**3GPP TSG-RAN WG4 Meeting # 102-e R4-2206283**

**Electronic Meeting, February 21 – March 3, 2022**

**Agenda item:** 8

**Source:** CMCC

**Title:** Rel-17 RAN4 UE feature list for NR

**Document for:** Approval

1. Introduction

This contribution includes the RAN4 UE feature list for Rel-17 NR in RAN4#102-e. The previous RAN4 UE feature list document is R4-2202400.

1. NR\_pos\_enh

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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** |
| 14. NR\_pos\_enh | 14-1 | per-FR MG for PRS measurement | Capability of supporting per-FR MG for PRS measurement | Rel-15 per-FR gap (independentGapConfig) | yes | no |  | Per UE | No | No | N/A |  | Optional with capability signalling |

1. NR\_ext\_to\_71GHz

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| 15. NR\_ext\_to\_71GHz | 15-1 | 64QAM for PUSCH for FR2-2 | 1) Support of 64QAM modulation for FR2-2 PUSCH | FFS | Yes | No | UE cannot support PUSCH 64QAM transmission | Per band | N/A | Applicable to FR2-2 only | N/A |  | Optional with capability signalling |

1. NR\_RF\_FR1\_enh

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| 16. NR\_RF\_FR1\_enh | 16-1 | Dynamic Tx switching between 2CC 2Tx-2Tx switching | Indicate the supported switching period for dynamic UL Tx switching between two uplink carriers with two transmit antenna connectors in inter-band UL CA or SUL |  | Yes | N/A | UE does not support 2CC 2Tx-2Tx switching for inter-band UL CA and SUL band combinations. | UE signals supported switching period per pair of UL bands per UL band combination | No need | Applicable only to FR1 | Support mixture of FDD/TDD | Candidate value set: {35us, 140 us, 210us}  Detailed information can refer to the LS to RAN2 in R4-2103234 and R4-2107847. | Optional with capability signalling |
| 16. NR\_RF\_FR1\_enh | 16-2 | Dynamic Tx switching between 3CC 1Tx-2Tx switching | Indicate the supported switching period for dynamic UL Tx switching between one band (with one carrier) capable of one transmit antenna connector and one band (with two carriers) capable of two transmit antenna connectors in inter-band UL CA or SUL |  | Yes | N/A | UE does not support Tx switching between 3CC 1Tx-2Tx switching for inter-band UL CA and SUL band combinations. | UE signals supported switching period per pair of UL bands per UL band combination | No need | Applicable only to FR1 | Support mixture of FDD/TDD | Candidate value set: {35us, 140 us, 210us}  Detailed information can refer to the LS to RAN2 in R4-2103234 and R4-2107847. | Optional with capability signalling |
| 16. NR\_RF\_FR1\_enh | 16-3 | Dynamic Tx switching between 3CC 2Tx-2Tx switching | Indicate the supported switching period for dynamic UL Tx switching between one band (with one carrier) capable of two transmit antenna connectors and one band (with two carriers) capable of two transmit antenna connectors in inter-band UL CA or SUL |  | Yes | N/A | UE does not support Tx switching between 3CC 2Tx-2Tx switching for inter-band UL CA and SUL band combinations. | UE signals supported switching period per pair of UL bands per UL band combination | No need | Applicable only to FR1 | Support mixture of FDD/TDD | Candidate value set: {35us, 140 us, 210us}  Detailed information can refer to the LS to RAN2 in R4-2103234 and R4-2107847. | Optional with capability signalling |
| 16. NR\_RF\_FR1\_enh | 16-4 | Application of DL interruptions due to dynamic UL Tx switching | Capability to indicate that for the band where DL interruption is needed, the RRM interruption requirements defined in RAN4 shall be applied for duplex mode combinations except the combinations   * SUL+TDD * TDD+TDD CA with the same UL-DL pattern | 16-1, 16-2, or 16-3 | Yes | N/A | UE not reporting this capability means DL interruption is not required | UE capability is defined as per band per band combination for each band pair supporting UL Tx switching | No need | Applicable only to FR1 | Support mixture of FDD/TDD | The same capability for Rel-16 DL interruption due to Tx switching is reused.  Detailed information can refer to the LS to RAN2 in R4-2103234. | Optional with capability signalling |
| 16. NR\_RF\_FR1\_enh | 16-5 | UL-MIMO coherence capability for dynamic Tx switching between 3CC 1Tx-2Tx switching | Capability to indicate whether UL-MIMO coherence is supported when dynamic Tx switching between 3CC (within 2 bands) 1Tx-2Tx switching is conducted. | 16-2 | Yes | N/A | Rel-15 per band capability *pusch-TransCoherence* is applicable | Per BC | No need | Applicable only to FR1 | Support mixture of FDD/TDD | The Rel-16 UL-MIMO capability for 2CC 1Tx-2Tx switching is reused.  Detailed information can refer to the LS to RAN2 in R4-2120039. | Optional with capability signalling |
| 16. NR\_RF\_FR1\_enh | 16-6 | UL-MIMO coherence capability for dynamic Tx switching between 2Tx-2Tx switching | Capability to indicate whether UL-MIMO coherence is supported when dynamic Tx switching between 2CC or 3CC (within 2 bands) 2Tx-2Tx switching is conducted. | 16-1 or 16-3 | Yes | N/A | The per BC UL-MIMO coherence capability for 1Tx-2Tx switching or Rel-15 per band capability *pusch-TransCoherence* is applicable | Per band per BC | No need | Applicable only to FR1 | Support mixture of FDD/TDD | Detailed information can refer to the LS to RAN2 in R4-2120039. | Optional with capability signalling |
| 16. NR\_RF\_FR1\_enh | 16-7 | [Support RRC configuration to prevent SCell dropping for CA] | FFS |  | Yes | N/A | [UE may drop SCell without enough transmission power according the current power control mechanism for CA] | FFS | No | No | N/A | Details for the signalling is FFS pending on the final solution to address the CA SCell dropping issue | Optional with capability signalling |

1. NR\_RF\_FR2\_req\_enh2

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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 |
| UL gap for Tx power management | 17-1 | Support of UL gap for Tx power management | Capability of performing BPS sensing for Tx power management. The UE indicating this capability shall meet the corresponding enhanced UE requirements defined in Section TBD. |  | yes | no | UE does not support UL gap for Tx power management | Per band | No | FR2 only |  |  | Optional with capability signalling |
| UL gap pattern for Tx power management ? | [17-2] |  |  |  |  |  |  |  |  |  |  |  |  |
| [UL gap for coherent UL MIMO ] | [17-3] | Support of UL gap for coherent UL MIMO | Capability of performing coherent UL MIMO calibration in UL gap. The UE indicating this capability shall meet the corresponding enhanced UE requirements defined in Section TBD. |  | yes | no | UE does not support UL gap for coherent UL MIMO calibration | per UE | No | FR2 only |  |  | Optional with capability signalling |
| 17. FR2 interband CA | 17-4 | Support of beam management | Capability of support of specific beam management type. |  | yes | no | UE does not support FR2 interband CA | FFS per band or per UE | No | FR2 only |  | Indicate the supported beam management type for inter-band CA within FR2. Beam management type can be independent beam management (IBM) or common beam management (CBM), or both | Optional with capability signalling |
| DC-location | [17-5] | Support of UL DC location(s) report | [Capability of support for the extended DC location reporting (based on indicated default DC location) for at least 2 UL CCs.] |  | yes | no | UE does not support the Rel-17 extended UL DC location reporting | [Per band per BC] | No | No |  |  | Optional with capability signalling |
| New CA BW clases | [17-6] | Support of new CA BW Classes | RAN4 has introduced new CA BW Classes ‘R, S, T, U’ for REL17 |  | yes | no | UE does not support the Rel-17 extended FBG2 bandwidths | per band | No | FR2 only |  |  | Optional with capability signalling |
| [FBG 3+2] | [17-7] | [Support of new CA BW Classes] | RAN4 may introduce new fall back group and or new CA BW classes under FBG3+2 discussion |  | yes | no |  | per band | No | FR2 only |  |  | Optional with capability signalling |

1. NR\_HST\_FR1\_enh

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| 18. NR\_HST\_FR1\_enh | 18-1 | Enhanced RRM requirements specified for CA for FR1 HST | Support of the enhanced RRM for requirements CA to support FR1 high speed up to 500 km/h, as specified in TS 38.133 | Rel-16 RAN4 feature 10-1 or 10-4 | Yes | No | The performance of RRM for CA in FR1 HST scenario cannot be guaranteed | Per UE | NO | FR1 only | N/A |  | Optional with capability signalling |
| 18. NR\_HST\_FR1\_enh | 18-2 | Enhanced RRM requirements specified for inter-frequency measurement in connected mode for FR1 HST | Support of the enhanced RRM requirements for inter-frequency measurement in connected mode to support FR1 high speed up to 500 km/h, as specified in TS 38.133 | Rel-16 RAN4 feature 10-1 or 10-4 | Yes | No | The performance of RRM for inter-frequency measurement in connected mode for FR1 HST cannot be guaranteed | Per UE | NO | FR1 only | N/A |  | Optional with capability signalling |
| 18. NR\_HST\_FR1\_enh | 18-3 | Enhanced RRM requirements specified for inter-frequency measurement in Idle and Inactive mode for FR1 HST | Support of the enhanced RRM requirements for inter-frequency measurement in idle and Inactive mode to support FR1 high speed up to 500 km/h, as specified in TS 38.133 |  | No | No | The performance of RRM for inter-frequency measurement in idle and Inactive mode for FR1 HST cannot be guaranteed | Per UE | NO | FR1 only | N/A |  | Optional without capability signalling |
| 18. NR\_HST\_FR1\_enh | 18-4 | Support of enhanced Demodulation requirements for CA in HST SFN FR1 | 1) Support of demodulation processing for HST SFN CA scenario in FR1 | Rel-16 RAN4 feature 10-2 | Yes | No | UE is not able to apply demodulation processing for HST SFN CA scenario in FR1 | per band combination | No | FR1 only | N/A |  | Optional with capability signalling |

1. NR\_MG\_enh

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| 19. NR\_MG\_enh | 19-1 | Network controlled small gap (NCSG) | Support of NCSG |  | yes | no | UE cannot be configured with NCSG | per-UE | No | No |  |  | Optional with capability signalling |
| 19. NR\_MG\_enh | 19-2 | Concurrent measurement gaps | o Support of more than 1 per-UE measurement gap configurations  o Support of more than 1 per-FR gap measurement gap configurations in an FR, or simultaneous 1 per-UE measurement gap plus 1 per-FR measurement gap configurations in an FR, or more than 1 per-UE measurement gap configurations for UE capable of Rel-15 per-FR gap (independentGapConfig)  Note: The above 2 bullets are not 2 separate indications but a single indication with different interpretations, depending on the support of independentGapConfig. |  | yes | no | UE cannot be configured with concurrent gaps | per UE | No |  |  | This is the baseline capability is to indicate UE support multiple concurrent gaps. | Optional with capability signalling |
| 19. NR\_MG\_enh | 19-3-1 | Pre-configured measurement gap with network-controlled activation and deactivation mechanism | Capability of supporting preconfigured measurement gap with network-controlled mechanism for activation and deactivation |  | yes | no | UE does not support pre-configured measurement gap with Network-controlled mechanism | per UE | No | No |  |  | Optional with capability signalling |
| 19. NR\_MG\_enh | 19-3-2 | Pre-configured measurement gap with UE autonomous activation and deactivation mechanism | Capability of supporting preconfigured measurement gap with UE autonomous mechanism for activation and deactivation |  | yes | no | UE does not support pre-configured measurement gap with UE autonomous mechanism | per UE | No | No |  |  | Optional with capability signalling |

1. NR\_SAR\_PC2\_interB\_SUL\_2BUL

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| 20. NR\_SAR\_PC2\_interB\_SUL\_2BUL | 20-1 | Maximum uplink duty cycle for NR inter-band CA power class 2 (*maxUplinkDutyCycle-interBandCA-PC2-r17*  ) | Indicates the maximum average percentage of symbols during a certain evaluation period that can be scheduled for uplink transmission so as to ensure compliance with applicable electromagnetic energy absorption requirements provided by regulatory bodies. The average percentage of uplink symbols is specified in 6.2A.1.3 in TS 38101-1[2] and the capability applies to the CA combinations listed in table 6.2A.1.3-1 in TS 38101-1[2].  If the field is absent, UE shall work on power class 2 regardless of UL duty cycle and may use P-MPRc as defined in 6.2.4 in TS 38101-1[2] if necessary.  Value n50 corresponds to 50%, value n60 corresponds to 60% and so on.  NOTE: Specific targeted UL duty cycle percentage is not assumed if the field is absent. |  | Yes | No | UE shall work on power class 2 regardless of UL duty cycle and may use P-MPRc as defined in 6.2.4 in TS 38101-1[2] if necessary. | Per BC | N/A | FR1 only |  |  | Optional with capability signalling |
| 20. NR\_SAR\_PC2\_interB\_SUL\_2BUL | 20-2 | Maximum uplink duty cycle for NR SUL combination power class 2 (*maxUplinkDutyCycle-SULcombination-PC2-r17*  ) | Indicates the maximum average percentage of symbols during a certain evaluation period that can be scheduled for uplink transmission so as to ensure compliance with applicable electromagnetic energy absorption requirements provided by regulatory bodies. The average percentage of uplink symbols is specified in 6.2C.1 in TS 38101-1[2] and the capability applies to all the SUL configurations with 1 SUL band + 1 TDD band.  If the field is absent, UE shall work on power class 2 regardless of UL duty cycle and may use P-MPRc as defined in 6.2.4 in TS 38101-1[2] if necessary.  Value n50 corresponds to 50%, value n60 corresponds to 60% and so on.  NOTE: Specific targeted UL duty cycle percentage is not assumed if the field is absent. |  | Yes | No | If the field is absent, UE shall work on power class 2 regardless of UL duty cycle and may use P-MPRc as defined in 6.2.4 in TS 38101-1[2] if necessary. | Per BC | N/A | FR1 only |  |  | Optional with capability signalling |

1. NR\_PC2\_UE\_FDD

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| [21. NR\_PC2\_UE\_FDD] | [21-1] | [MSD reduction] | [Support of reducing UE Tx power for certain bandwidth in specific bands, where the MSD is larger than or equal to [FFS]dB under power class 2 operation.] | [N/A] | [Yes] | [No] | [UE does not support lowering the MSD by reducing UE Tx power] | [Per Band] | [FDD only] | [FR1 only] | [N/A] | [Network can configure whether to enable the UE capability] | [Optional with capability signalling] |
| [21. NR\_PC2\_UE\_FDD] | [21-2] | [Hybrid duplex operation] | [Support of hybrid duplex operation] | [N/A] | [Yes] | [No] | [UE does not support hybrid duplex operation] | [Per Band] | [FDD only] | [FR1 only] | [N/A] | [FFS RAN1 impact] | [Optional with capability signalling] |

1. NR\_HST\_FR2

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| 22. NR\_HST\_FR2 | 22-1 | Support of FR2 HST operation | 1) Support of FR2 UE PC6  2) Support of enhanced RRM requirements for FR2 HST (except the requirement for one shot large UL timing adjustment)  3) Support of demodulation processing for FR2 HST |  | Yes | No | UE does not meet FR2 high speed train scenario | Per Band | NO | FR2 only | N/A | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signalling |