] | 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 | 10-2b | 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 [for dynamic channel access mode] | 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 | 10-2d | SSB-based RLM [for semi-static channel access mode] | 1. SSB-based RLM [for semi-static channel access mode] | 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 | 10-2e | 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 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 | 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 | LBT bandwidth size of 10MHz | 1. LBT bandwidth size of 10MHz | 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 | 10-10 | RSSI and channel occupancy measurement and reporting | 1. RSSI measurement 2. 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 |
| 10. NR-unlicensed | 10-11 | SRS starting position at any OFDM symbol in a slot | 1. SRS starting position at any OFDM symbol in a slot | TBD | Yes | N/A |  | Per band or per UE | N/A | N/A | N/A | Support transmitting SRS starting in all symbols (0,…,13) of a slot | 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  Need discussion for licensed use | 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  Need discussion for licensed use | 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 SCell from 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 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\_0is 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 |

# **References**

[1] R1-2001484 RAN1 UE features list for Rel-16 NR after RAN1#100-E Moderator (AT&T, NTT DOCOMO, INC.)

[2] R1-2001715 Discussion on the UE features for NR-U ZTE, Sanechips

[3] R1-2001720 Discussion on Rel-16 NRU UE features vivo

[4] R1-2001765 Discussion on UE feature for NRU OPPO

[5] R1-2001826 Views on Rel-16 UE features for NR-U MediaTek Inc.

[6] R1-2001941 Discussion on UE features for NR-U LG Electronics

[7] R1-2002016 UE features for NR-U Intel Corporation

[8] R1-2002037 UE features for NR-U Ericsson

[9] R1-2002151 UE features for NR-U Samsung

[10] R1-2002350 Discussions on NR-U UE features Apple

[11] R1-2002393 Discussion on UE feature for NR-U Sharp

[12] R1-2002480 On UE features NR Unlicensed Nokia, Nokia Shanghai Bell

[13] R1-2002563 Discussion on NR-U UE features Qualcomm Incorporated

[14] R1-2002589 Rel-16 UE features for NR-U Huawei, HiSilicon

[15] R1-2002683 UE Features for NR-U TCL Communications

[16] R1-2002862 Summary on Email discussion [100b-e-NR-UEFeatures-NRU-01] Moderator (NTT DOCOMO, INC.)