**3GPP TSG-RAN WG4 Meeting #110bis R4-2408934**

**Changsha, China, 15th – 19th April, 2024**

**Agenda item:** 9

**Source:** Moderator (CMCC)

**Title:** Topic summary for [111][123] NR\_LTE\_Rel-18\_feature\_list

**Document for:** Information

# Introduction

This summary focuses on the Rel-18 UE feature list for LTE and NR including agenda 9. The previous UE feature list are in R4-2321993, R4-2403842, R4-2406680.

Companies contributions are listed as below.

|  |  |  |  |
| --- | --- | --- | --- |
| **TDoc** | **Title** | **Source** | **Related features** |
| [**R4-2407294**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407294.zip) | On Rel-18 UE feature list | Apple | 30. NR\_FR2\_multiRX\_DL  36. NR\_demod\_enh3 |
| [**R4-2407943**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2407943.zip) | Discussion on mandatory of enhanced channel raster | CMCC | 28. NR\_channel\_raster\_enh |
| [**R4-2408057**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408057.zip) | Consideration on Rel-18 RAN4 UE feature list for NR | Huawei, HiSilicon | 28. NR\_channel\_raster\_enh  32. NR\_MG\_enh2 |
| [**R4-2408612**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408612.zip) | Views on RAN4 Rel-18 UE feature list | Intel Corporation | 32. NR\_MG\_enh2  41 NR\_cov\_enh2  42. Netw\_Energy\_NR |
| [**R4-2408838**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_111/Docs/R4-2408838.zip) | Rel-18 RAN4 UE feature list for NR\_MC\_enh | NTT DOCOMO INC. | 38. NR\_MC\_enh |

# NR\_channel\_raster\_enh

Agreement in RAN4#110bis:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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** |
| 28. NR\_channel\_raster\_enh | 28-1 | Enhanced channel raster | The UE supports the requirements for UE channel bandwidths located on the enhanced channel raster of a band as specified in TS 38.101-1, TS 38.101-5 |  | Yes |  | UE may not support requirements for UE specific channel bandwidths located on enhanced channel raster;  configuring a narrower UE-specific channel bandwidth inside a wider gNB channel bandwidth may not be possible. | Per Band | No | FR1 only | The feature is supported for applicable bands in FDD-TDD and FR1/FR2 combinations | Applies only for bands with a 100 kHz channel raster for both TN and NTN.  Should be early implementable from Rel-16. | Mandatory with capability signaling for all Rel-18 UEs for certain bands as defined in 38.101-1 and 38.101-5  Optional otherwise  FFS for (e)RedCap |

**Recommended WF:**

**Discuss following proposals for “mandatory/optional” column.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **…** | **Mandatory/Optional** |
| 28. NR\_channel\_raster\_enh | 28-1 | Enhanced channel raster | Unchanged columns are omitted | **Option 1 (Huawei):**  Mandatory with capability signaling for all Rel-18 UEs for certain bands as defined in 38.101-1 and 38.101-5  Optional otherwise  ~~FFS for RedCap~~  **Option 2 (CMCC):**  Mandatory with capability signaling for all Rel-18 UEs for certain bands as defined in 38.101-1 and 38.101-5  Optional otherwise  Mandatory for (e)RedCap UEs from Rel-18. |

1. NR\_FR2\_multiRX\_DL

**Recommended WF:**

**Discuss the following proposal from Apple**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 30. NR\_FR2\_multiRX\_DL | 30-1 | Supports scheduling restriction relaxation and measurement restriction relaxation | * Supports simultaneous reception of CSI-RS for layer 1 measurement and PDSCH with different QCL Type-D on overlapping OFDM symbols. * Supports Simultaneous layer 1 measurement of CSI-RS overlapping with another CSI-RS with different QCL Type-D on overlapping OFDM symbol(s). | 16-2c, 23-5-1, and at least one of 16-2a, 16-2b-1, 16-2b-2 and 16-2b-3 | Yes | N/A |  | Per FSPC | TDD only | FR2-1 only |  | Note: It can be supported for PC3 only. |  |

## 30-1 Supports scheduling restriction relaxation and measurement restriction relaxation

**Recommended WF:**

**Discuss the following proposal from Apple and Huawei. Changed parts are highlighted in yellow.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 30. NR\_FR2\_multiRX\_DL | 30-1 | Supports scheduling restriction relaxation and measurement restriction relaxation | * Supports simultaneous reception of CSI-RS for layer 1 measurement and PDSCH with different QCL Type-D on overlapping OFDM symbols. * Supports Simultaneous layer 1 measurement of CSI-RS overlapping with another CSI-RS with different QCL Type-D on overlapping OFDM symbol(s). | 16-2c, 23-5-1, ~~[~~at least one of 16-2a, 16-2b-1, 16-2b-2 and 16-2b-3~~]~~ | Yes | N/A |  | Per FSPC | TDD only | FR2-1 only |  | Note: It can be supported for PC3 only. | [Optional with capability signalling] |

## 30-2 Fast beam sweeping for layer 1 measurement

**Recommended WF:**

**Discuss the following proposal from Apple. Changed parts are highlighted in yellow.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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 |
| 30. NR\_FR2\_multiRX\_DL | [30-2] | Fast beam sweeping for layer 1 measurement | * Supports beam sweeping factor reduction for SSB-based layer 1 measurement when the UE is in multi-RX operation. | 16-2c, 23-5-1 | [Yes] | N/A |  | Per band | N/A | FR2-1 only |  | Candidate values for Component 2: {2,4,6} for FR2-1  [Note: It can be supported for all power classes excepted PC6.] | [Optional with capability signalling] |

1. NR\_MG\_enh2

## 32-6 Effective measurement window for inter-RAT EUTRAN measurements

**Recommended WF:**

**Discuss the following changes**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 32. NR\_MG\_enh2 | 32-6 | Effective measurement window for inter-RAT EUTRAN measurements | Support configuration of effective measurement window for inter-RAT EUTRAN measurements, including offset, duration and periodicity. | 32-4 or 32-5 | Yes | No | UE is not allowed to cause scheduling restriction defined in TS 38.133 for 32-4 or 32-5 | Per UE | No | No | N.A | * A bitmap for 6 effective measurement window (EMW) patterns defined in TS 38.133. * #0 and #1 are mandatory, if UE supports EMW feature.   Other patterns are optional  Note: If UE supports 32-4 or 32-5 and UE requires scheduling restriction, UE should support this FG | Optional with capability signalling |

## 32-xx Rel-18 LTE UE features for NR\_MG\_enh2 WI.

**Recommended WF:**

**Discuss the following proposals**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 32. NR\_MG\_enh2 | x-y | interRAT-NeedForInterruptionNR-r18 | Support of inter-RAT NR measurements without gap with or without interruption when the interRAT-NeedForGapsNR-r16 is false.  Note: This feature already has a defined UE capability: ‘interRAT-NeedForInterruptionNR-r18’. The intention of adding this FG is only keep consistency between 38.822 and 36.306. | interRAT-NeedForGapsNR-r16 | Yes | NA | The UE does not support inter-RAT NR measurements without gap with or without interruption for performing inter-RAT NR measurement without gap | **Intel:**  Per target band per BC  Note: the same granularity as interRAT-NeedForGapsNR-r16 | No | No | NA | Candidate value: “{no-gap-with-interruption, no-gap-no-interruption}” | Optional with capability signalling |
|  | [x-y]  Option 1 (Intel) | Simultaneous reception of LTE data and NR SSB with 30kHz SCS | Support concurrent inter-RAT NR measurement with a different numerology than 15kHz and reception from LTE serving cell |  | Yes | NA | Scheduling restriction is applicable | Per UE | No | No | NA |  | Optional with capability signalling |
| 32. NR\_MG\_enh2 | x-z  Option 2 (Huawei) | Simultaneous reception of E-UTRAN data and NR SSB with different numerology | Support concurrent inter-RAT measurement on NR cell with NR SSB and PDCCH or PDSCH reception from the E-UTRAN serving cell with a different numerology | x-y (interRAT-NeedForInterruptionNR-r18) | Yes | No | scheduling restriction is applicable | Per UE | No | FR1 only | N/A |  | Optional with capability signalling |

1. NR\_demod\_enh3

**Recommended WF:**

**Discuss following changes from Apple**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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** |
| 36. NR\_demod\_enh3 | 36-1 | MU-MIMO Interference Mitigation advanced receiver | R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression, for MU-MIMO up to *maxNumberMIMO-LayersPDSCH* layers across target and co-scheduled UEs with 2 RX and 4RX antennas, when co-scheduled UE(s)’ modulation order is explicitly signaled by DCI index 1-5 in Table 7.3.1.2.2-12 of TS38.212. | 3-4 | Yes | N/A | UE not capable of advanced receiver to suppress inter-user inference in MU-MIMO | Per UE  Note: UE supports R-ML on MU-MIMO on single carrier operation. UE optionally supports R-ML on MU-MIMO on one or more carriers in CA , NE-DC, NR-DC and EN-DC operation | No | FR1 only |
| 36. NR\_demod\_enh3 | 36-2a | MU-MIMO Interference Mitigation advanced receiver with modulation order detection | R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression for MU-MIMO [for 2 layers across target and co-scheduled UEs with 2RX and 4RX] when the co-scheduled UE information with DCI index 6 or 7 in Table 7.3.1.2.2-12 of TS38.212 is signalled. | 36-1 | No | N/A | UE not capable of advanced receiver to suppress inter-user inference in MU-MIMO with modulation order detection | N/A | No | FR1 only |
| 36. NR\_demod\_enh3 | 36-2b | MU-MIMO Interference Mitigation advanced receiver with modulation order detection | R-ML (reduced complexity ML) receivers with enhanced inter-user interference suppression for MU-MIMO [for 2 layers across target and co-scheduled UEs with 2RX and *maxNumberMIMO-LayersPDSCH* layers across target and co-scheduled UEs with 4RX] when the co-scheduled UE information with DCI index 6 in Table 7.3.1.2.2-12 of TS38.212 is signalled. | 36-1 | No | N/A | UE not capable of advanced receiver to suppress inter-user inference in MU-MIMO with modulation order detection | N/A | No | FR1 only |

1. NR\_MC\_enh

**Recommended WF: Update the FG 38-4 and 38-5 based on RAN2 progress.**

**Proposal (DOCOMO): At latest, RAN4 will check the progress in RAN2 in Friday morning and update the UE feature list according to the agreement in last meeting.**

|  |
| --- |
| **Agreement: for FG 38-4 and FG 38-5**   * RAN4 did not reach consensus on merging FG 38-4 and FG38-5 and there is no corresponding update of the feature list. * Companies are encouraged to further discuss the capability issue in RAN2 * Check RAN2 progress during May meeting. If RAN2 keep the agreement, RAN4 will agree on Option 2 and update the feature list in May meeting. |

**Option 1:**

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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*** |
| 38.  NR\_MC\_enh | 38-5 | preferredBandPairs for four-band switching case | 1. Support the indication of the switching period can be improved to min {max(Tswitch\_A-C, Tswitch\_B-D), max(Tswitch\_A-D, Tswitch\_B-C)} assuming UE’s preferred (switched-from, switched-to) band pairs for parallel UL transmission switching for a band combination consisting of four different bands. | 38-1 | Yes | N/A | [Network can only assume the maximum switch period] | Per BC | No | FR1 only | Support mixture of FDD/TDD | [Note: Detailed information can refer to the LS to RAN2 in R4-2317609] | Optional with capability signalling |

**Option 2:**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***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*** |
| 38.  NR\_MC\_enh | 38-4 | Additional switching Period for switching case across three or four bands for Dual UL | 1. Indicate additionally the supported Tx switching period for switching case across three or four bands, when Rel-18 UL Tx switching is configured by uplinkTxSwitchingMoreBands-r18. If the capability is not reported, the switching period reported in switchingPeriodFor2T-r18 or switchingPeriodFor1T-r18 applies, as specified in TS 38.214 and TS 38.101-1. | 38-1 | Yes | N/A | UL Tx switching across more than 2 bands cannot be supported for the band pair in the band combination. | Per BC | No | FR1 only | Support mixture of FDD/TDD | Component 1 candidate value: {35us, 140 us, 210us} | Optional with capability signaling |
| 38.  NR\_MC\_enh | 38-5 | Void |  |  |  |  |  |  |  |  |  |  |  |

1. NR\_cov\_enh2

**Recommended WF:**

**Discuss the following proposal from Intel.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 41.NR\_cov\_enh2 | 41-2 | Power boosting for DFT-s-OFDM pi/2 BPSK and QPSK transmissions without modified spectrum flatness requirement | 1. Support of UE power boosting for DFT-s-OFDM pi/2 BPSK and QPSK without modified spectrum flatness requirement for PC3 and PC2 MPR reduction, when applicable as defined in 6.2 of TS 38.101-1.The power boosting is only enabled when signalled via RCC powerBoostPi2BPSKRel18 for BPSK and powerBoostQPSKRel18 for QPSK | 1-6, 1-7 | Yes | N/A | UE cannot power boost without modified spectrum flatness requirement | Per FS | NO | FR1 only | N/A | ~~FFS – RAN4 is still discussing the applicable scenarios~~  The feature is applicable for the following scenarios:  1) single carrier DL/UL in FR1 bands  2) FR1 CA/DC with single UL carrier  3) FR1 CA/DC with inter-band UL CA with at least one indicated band supporting the power boosting, where a single CC is used for transmission in each power boosted uplink band.  4) FR1-FR2 CA/DC with at least one indicated FR1 band supporting the power boosting, where a single FR1 UL CC is used for transmission in uplink FR1 band.  FFS for FR1 CA/DC with intra-band UL CA | Optional with capability signalling |
| 41.NR\_cov\_enh2 | 42-3 | Power boosting for DFT-s-OFDM pi/2 BPSK and QPSK transmissions with modified spectrum flatness requirement shaping | 1. Support of UE power boosting for DFT-s-OFDM pi/2 BPSK and QPSK with modified spectrum flatness requirement for PC3 and PC2 MPR reduction, when applicable as defined in 6.2 of TS 38.101-1. The power boosting is only enabled when signalled via RCC powerBoostPi2BPSKRel18 for BPSK and powerBoostQPSKRel18 for QPSK | 1-6, 1-7 | Yes | N/A | UE cannot power boost with modified spectrum flatness requirement | Per FS | NO | FR1 only | N/A | ~~FFS – RAN4 is still discussing the applicable scenarios~~  The feature is applicable for the following scenarios:  1) single carrier DL/UL in FR1 bands  2) FR1 CA/DC with single UL carrier  3) FR1 CA/DC with inter-band UL CA with at least one indicated band supporting the power boosting, where a single CC is used for transmission in each power boosted uplink band.  4) FR1-FR2 CA/DC with at least one indicated FR1 band supporting the power boosting, where a single FR1 UL CC is used for transmission in uplink FR1 band.  FFS for FR1 CA/DC with intra-band UL CA | Optional with capability signalling |

1. Netw\_Energy\_NR

**Recommended WF:**

**Discuss the following new proposal from Intel.**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
|  | 42-2 | SCell without SS/PBCH block for intra-band non-contiguous CA | Support of SCell without SS/PBCH block for intra-band non-contiguous CA |  | Yes | NA | UE does not support SCell without SS/PBCH block for intra-band non-contiguous CA | Per FS | NA | FR1 only | NA | For each carrier within the combination, UE indicates if it supports the SSB-less operation when any of the carrier can be the reference carrier and other(s) in the combination be the SSB-less carrier(s).  If UE indicates ‘support’ for a combination, it means all the carriers in the combination can be configured as SSB-less carriers. | Optional with capability signalling |