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Technical Report

3rd Generation Partnership Project;

Technical Specification Group Radio Access Network;

NR;

User Equipment (UE) feature list

(Release 17)

 

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# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

In the present document, certain modal verbs have the following meanings:

**shall** indicates a mandatory requirement to do something

**shall not** indicates an interdiction (prohibition) to do something

NOTE 1: The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

NOTE 2: The constructions "must" and "must not" are not used as substitutes for "shall" and "shall not". Their use is avoided insofar as possible, and they are not used in a normative context except in a direct citation from an external, referenced, non-3GPP document, or so as to maintain continuity of style when extending or modifying the provisions of such a referenced document.

**should** indicates a recommendation to do something

**should not** indicates a recommendation not to do something

**may** indicates permission to do something

**need not** indicates permission not to do something

NOTE 3: The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

**can** indicates that something is possible

**cannot** indicates that something is impossible

NOTE 4: The constructions "can" and "cannot" shall not to be used as substitutes for "may" and "need not".

**will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document

**might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

**might not** indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

**is** (or any other verb in the indicative mood) indicates a statement of fact

**is not** (or any other negative verb in the indicative mood) indicates a statement of fact

NOTE 5: The constructions "is" and "is not" do not indicate requirements.

# 1 Scope

The present document provides the list of UE features for NR. For each NR UE feature, the corresponding field name of UE capability, as specified in TS 38.331 [2] is also captured in this document. The Release 15 UE feature list described in clause 4 reflects the status of Release 15 in June 2019 and has not been maintained after this date. The Release 16 UE feature list described in clause 5 reflects the status of Release 16 in June 2021 and has not been maintained after this date.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification".

[3] 3GPP R1-1907862: "RAN1 NR UE features", contribution to TSG-RAN WG1 meeting #XX.

[4] 3GPP R2-1906665: "Update of L2/3 feature lists", contribution to TSG-RAN WG2 meeting #105bis.

[5] 3GPP R4-1907593: "RAN4 NR UE features", contribution to TSG-RAN WG4 meeting #XX.

[6] 3GPP R1-2106160: "Updated RAN1 UE features list for Rel-16 NR after RAN1#105-e", contribution to TSG-RAN WG1 meeting #105-e.

[7] 3GPP R2-2100378:"RAN2 UE features list for Rel-16 NR", contribution to TSG-RAN WG2 meeting #113e.

[8] 3GPP R4-2108334:"Updated RAN4 UE features list for Rel-16", contribution to TSG-RAN WG4 meeting #99-e.

[9] 3GPP TS 37.355: "LTE Positioning Protocol (LPP)".

[10] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[11] 3GPP TS 38.340: "NR; Backhaul Adaptation Protocol (BAP) specification".

[12] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[13] 3GPP TS 37.324: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Service Data Adaptation Protocol (SDAP) specification".

[14] 3GPP TS 36.306: "UE Radio Access capabilities".

[15] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) specification".

[16] 3GPP TS 38.300: "NR; NR and NG-RAN Overall description; Stage-2".

[17] 3GPP R1-2212895: "Updated RAN1 UE features list for Rel-17 NR after RAN1#111".

[18] 3GPP R4-2215143: "Rel-17 RAN4 UE feature list for NR".

[19] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in idle mode and in RRC Inactive state".

[20] 3GPP TS 38.214: "NR; Physical layer procedures for data".

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

**example:** text used to clarify abstract rules by applying them literally.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

# 4 Release 15 UE feature list

## 4.1 Layer-1 UE features

Table 4.1-1 provides the list of Layer-1 features, as shown in [3] and the corresponding UE capability field name, as specified in TS 38.331 [2].

Table 4.1-1: Layer-1 feature list

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 0. Waveform, modulation, subcarrier spacings, and CP | 0-1 | CP-OFDM waveform for DL and UL | 1) CP-OFDM for DL  2) CP -OFDM for UL |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 0-2 | DFT-S-OFDM waveform for UL | Transform precoding for single-layer PUSCH |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 0-3 | DL modulation scheme | 1) QPSK modulation  2) 16QAM modulation  3) 64QAM modulation for FR1 |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 0-4 | UL modulation scheme | 1) QPSK modulation  2) 16QAM modulation |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 0-5 | Extended CP | Extended CP | 1-1 in Table 4.3-1 | *extendedCP* | *BandNR* | n/a | n/a |  | Optional with capability signalling |
| 1. Initial access and mobility | 1-1 | Basic initial access channels and procedures | 1) RACH preamble format  2) SS block based RRM measurement  3) Broadcast SIB reception including RMSI/OSI and paging |  | n/a | n/a | No | No | Broadcast SIB reception including RMSI/OSI and paging are components of basic initial access channels and procedures for NR standalone and NE-DC | Mandatory without capability signalling |
| 1-2 | SS block based SINR measurement (SS-SINR) | SS-SINR measurement | 1-1 | *ss-SINR-Meas* | *MeasAndMobParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 1-3 | SS block based RLM | SS block based RLM | 1-1 | *ssb-RLM* | *MeasAndMobParametersCommon* | No | No |  | Mandatory with capability signalling which shall be set to '1' |
| 1-4 | CSI-RS based RRM measurement with associated SS-block | 1) CSI-RSRP measurement  2) CSI-RSRQ measurement | 1-1, CSI-RS | *csi-RSRP-AndRSRQ-MeasWithSSB* | *MeasAndMobParametersFRX-Diff* | No | Yes | This does not discourage RAN4 to complete their work. There is expectation that RAN4 will complete the corresponding RRM measurement | Optional with capability signalling |
| 1-5 | CSI-RS based RRM measurement without associated SS-block | 1) CSI-RSRP measurement  2) CSI-RSRQ measurement  3) There is SS-block in the target frequency on which the RRM measurement is performed | 1-1, CSI-RS | *csi-RSRP-AndRSRQ-MeasWithoutSSB* | *MeasAndMobParametersFRX-Diff* | No | Yes | This does not discourage RAN4 to complete their work. There is expectation that RAN4 will complete the corresponding RRM measurement | Optional with capability signalling |
| 1-6 | CSI-RS based RS-SINR measurement | CSI-SINR measurements | 1-1, 1-4 | *csi-SINR-Meas* | *MeasAndMobParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 1-7 | CSI-RS based RLM | CSI-RS based RLM | 1-1, CSI-RS | *csi-RS-RLM* | *MeasAndMobParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 1-8 | RLM based on a mix of SS block and CSI-RS signals within active BWP | RLM based on a mix of SS block and CSI-RS signals within active BWP | 1-3 and 1-7 | *ssb-AndCSI-RS-RLM* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 1-9 | CSI-RS based contention free RA for HO | CSI-RS based contention free RA for HO | 1-1, CSI-RS, 1-4 or 1-5 | *csi-RS-CFRA-ForHO* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 1-10 | Support of SCell without SS/PBCH block | Support SCell without SS/PBCH block | 1-1 | *scellWithoutSSB* | *FeatureSetDownlink* | n/a | n/a | Component 1) Whether or not UE is able to use SS/PBCH block from other Cells for time/frequency synchronization of SCell without SS/PBCH block | Mandatory with capability signalling for intra-band CA  This feature is not supported for inter band CA |
| 1-11 | Support of CSI-RS RRM measurement for SCell without SS/PBCH block |  | 1-10 | *csi-RS-MeasSCellWithoutSSB* | *FeatureSetDownlink* | n/a | n/a |  | Optional with capability signalling |
| 1-12 | E-UTRA RS-SINR measurement |  |  | *rs-SINR-MeasEUTRA* | *EUTRA-ParametersCommon* | No | No |  | Optional with capability signalling |
| 1-13 | Maximal number of CSI-RS resources for RRM and RS-SINR measurement across all measurement frequencies per slot |  | 1-4 or 1-5 or 1-6 | *maxNumberCSI-RS-RRM-RS-SINR* | *MeasAndMobParametersCommon* | No | No | If UE supports any of 1-5, 1-5a, and 1-6, UE shall report this capability 1-13 | Candidate value set: {4,8,16,32,64, 96} |
| 1-14 | Maximal number of CSI-RS resources within a slot per PCell/PSCell for CSI-RS based RLM |  | 1-7 or 1-8 | *maxNumberResource-CSI-RS-RLM* | *MeasAndMobParametersFRX-Diff* | No | Yes | If UE supports any of 1-7 and 1-8, UE shall report this capability 1-14 | Candidate value set: {2,4, 6, 8} |
| 2. MIMO | 2-1 | Basic PDSCH reception | 1) Data RE mapping  2) Single layer transmission  3) Support one TCI state |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 2-2 | PDSCH beam switching | 1) Time duration (definition follows clause 5.1.5 in TS 38.214), Xi, to determine and apply spatial QCL information for corresponding PDSCH reception.  Time duration is defined counting from end of last symbol of PDCCH to beginning of the first symbol of PDSCH.  Xi is the number of OFDM symbols, i is the index of SCS, l=1,2, corresponding to 60,120 kHz SCS. | 2-1 | *timeDurationForQCL* | *FeatureSetDownlink* | No | Applicable only to FR2 |  | Mandatory with capability signalling for FR2  Candidate value set for X1 is {7, 14, 28},  Candidate value set for X2, {14, 28} |
| 2-3 | PDSCH MIMO layers | Supported maximal number of MIMO layers | 2-1 | *maxNumberMIMO-LayersPDSCH* | *FeatureSetDownlinkPerCC* | n/a | n/a |  | For single CC standalone NR, it is mandatory with capability signalling to support at least 4 MIMO layers in the bands where 4Rx is specified as mandatory for the given UE and at least 2 MIMO layers in FR2.  Some relaxations to this requirement may be applicable in the future (including in Rel-15).  Mandatory in all cases means mandatory with capability signalling.  It is not expected that there is a signalling change (i.e. signalling remains to be defined as {1, 2, 4, 8} in every band and every band combination, including FR1 and FR2 in all cases. |
| 2-4 | TCI states for PDSCH | 1) Support number of active TCI states per BWP per CC, including control and data  2) Maximum number of configured TCI states per CC for PDSCH | 2-1 | *tci-StatePDSCH {*  1. *maxNumberActiveTCI-PerBWP*  2. *maxNumberConfiguredTCIstatesPerCC*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | UE is required to track only the active TCI states  For component 1 of FG2-4, if a UE reports X active TCI state(s), it is not expected that more than X active QCL type D assumption(s) for any PDSCH and any CORESETs for a given BWP of a serving cell become active for the UE. | Mandatory with capability signalling  Component-1: Candidate value set: {1, 2, 4, 8}  Component-2: candidate value set: {4, 8, 16, 32, 64, 128}  UE is mandated to signal 64 for FR2.  For FR1, UE is mandated to report at least the max number of allowed SSB in the band. |
| 2-4a | Additional active TCI state for PDCCH | Support one additional active TCI state for control in addition to the supported number of active TCI states for PDSCH | 2-1 | *additionalActiveTCI-StatePDCCH* | *MIMO-ParametersPerBand* | n/a | n/a | Only applicable if Component-1 of 2-4 is set to 1 | Mandatory with capability signalling |
| 2-5 | Basic downlink DMRS  for scheduling type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols for at least one port. | 2-1 | n/a | n/a | n/a | n/a | conditioned to whether PDSCH scheduling type A is supported | Mandatory without capability signalling (condition to scheduling capability) |
| 2-6 | Basic downlink DMRS  for scheduling type B | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol |  | n/a | n/a | n/a | n/a | conditioned to whether PDSCH scheduling type B is supported | Mandatory without capability signalling (condition to scheduling capability) |
| 2-6a | Support 1+2 DMRS (downlink) | Support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port | 2-5 | *oneFL-DMRS-TwoAdditionalDMRS-DL* | *FeatureSetDownlink-v1540* | No | Yes |  | Mandatory with capability signalling |
| 2-6b | Support alternative additional DMRS location | Support alternative additional DMRS position for co-existence with LTE CRS | 2-5 and 5-28 | *additionalDMRS-DL-Alt* | *FeatureSetDownlink-v1540* | No | n/a | This FG applies to FR1 only and 15kHz SCS. This applies to one additional DMRS case only | Optional with capability signalling |
| 2-7 | Supported 2 symbols front-loaded DMRS (downlink) | Support 2 symbols FL-DMRS | 2-5 | *twoFL-DMRS* (MSB) | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 2-8 | Supported 2 symbols front-loaded +2 symbols additional DMRS (downlink) | Support 2-symbol FL DMRS + one additional 2-symbols DMRS | 2-5 | *twoFL-DMRS-TwoAdditionalDMRS-DL* | *FeatureSetDownlink-v1540* | No | Yes |  | Optional with capability signalling |
| 2-9 | Support 1+3 DMRS symbols(downlink) | Support 1 symbol FL DMRS and 3 additional DMRS symbols | 2-5 | *oneFL-DMRS-ThreeAdditionalDMRS-DL* | *FeatureSetDownlink-v1540* | No | Yes |  | Optional with capability signalling |
| 2-10 | Support DMRS type (downlink) | Support DMRS {type 1, both type 1 and type 2} |  | *supportedDMRS-TypeDL* | *Phy-ParametersFRX-Diff* | No | Yes |  | Type 1 is mandatory with capability signalling.  Type 2 is optional with capability signalling |
| 2-11 | Downlink dynamic PRB bundling (downlink) | Support dynamic PRB bundling indication via DCI | 2-1 | *dynamicPRB-BundlingDL* | *Phy-ParametersCommon* | No | No | Support of semi-static PRB bundling is mandatory | Optional with capability signalling |
| 2-12 | Basic PUSCH transmission | Data RE mapping  Single layer (single Tx) transmission  Single port, single resource SRS transmission (SRS set use is configured as for codebook) |  | n/a | n/a | n/a | n/a | Support of SRS set usage configured as for codebook does not imply UE support of codebook based PUSCH MIMO transmission. | Mandatory without capability signalling |
| 2-13 | PUSCH codebook coherency subset | Supported codebook coherency subset type | 2-12 | *pusch-TransCoherence* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with UE capability  Candidate value set: {non-coherent, partial/non-coherent, full/partial/non-coherent} |
| 2-14 | Codebook based PUSCH MIMO transmission | 1) Supported codebook based PUSCH MIMO with maximal number of supported layers  2) Supported max number of SRS resource per set (SRS set use is configured as for codebook). | 2-13 | *mimo-CB-PUSCH {*  1. *maxNumberMIMO-LayersCB-PUSCH*  2. *maxNumberSRS-ResourcePerSet*  *}* | *FeatureSetUplinkPerCC* | n/a | n/a | For SUL, uplink MIMO is not supported. | Optional with UE capability  Component-1:  Candidate value: {no-codebook based MIMO, 1, 2, 4}  Component-2  Candidate value: {1, 2} |
| 2-15 | non-codebook based PUSCH transmission | 1) Maximal number of supported layers (non-codebook transmission scheme)  2) Supported max number of SRS resource per set (SRS set use is configured as for non-codebook transmission).  3) Maximum number of simultaneous transmitted SRS resources at one symbol | 2-12 | 1. *maxNumberMIMO-LayersNonCB-PUSCH*  *mimo-NonCB-PUSCH {*  2. *maxNumberSRS-ResourcePerSet*  3. *maxNumberSimultaneousSRS-ResourceTx*  *}* | 1. *FeatureSetUplinkPerCC*  2, 3. *FeatureSetUplinkPerCC-v1540* | n/a | n/a | For SUL, uplink MIMO is not supported | Optional with UE capability  Component-1 candidate values: {1, 2, 4}  Component-2  Candidate value: {1,2,3,4}  Component-3  Candidate value: {1,2,3,4} |
| 2-15a | Association between CSI-RS and SRS | 1) Support association between NZP-CSI-RS and SRS resource set via RRC parameter "SRSresoureset" 2) A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously. | 2-15 | *srs-AssocCSI-RS*  *SEQUENCE (SIZE (1..maxNrofCSI-RS-Resources)) OF {*  2.1. *maxNumberTxPortsPerResource*  2.2. *maxNumberResourcesPerBand*  2.3. *totalNumberTxPortsPerBand*  *}* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signalling  Component-2:  Maximum size of the list is 16.  the candidate values for the max # of Tx port in one resource is  {2, 4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {from 1 to 64}  The candidate value set of total # of ports is:  {from 2 to 256} |
| *csi-RS-IM-ReceptionForFeedbackPerBandComb {*  2.2. *maxNumberSimultaneousNZP-CSI-RS-ActBWP-AllCC*  2.3. *totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC*  *}* | *CA-ParametersNR-v1540* |
| 2-15b | CSI-RS processing framework for SRS | 1) Maximum number of periodic SRS resources associated with CSI-RS per BWP  2) Maximum number of aperiodic SRS resources associated with CSI-RS per BWP  3) Maximum number of semi-persistent SRS resources associated with CSI-RS per BWP  4) UE can process Y SRS resources associated with CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS.  5) UE can process X SRS resources associated with CSI-RS resources simultaneously across all CCs. Includes P/SP/A SRS. | 2-15a | *csi-RS-ProcFrameworkForSRS {*  1. *maxNumberPeriodicSRS-AssocCSI-RS-PerBWP*  2. *maxNumberAperiodicSRS-AssocCSI-RS-PerBWP*  3. *maxNumberSP-SRS-AssocCSI-RS-PerBWP*  4. *simultaneousSRS-AssocCSI-RS-PerCC*  } | *MIMO-ParametersPerBand*  *Phy-ParametersFRX-Diff* (for FR1 + FR2 band combination) | n/a | n/a | Other MIMO capabilities than component 5 may further restrict (reduce) the number of SRS associated with CSI-RS that the UE has to simultaneously derive. | Optional with capability signalling  Component-1 candidate values: {1, 2, 3, 4}  Component-2 candidate values {1, 2, 3, 4}  Component-3 candidate values: {0, 1, 2, 3, 4}  Component-4  candidate values: {from 1 to 8}  Component-5:  candidate values: {from 5 to 32} |
| 5. *simultaneousSRS-AssocCSI-RS-AllCC* | *CA-ParametersNR-v1540* |
| 2-16 | Basic uplink DMRS (uplink) for scheduling type A | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbols  3) Support 1 symbol FL DMRS and 2 additional DMRS symbols |  | n/a | n/a | n/a | n/a | Conditioned to whether PUSCH scheduling type A is supported | Mandatory without capability signalling |
| 2-16a | Basic uplink DMRS  for scheduling type B | 1) Support 1 symbol FL DMRS without additional symbol(s)  2) Support 1 symbol FL DMRS and 1 additional DMRS symbol |  | n/a | n/a | n/a | n/a | conditioned to whether PUSCH scheduling type B is supported | Mandatory without capability signalling |
| 2-16b | Support 1+2 DMRS (uplink) | Support 1 symbol FL DMRS and 2 additional DMRS symbols for more than one port | 2-16a and 2-16 | *oneFL-DMRS-TwoAdditionalDMRS-UL* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 2-17 | Support DMRS type (uplink) | Support DMRS {type 1, both type 1 and type 2} | 2-16 | *supportedDMRS-TypeUL* | *Phy-ParametersFRX-Diff* | No | Yes |  | Support both type 1 and type 2 are mandatory with capability signalling |
| 2-18 | Supported 2 symbols front-loaded DMRS (uplink) | Support 2 symbols FL-DMRS | 2-16 | *twoFL-DMRS* (LSB) | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 2-18a | Supported 2 symbols front-loaded +2 symbols additional DMRS (uplink) | Support 2-symbol FL DMRS + one additional 2-symbols DMRS | 2-16 | *twoFL-DMRS-TwoAdditionalDMRS-UL* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 2-19 | Support 1+3 uplink DMRS symbols(uplink) | Support 1 symbol FL DMRS and 3 additional DMRS symbols | 2-16 | *oneFL-DMRS-ThreeAdditionalDMRS-UL* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 2-20 | Beam correspondence | Support Beam correspondence |  | *beamCorrespondenceWithoutUL-BeamSweeping* | *MIMO-ParametersPerBand* | No | Applicable only to FR2 | Beam correspondence means each Tx port can be beamformed in a desirable direction but does not imply setting phase across ports. | Mandatory with capability signalling  - UE that fulfils the beam correspondence requirement without the uplink beam sweeping shall set the bit to 1  - UE that fulfils the beam correspondence requirement with the uplink beam sweeping shall set the bit to 0 |
| 2-21 | Periodic beam report | 1) Support report on PUCCH formats over 1 – 2 OFDM symbols once per slot  2) Support report on PUCCH formats over 4 – 14 OFDM symbols once per slot |  | *periodicBeamReport* | *MIMO-ParametersPerBand* | n/a | n/a |  | Mandatory with capability signalling for both FR1 and FR2 |
| 2-22 | Aperiodic beam report | Support aperiodic report on PUSCH |  | *aperiodicBeamReport* | *MIMO-ParametersPerBand* | n/a | n/a |  | Mandatory with capability signalling for both FR1 and FR2 |
| 2-23 | Semi-persistent beam report on PUCCH | 1) Support report on PUCCH formats over 1 – 2 OFDM symbols once per slot (or piggybacked on a PUSCH)  2) Support report on PUCCH formats over 4 – 14 OFDM symbols once per slot (or piggybacked on a PUSCH) |  | *sp-BeamReportPUCCH* | *MIMO-ParametersPerBand* | n/a | Yes |  | Optional with capability signalling |
| 2-23a | Semi-persistent beam report on PUSCH | Support semi-persistent report on PUSCH |  | *sp-BeamReportPUSCH* | *MIMO-ParametersPerBand* | n/a | Yes |  | Optional with capability signalling |
| 2-24 | SSB/CSI-RS for beam measurement | 1) The max number of SSB/CSI-RS (1Tx) resources (sum of aperiodic/periodic/semi-persistent) across all CCs configured to measure L1-RSRP within a slot shall not exceed MB\_1  2) The max number of CSI-RS resources (sum of aperiodic/periodic/semi-persistent) across all CCs configured to measure L1-RSRP shall not exceed MC\_1  3) The max number of CSI-RS (2Tx) resources (sum of aperiodic/periodic/semi-persistent) across all CCs to measure L1-RSRP within a slot shall not exceed MB\_2  4) Supported density of CSI-RS  5) The max number of aperiodic CSI-RS resources across all CCs configured to measure L1-RSRP shall not exceed MD\_1 | 2-21, 2-22 or 2-23, 2-23a | *beamManagementSSB-CSI-RS* {  1. *maxNumberSSB-CSI-RS-ResourceOneTx*  2. *maxNumberCSI-RS-Resource*  3. *maxNumberCSI-RS-ResourceTwoTx*  4. *supportedCSI-RS-Density*  5. *maxNumberAperiodicCSI-RS-Resource*  } | *MIMO-ParametersPerBand* | No | Yes |  | Mandatory with capability signalling  Component-1, candidate value set for MB\_1 is {0, 8, 16, 32, 64}  On FR2, UE is mandated to signal MB\_1 >=8  On FR1, MB\_1 >=8 is supported mandatory with capability signalling.  Component-2, candidate value set for MC\_1 is {0, 4, 8, 16, 32, 64}  For FR1, UE is mandated to report at least 8.  Component-3, candidate value set for MB\_2 is {0, 4, 8, 16, 32, 64}  Component-4: candidate value set:  {"not supported", "1 only", "3 only", "both 1 and 3"}  On FR2, UE is mandated to signal either "3 only" or "both 1 and 3"  On FR1, either "3 only" or "both 1 and 3" is mandatory with UE capability signalling.  Component-5, candidate value set for MD\_2 is {0, 1, 4, 8, 16, 32, 64}  For both FR1 and FR2, UE is mandated to report at least 4 |
| 2-25 | Beam reporting timing | The number of symbols, Xi, between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing beam report is at least RBi, where  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS. | 2-24 | *beamReportTiming* | *MIMO-ParametersPerBand* | n/a | n/a |  | Mandatory with capabilit  Candidate value sets:  X1 is {2, 4, 8}  X2 is {4, 8, 14, 28}  X3 is {8,14, 28}  X4 is{14,28, 56} |
| 2-26 | Receiving beam selection using CSI-RS resource repetition "ON" | 1. Support Rx beam switching procedure using CSI-RS resource repetition "ON"  2. Recommended CSI-RS resource repetition number per resource set, |  | *maxNumberRxBeam* | *MIMO-ParametersPerBand* | n/a | n/a |  | Mandatory with UE capability at least for FR2  Componet-2: candidate value set {2, 3, 4, 5, 6, 7, 8} |
| 2-27 | Beam switching | Maximum number of Tx + Rx beam changes a UE can conduct during a slot across the whole band CC B\_(B\_Total,). This number is defined as per SCS | 2-24 | *maxNumberRxTxBeamSwitchDL* | *MIMO-ParametersPerBand* | n/a | Applicable only to FR2 | It is assumed that spec enable the possibility to restrict the same beam across intra-band CCs | Optional with capability signalling  Candidate value set: {4, 7, 14} |
| 2-28 | A-CSI-RS beam switching timing | Minimum time between the DCI triggering of AP-CSI-RS and aperiodic CSI-RS transmission shall be at least KBi symbols. (Symbols measured from last symbol containing the indication to first symbol of CSI-RS), where  i is the index of SCS, l=1,2 corresponding to 60,120 kHz SCS. |  | *beamSwitchTiming* | *MIMO-ParametersPerBand* | n/a | Applicable only to FR2 |  | Optional with capability signalling  Candidate values:  {14, 28, 48, 224, 336} |
| 2-29 | Non-group based beam reporting | Support of non-group based RSRP reporting with N\_max RSRP values reported |  | *maxNumberNonGroupBeamReporting* | *MIMO-ParametersPerBand* | n/a | n/a |  | Mandatory with capability for both FR1 and FR2  candidate value set is {1, 2, 4} |
| 2-29a | Group based beam reporting | Support of beam group RSRP reporting for group of 2 beams |  | *groupBeamReporting* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signalling |
| 2-30 | Uplink beam management | 1) Support of SRS based beam management  2) Supported max number of SRS resource per set (SRS set use is configured as for beam management).  3) Supported max number of SRS resource sets (SRS set use is configured as for beam management). |  | *uplinkBeamManagement* {  2. *maxNumberSRS-ResourcePerSet-BM*  3. *maxNumberSRS-ResourceSet*  } | *MIMO-ParametersPerBand* | n/a | n/a | Component-3 also impose additional constraint on the maximum number of SRS resource sets per supported time domain behaviour (periodic/semi-persistent/aperiodic) as {1,1,1,2,2,2,4,4} corresponding to reported values {from 1 to 8} | Optional with capability signalling  - Capability signalling shall be set to 1 if 2-20 is set to 0  - For the UE meeting the minimum peak EIRP and spherical coverage requirements without the uplink beam sweeping, this feature is optional  Component-2, candidate value set is {2, 4, 8, 16}  Component-3, candidate value set is {from 1 to 8} |
| 2-31 | Beam failure recovery | 1) Maximal number of CSI-RS resources across all CCs for UE to monitor PDCCH quality  2) Maximal number of different SSBs across all CCs for UE to monitor PDCCH quality  3) Maximal number of different CSI-RS and/or SSB resources across all CCs for new beam identifications. | 1-7 for CSI-RS based BFD/BFR | 1. *maxNumberCSI-RS-BFD*  2. *maxNumberSSB-BFD*  3. *maxNumberCSI-RS-SSB-CBD* | *MIMO-ParametersPerBand* | n/a | n/a |  | Mandatory with capability signalling for FR2  Optional with capability signalling for FR1  Component-1 candidate value set: {from 1 to 16}  Component-2 candidate: {from 1 to 16}  Component-3:  Candidate value set is: {from 1 to 128}  UE is mandated to support at least 32 for FR2 |
| 2-32 | Basic CSI feedback | 1) Type I single panel codebook based PMI (further discuss which mode or both to be supported as mandatory)  2) 2Tx codebook for FR1 and FR2  3) 4Tx codebook for FR1  4) 8Tx codebook for FR1 when configured as wideband CSI report  5) p-CSI on PUCCH formats over 1 – 2 OFDM symbols once per slot (or piggybacked on a PUSCH)  6) p-CSI report on PUCCH formats over 4 – 14 OFDM symbols once per slot (or piggybacked on a PUSCH)  7) a-CSI on PUSCH (at least Z value >= 14 symbols, detail processing time to be discussed separately)  further check a-CSI on p-CSI-RS and/or SP-CSI-RS from component-7 |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 2-32a | Semi-persistent CSI report on PUCCH | 1) Support report on PUCCH formats over 1 – 2 OFDM symbols once per slot (or piggybacked on a PUSCH) s  2) Support report on PUCCH formats over 4 – 14 OFDM symbols once per slot (or piggybacked on a PUSCH) |  | *sp-CSI-ReportPUCCH* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 2-32b | Semi-persistent CSI report on PUSCH | Support semi-persistent CSI report on PUSCH |  | *sp-CSI-ReportPUSCH* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 2-32c | New CQI table | CQI table with target BLER of 10^-5 |  | *cqi-TableAlt* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 2-33 | CSI-RS and CSI-IM reception for CSI feedback | 1) Supported max # of configured NZP-CSI-RS resources per CC,  2) Supported max # of ports across all configured NZP-CSI-RS resources per CC  3) Supported max # of configured CSI-IM resources per CC  4) Supported max # simultaneous NZP-CSI-RS resources in active BWPs across all CCs  5) Supported max # simultaneous NZP-CSI-RS resources per CC  6) Supported max total # of CSI-RS ports in simultaneous NZP-CSI-RS resources in active BWPs across all CCs  7) Supported max total # of CSI-RS ports in simultaneous NZP-CSI-RS resources per CC | 2-32 | *csi-RS-IM-ReceptionForFeedback* {  1. *maxConfigNumberNZP-CSI-RS-PerCC*  2. *maxConfigNumberPortsAcrossNZP-CSI-RS-PerCC*  3. *maxConfigNumberCSI-IM-PerCC*  5. *maxNumberSimultaneousNZP-CSI-RS-PerCC*  7. *totalNumberPortsSimultaneousNZP-CSI-RS-PerCC*  } | *MIMO-ParametersPerBand*  *Phy-ParametersFRX-Diff* (for FR1 + FR2 band combination) | n/a | n/a | All the candidate values are the range of capability signalling which doesn't determine whether UE is mandatory to support all the signalling values. | Mandatory with capability signalling  Component-1 candidate values: {from 1 to 32}  Component-2 candidate values: {2, 4, 8, 12, 16, 24, 32, 40, 48 … ,256}  Component-3: candidate values: {1,2,4,8,16,32}  Component-4: candidate values {5, 6, 7, 8, 9, 10, 12, 14, 16, …, 62, 64} (includes all even numbers between 16 and 64)  Component-5: candidate values {1, 2, 3 … 32}  Component-6: candidate values {8, 16, 24, …, 248, 256}  Component-7: candidate values {8, 16, 24, … 128 } |
| *csi-RS-IM-ReceptionForFeedbackPerBandComb* {  4. *maxNumberSimultaneousNZP-CSI-RS-ActBWP-AllCC*  6. *totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC*  } | *CA-ParametersNR-v1540* |
| 2-33a | Supported PDSCH RE-mapping patterns | 1) Supported max # of RE mapping patterns, each pattern can be described as a resource (including NZP/ZP CSI-RS and CRS, CORESET and SSB and bitmap configured in 5-26/27)  Note: patterns are counted as per symbol per CC  2) Supported max # of RE mapping patterns, each pattern can be described as a resource (including NZP/ZP CSI-RS and CRS, CORESET and SSB and bitmap configured in 5-26/27/27a)  Note: patterns are counted as per slot per CC |  | 1. *pdsch-RE-MappingFR1-PerSymbol*  2. *pdsch-RE-MappingFR1-PerSlot* | *Phy-ParametersFR1* | No | Yes |  | Mandatory with capability signalling  candidate values: {10, 20} for FR1  {6, 20} for FR2  Compponent-2 candidate values: {from 16: 16: 256} for FR1  {16: 16: 256} for FR2 |
| 1. *pdsch-RE-MappingFR2-PerSymbol*  2. *pdsch-RE-MappingFR2-PerSlot* | *Phy-ParametersFR2* |
| 2-33b | SP CSI-RS | Support SP CSI-RS | 2-1 | *sp-CSI-RS* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 2-33c | SP CSI-IM | Support SP CSI-IM | 2-1 | *sp-CSI-IM* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 2-34 | NZP-CSI-RS based interference measurement | Support NZP-CSI-RS based interference measurement | 2-33 | *nzp-CSI-RS-IntefMgmt* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 2-35 | CSI report framework | 1) Maximum number of periodic CSI report setting per BWP for CSI report  2) Maximum number of periodic CSI report setting per BWP for beam report  3) Maximum number of aperiodic CSI report setting per BWP for CSI report  4) Maximum number of aperiodic CSI report setting per BWP for beam report  5) Maximum number of configured aperiodic CSI triggering states in *CSI-AperiodicTriggerStateList* per CC,  6) Maximum number of semi-persistent CSI report setting per BWP for CSI report  7) Maximum number of semi-persistent CSI report setting per BWP for beam report  8) UE can process Y CSI report(s) simultaneously in a CC. CSI reports can be P/SP/A CSI and any latency class and codebook type.  9) UE can process X CSI report(s) simultaneously across all CCs. CSI reports can be P/SP/A CSI and any latency class and codebook type. | 2-32 | *csi-ReportFramework* {  1. *maxNumberPeriodicCSI-PerBWP-ForCSI-Report*  2. *maxNumberAperiodicCSI-PerBWP-ForCSI-Report*  3. *maxNumberSemiPersistentCSI-PerBWP-ForCSI-Report*  4. *maxNumberPeriodicCSI-PerBWP-ForBeamReport*  5. *maxNumberAperiodicCSI-PerBWP-ForBeamReport*  6. *maxNumberAperiodicCSI-triggeringStatePerCC*  7. *maxNumberSemiPersistentCSI-PerBWP-ForBeamReport*  8. *simultaneousCSI-ReportsPerCC*  } | *MIMO-ParametersPerBand*  *Phy-ParametersFRX-Diff* (for FR1 + FR2 band combination) | n/a | n/a | Other MIMO capabilities than component 5 may further restrict (reduce) the number of simultaneously CSI report that UE is required to update  The CSI report in component 4 and 5 includes the beam report and CSI report  Each component is independent  CSI report setting are counted in the CC indicated by the parameter carrier in *CSI-ResourceConfig*. | Mandatory with capability signaling  Component-1 candidate values: {1, 2, 3, 4}  Component-1a candidate values: {1, 2, 3, 4}  Component-2 candidate values {1, 2, 3, 4}  Component-2a candidate values {1, 2, 3, 4}  Component-2b candidate values {3, 7, 15, 31, 63, 128}  Component-3 candidate values: {0, 1, 2, 3, 4}  Component-3a candidate values: {0, 1, 2, 3, 4}  Component-4  candidate values: {from 1 to 8}  Component-5:  candidate values: {from 5 to 32} |
| 9. *simultaneousCSI-ReportsAllCC* | *CA-ParametersNR-v1540* |
| 2-36 | Type I single panel codebook | 1) A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously. Note: the above list doesn't differentiate the latency class and feedback type.  2) Supported Codebook Mode(s)  3) Max # of CSI-RS resource in a resource set | 2-35 | 1. *supportedCSI-RS-ResourceList*  *SEQUENCE (SIZE (1..maxNrofCSI-RS-Resources)) OF* {  1.1. *maxNumberTxPortsPerResource*  1.2. *maxNumberResourcesPerBand*  1.3. *totalNumberTxPortsPerBand*  }  2. *modes*  3. *maxNumberCSI-RS-PerResourceSet* | *CodebookParameters* | No | n/a | Simultaneously doesn't mean in the same slot  For the purpose of component-1 calculation: CSI-RS resources and CSI-RS ports within one CSI-RS resource are counted N times if the CSI-RS resource is referred by N report settings. | Mandatory with capability signalling  Component-1:  Maximum size of the list is 16.  the candidate values for the max # of Tx port in one resource is  {2, 4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {from 1 to 64}  The candidate value set of total # of ports (including both channel and NZP-CSI-RS based interference measurement) is:  {from 2 to 256}  Component-2 candidate values:  {"Mode-1 only\2, "Mode-1 and Mode-2"}.  Component-3 Candidate values set: {1:8} |
| *csi-RS-IM-ReceptionForFeedbackPerBandComb* {  1.2. *maxNumberSimultaneousNZP-CSI-RS-ActBWP-AllCC*  1.3. *totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC*  } | *CA-ParametersNR-v1540* |
| 2-37 | Support Semi-open loop CSI | Support Semi-open loop CSI report | 2-35 | *semiOpenLoopCSI* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 2-38 | CSI report without PMI | Support CSI report without PMI | 2-35 | *csi-ReportWithoutPMI* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 2-39a | CSI report without CQI | Support CSI report without CQI | 2-35 | *csi-ReportWithoutCQI* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 2-40 | Type I multi-panel codebook | 1) A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously. Note: the above list doesn't differentiate the latency class and feedback type.  2) Supported Codebook Mode(s):  3) Supported number of panels, Ng  4) Max # of CSI-RS resource in a resource set | 2-35 | 1. *supportedCSI-RS-ResourceList*  *SEQUENCE (SIZE (1..maxNrofCSI-RS-Resources)) OF* {  1.1. *maxNumberTxPortsPerResource*  1.2. *maxNumberResourcesPerBand*  1.3. *totalNumberTxPortsPerBand*  }  2. *modes*  3. *nrofPanels*  4. *maxNumberCSI-RS-PerResourceSet* | *CodebookParameters* | n/a | n/a | Simultaneously doesn't mean in the same slot  For the purpose of component-1 calculation: CSI-RS resources and CSI-RS ports within one CSI-RS resource are counted N times if the CSI-RS resource is referred by N report settings. | Optional with capability signalling  Component-1:  Maximum size of the list is 16.  the candidate values for the max # of Tx port in one resource is  {8, 16, 32}  The candidate value set of the max # of resources is:  {from 1 to 64}  The candidate value set of total # of ports (including both channel and NZP-CSI-RS based interference measurement) is:  {from 2 to 256}  Component-2 candidate values:  {Mode-1, Mode-2, both}  Component-3:  Candidate value: {2,4}  Component-4: candidate value set is {1:8} |
| *csi-RS-IM-ReceptionForFeedbackPerBandComb* {  1.2. *maxNumberSimultaneousNZP-CSI-RS-ActBWP-AllCC*  1.3. *totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC*  } | *CA-ParametersNR-v1540* |
| 2-41 | Type II codebook | 1) A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously. Note: the above list doesn't differentiate the latency class and feedback type.  2) Parameter "Lx" (number of beams) in codebook generation, where x is index of Tx ports, corresponding to 4,8,12,16,24 and 32 ports.  3) Support amplitude scaling type  4) Support amplitude subset restriction level | 2-35 | 1. *supportedCSI-RS-ResourceList*  *SEQUENCE (SIZE (1..maxNrofCSI-RS-Resources)) OF* {  1.1. *maxNumberTxPortsPerResource*  1.2. *maxNumberResourcesPerBand*  1.3. *totalNumberTxPortsPerBand*  }  2. *parameterLx*  3. *amplitudeScalingType*  4. *amplitudeSubsetRestriction* | *CodebookParameters* | n/a | n/a | Simultaneously doesn't mean in the same slot  For the purpose of component-1 calculation: CSI-RS resources and CSI-RS ports within one CSI-RS resource are counted N times if the CSI-RS resource is referred by N report settings. | Optional with capability signalling  Component-1: Maximum size of the list is 16.  the candidate values for the max # of Tx port in one resource is  {4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {from 1 to 64}  The candidate value set of total # of ports (including both channel and NZP-CSI-RS based interference measurement) is:  {from 2 to 256}  Component-2, candidate values {2,3,4}  Component-3, candidate values set: {wideband, wideband/subband}  Component-4, candidate value set: {"no amplitude subset restriction", "support amplitude subset restriction"} |
| *csi-RS-IM-ReceptionForFeedbackPerBandComb* {  1.2. *maxNumberSimultaneousNZP-CSI-RS-ActBWP-AllCC*  1.3. *totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC*  } | *CA-ParametersNR-v1540* |
| 2-42 | Support Type II SP-CSI feedback on long PUCCH | Support type II SP-CSI feedback part-1 on PUCCH formats over 4 – 14 OFDM symbols once per slot | 2-41 | *type2-SP-CSI-Feedback-LongPUCCH* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 2-43 | Type II codebook with port selection | 1) A list of supported combinations, each combination is {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} across all CCs simultaneously. Note: the above list doesn't differentiate the latency class and feedback type.  2) Parameter "Lx" (number of selected ports) in codebook generation, where x is index of Tx ports, corresponding to 4,8,12,16,24 and 32 ports.  3) Support amplitude scaling type |  | 1. *supportedCSI-RS-ResourceList*  *SEQUENCE (SIZE (1..maxNrofCSI-RS-Resources)) OF* {  1.1. *maxNumberTxPortsPerResource*  1.2. *maxNumberResourcesPerBand*  1.3. *totalNumberTxPortsPerBand*  }  2. *parameterLx*  3. *amplitudeScalingType* | *CodebookParameters* | n/a | n/a | Simultaneously doesn't mean in the same slot  For the purpose of component-1 calculation: CSI-RS resources and CSI-RS ports within one CSI-RS resource are counted N times if the CSI-RS resource is referred by N report settings. | Optional with capability signalling  Component-1:  Maximum size of the list is 16.  the candidate values for the max # of Tx port in one resource is  {4, 8, 12, 16, 24, 32}  The candidate value set of the max # of resources is:  {from 1 to 64}  The candidate value set of total # of ports (including both channel and NZP-CSI-RS based interference measurement) is:  {from 2 to 256}  Component-2, candidate values set for "Lx" is {2,3,4}  Component-3, candidate values set: {wideband, wideband/subband}  Component-4: candidate value set is {1:8} |
| *csi-RS-IM-ReceptionForFeedbackPerBandComb* {  1.2. *maxNumberSimultaneousNZP-CSI-RS-ActBWP-AllCC*  1.3. *totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC*  } | *CA-ParametersNR-v1540* |
| 2-44 | Basic DL PTRS | Support 1 port of DL PTRS |  | *onePortsPTRS* (MSB) | *Phy-ParametersFRX-Diff* | n/a | Yes |  | Mandatory with capability signalling for FR2  Optional with capability signalling for FR1 |
| 2-46 | Downlink PTRS density recommendation | Preferred threshold sets, TSi for determine PTRS density, candidate value range is the same as that of downlink PTRS RRC configuration.  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS. | 2-44 | *ptrs-DensityRecommendationSetDL* {  1. *frequencyDensity1*  2. *frequencyDensity2*  3. *timeDensity1*  4. *timeDensity2*  5. *timeDensity3*  } | *MIMO-ParametersPerBand* | n/a | n/a | For each TSi, it composes of two values each selected from {1..276} for frequency density, and three values each selected from {0..29} for time density | Optional with capability signalling |
| 2-47 | Basic UL PTRS | Support 1 port of UL PTRS |  | *onePortsPTRS* (LSB) | *Phy-ParametersFRX-Diff* | n/a | Yes |  | Mandatory with capability signalling for FR2  Optional with capability signalling for FR1 |
| 2-48 | Uplink PTRS | Supported 2 ports of PTRS | 2-47 | *twoPortsPTRS-UL* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signalling |
| 2-49 | Uplink PTRS density recommendation | Preferred threshold sets, TSi, for determine PTRS density, candidate value range is the same as that of uplink PTRS RRC configuration.  i is the index of SCS, i=1,2,3,4 corresponding to 15,30,60,120 kHz SCS. | 2-47 | *ptrs-DensityRecommendationSetUL* {  1. *frequencyDensity1*  2. *frequencyDensity2*  3. *timeDensity1*  4. *timeDensity2*  5. *timeDensity3*  6. *sampleDensity1*  7. *sampleDensity2*  8. *sampleDensity3*  9. *sampleDensity4*  10. *sampleDensity5*  } | *MIMO-ParametersPerBand* | n/a | n/a | For each TSi, it composes of two values each selected from {1..276} for frequency density, and three values each selected from {0..29} for time density, and five values each selected from {1..276} for sample density | Optional with capability signalling |
| 2-50 | Basic TRS | 1) Support of TRS (mandatory)  2) All the periodicity are supported.  3) Support TRS bandwidth configuration as both "BWP" and "min(52, BWP)" |  | n/a | n/a | n/a | n/a | TRS bandwidth configuration does not imply UE processing bandwidth | Mandatory without capability signalling |
| 2-51 | TRS (CSI-RS for tracking) | 1) TRS burst length (X),  2) Max # of TRS resource sets (per CC) UE is able to track simultaneously  3) Max # of TRS resource sets configured to UE per CC  4) Max # of TRS resource sets configured to UE across CCs | 2-50 | *csi-RS-ForTracking* {  1. *maxBurstLength*  2. *maxSimultaneousResourceSetsPerCC*  3. *maxConfiguredResourceSetsPerCC*  4. *maxConfiguredResourceSetsAllCC*  } | *MIMO-ParametersPerBand* | n/a | n/a |  | Mandatory with capability signalling  Component-1:  candidate values {1, "both 1 and 2"}. UE is mandated to report "both 1 and 2"  Component-2: Candidate value set: {1 to 8}  Component-3: Candidate value set: {1 to 64}  UE is mandated to report at least 8 for FR1 and 16 for FR2.  Component-4: Candidate value set: {1 to 256}  UE is mandated to report at least 16 for FR1 and 32 for FR2. |
| 2-51a | Aperiodic TRS | DCI triggering Aperiodic TRS associated with periodic TRS | 2-50 | *aperiodicTRS* | *MIMO-ParametersPerBand* | n/a | Yes |  | Optional with capability signalling |
| 2-52 | Basic SRS | 1) Support 1 port SRS transmission  2) Support periodic/aperiodic SRS transmission  3) Support SRS Frequency intra/inter-slot hopping within BWP  4) At least one SRS resource per CC for aperiodic and periodic separately |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 2-53 | SRS resources | 1) Maximum number of aperiodic SRS resources (configured to UE) per BWP  2) Maximum number of aperiodic SRS resources (configured to UE) per BWP per slot  3) Maximum number of periodic SRS resources (configured to UE) per BWP  4) Maximum number of periodic SRS resources (configured to UE) per BWP per slot  5) Maximum number of semi-persistent SRS resources (configured to UE) per BWP  6) Maximum number of semi-persistent SRS resources (configured to UE) per BWP per slot  7) Maximum number of SRS port per resource | 2-52 | *supportedSRS-Resources* {  1. *maxNumberAperiodicSRS-PerBWP*  2. *maxNumberAperiodicSRS-PerBWP-PerSlot*  3. *maxNumberPeriodicSRS-PerBWP*  4. *maxNumberPeriodicSRS-PerBWP-PerSlot*  5. *maxNumberSemiPersitentSRS-PerBWP*  6. *maxNumberSP-SRS-PerBWP-PerSlot*  7. *maxNumberSRS-Ports-PerResource*  } | *FeatureSetUplink* | n/a | n/a |  | Mandatory with capability signalling  Component-1: candidate value: {from 1, 2, 4, 8, 16}  Component-2 candidate value: {1,2,3,4,5,6}  Component-3: candidate value: {from 1, 2, 4, 8, 16}  Component-4 candidate value: {1,2,3,4,5, 6}  Component-5: candidate value: {from 1, 2, 4, 8, 16} }  Component-6 candidate value: {1, 2,3,4,5, 6}  Component-7 candidate values: {1, 2, 4}  Support SP-SRS is mandatory with capability |
| 2-55 | SRS Tx switch | 1) Support SRS Tx port switch,  2) Report whether the uplink TX switching impact to downlink receiving in a band,  3) Report whether the UL Tx is switched together with UL Tx in another band | 2-53 | *srs-TxSwitch* {  1. *supportedSRS-TxPortSwitch*  2. *txSwitchImpactToRx*  3. *txSwitchWithAnotherBand*  } | *BandParameters-v1540* | n/a | n/a | Component-2 is per band pair per band combination  Component-3 is per band pair per band combination  The band pair in Component-2 and Component-3 can be an LTE band and an NR band  2T4R is 2 pairs of antennas  "R" refers to a subset/set of receive antennas for PDSCH; "T" refers to the SRS antennas used for DL CSI acquisition | Mandatory with capability signalling  Component-1 is a list of TRx pairs, candidates are {"Not supported", "1T2R", "1T4R", "2T4R", "1T4R/2T4R", "1T=1R", "2T=2R", "4T=4R"}  Component-2: Candidate value set: {yes, no}  Component-3: Candidate value set: {yes, no} |
| 2-56 | SRS carrier switch | Report inter-cell switching time capability | 2-53 | *srs-CarrierSwitch* {  *srs-SwitchingTimesListNR*, or  *srs-SwitchingTimesListEUTRA*  } | *BandParameters-v1540* | No | n/a | RAN4 reply LS, R1-1805817, includes candidate value sets | Optional with capability signalling |
| 2-58 | For SRS for CB PUSCH and antenna switching on FR1, zero slot offset for aperiodic SRS transmission | For SRS for CB PUSCH and antenna switching on FR1, support of zero slot offset between aperiodic SRS triggering and transmission | 2-53 | *zeroSlotOffsetAperiodicSRS* | *FeatureSetUplink-v1540* | n/a | n/a |  | Optional with capability signalling |
| 2-59 | Configured spatial relations | Maximum number of configured spatial relations per CC for PUCCH and SRS |  | *spatialRelations* {  2-59. *maxNumberConfiguredSpatialRelations*  2-60. *maxNumberActiveSpatialRelations*  2-61. *additionalActiveSpatialRelationPUCCH*  2-62. *maxNumberDL-RS-QCL-TypeD*  } | MIMO-ParametersPerBand | n/a | Only applicable to FR2 |  | Candidate value set: {4, 8, 16, 32, 64, 96}  UE is mandated to report 16 or higher values. |
| 2-60 | Active spatial relations | Maximum total number of {unique DL RS (except for aperiodic NZP CSI-RS) and SRS without spatial relation configured, and, TCI states available for DCI triggering of aperiodic NZP CSI-RS}, for indicating spatial domain transmit filter for PUCCH and SRS for PUSCH, per BWP per CC | 2-59 | n/a | Only applicable to FR2 | "Unique" means RS identity. An SSB and a CSI-RS are always counted as different. Two CSI-RSs are different if they have different CSI-RS resource IDs. | Mandatory with capability signalling  Candidate value set: {1, 2, 4, 8, 14} |
| 2-61 | Additional active spatial relation for PUCCH | Support one additional active spatial relation for PUCCH | 2-60 | n/a | n/a | Only applicable if 2-60 is set to 1. | Mandatory with capability signalling |
| 2-62 | Max number of downlink RS resources used for QCL type-D in the active TCI states and active spatial relation info | Max number of downlink RS resources in the active TCI states and active spatial relation info per CC | 2-4, 2-4a and 2-60 | n/a | n/a | Reference relationship follows 2-4/2-60 | Optional with capability signalling  Candidate value set: {1,2,4,8, 14} |
| 3. DL control channel and procedure | 3-1 | Basic DL control channel | 1) One configured CORESET per BWP per cell in addition to CORESET0  - CORESET resource allocation of 6RB bit-map and duration of 1 – 3 OFDM symbols for FR1  - For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSSs, CORESET resource allocation of 6RB bit-map and duration 1-3 OFDM symbols for FR2  - For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 1-2 OFDM symbols for FR2  - REG-bundle sizes of 2/3 RBs or 6 RBs  - Interleaved and non-interleaved CCE-to-REG mapping  - Precoder-granularity of REG-bundle size  - PDCCH DMRS scrambling determination  - TCI state(s) for a CORESET configuration  2) CSS and UE-SS configurations for unicast PDCCH transmission per BWP per cell  - PDCCH aggregation levels 1, 2, 4, 8, 16  - UP to 3 search space sets in a slot for a scheduled SCell per BWP  This search space limit is before applying all dropping rules.  - For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  - For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the monitoring occasion can be any OFDM symbol(s) of a slot, with the monitoring occasions for any of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS configurations within a single span of three consecutive OFDM symbols within a slot  3) Monitoring DCI formats 0\_0, 1\_0, 0\_1, 1\_1  4) Number of PDCCH blind decodes per slot with a given SCS follows Case 1-1 table  5) Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot per scheduled CC for FDD  6) Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot per scheduled CC for TDD |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 3-1' | For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 3 OFDM symbols for FR2 | For type 1 CSS with dedicated RRC configuration and for type 3 CSS, UE specific SS, CORESET resource allocation of 6RB bit-map and duration 3 OFDM symbols for FR2 |  | *type1-3-CSS* | *FeatureSetDownlink* | n/a | n/a |  | Mandatory with capability signalling |
| 3-2 | PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot | For a given UE, all search space configurations are within the same span of 3 consecutive OFDM symbols in the slot |  | *pdcchMonitoringSingleOccasion* | *Phy-ParametersFR1* | No | Applicable only to FR1 |  | Optional with capability signalling |
| 3-3 | More than one  CORESET configurations per BWP in addition to CORESET0 | More than one  CORESET configurations per BWP in addition to CORESET0 |  | *multipleCORESET* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling for FR1  Mandatory with capability signalling for FR2 |
| 3-4 | More than one TCI state configurations per CORESET | More than one TCI state configurations per CORESET |  | *multipleTCI* | *BandNR* | n/a | n/a | UE is only required to track one active TCI state per CORESET  UE is required to support minimum between 64 and number of configured TCI states in 2-4, component 2). | Mandatory with capability signaling which shall be set to '1' |
| 3-5 | For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 | For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 |  | *pdcch-MonitoringAnyOccasions* {  3-5. *withoutDCI-Gap*  3-5a. *withDCI-Gap*  } | *FeatureSetDownlink* | n/a | n/a |  | Optional with capability signalling |
| 3-5a | For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 with a DCI gap | For type 1 CSS with dedicated RRC configuration, type 3 CSS and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2, with minimum time separation (including the cross-slot boundary case) between two DL unicast DCIs, between two UL unicast DCIs, or between a DL and an UL unicast DCI in different monitoring occasions where at least one of them is not the monitoring occasions of FG-3-1, for a same UE as  - 2OFDM symbols for 15kHz  - 4OFDM symbols for 30kHz  - 7OFDM symbols for 60kHz with NCP  - 11OFDM symbols for 120kHz  Up to one unicast DL DCI and up to one unicast UL DCI in a monitoring occasion except for the monitoring occasions of FG 3-1.  In addition for TDD the minimum separation between the first two UL unicast DCIs within the first 3 OFDM symbols of a slot can be zero OFDM symbols. |  | n/a | n/a |  | Optional with capability signalling |
| 3-5b | All PDCCH monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 with a span gap | PDCCH monitoring occasions of FG-3-1, plus additional PDCCH monitoring occasion(s) can be any OFDM symbol(s) of a slot for Case 2, and for any two PDCCH monitoring occasions belonging to different spans, where at least one of them is not the monitoring occasions of FG-3-1, in same or different search spaces, there is a minimum time separation of X OFDM symbols (including the cross-slot boundary case) between the start of two spans, where each span is of length up to Y consecutive OFDM symbols of a slot. Spans do not overlap. Every span is contained in a single slot. The same span pattern repeats in every slot. The separation between consecutive spans within and across slots may be unequal but the same (X, Y) limit must be satisfied by all spans. Every monitoring occasion is fully contained in one span. In order to determine a suitable span pattern, first a bitmap b(l), 0<=l<=13 is generated, where b(l)=1 if symbol l of any slot is part of a monitoring occasion, b(l)=0 otherwise. The first span in the span pattern begins at the smallest l for which b(l)=1. The next span in the span pattern begins at the smallest l not included in the previous span(s) for which b(l)=1. The span duration is max{maximum value of all CORESET durations, minimum value of Y in the UE reported candidate value} except possibly the last span in a slot which can be of shorter duration. A particular PDCCH monitoring configuration meets the UE capability limitation if the span arrangement satisfies the gap separation for at least one (X, Y) in the UE reported candidate value set in every slot, including cross slot boundary.  For the set of monitoring occasions which are within the same span:  • Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for FDD  • Processing one unicast DCI scheduling DL and two unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD  • Processing two unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD  The number of different start symbol indices of spans for all PDCCH monitoring occasions per slot, including PDCCH monitoring occasions of FG-3-1, is no more than floor(14/X) (X is minimum among values reported by UE).  The number of different start symbol indices of PDCCH monitoring occasions per slot including PDCCH monitoring occasions of FG-3-1, is no more than 7.  The number of different start symbol indices of PDCCH monitoring occasions per half-slot including PDCCH monitoring occasions of FG-3-1 is no more than 4 in SCell. |  | *pdcch-MonitoringAnyOccasionsWithSpanGap*  (X, Y):  *set1* = (7, 3);  *set2* = (4, 3) and (7, 3);  *set3* = (2, 2) and (4, 3) and (7, 3). | *FeatureSetDownlink-v1540* | n/a | n/a | This capability is necessary for each SCS. | Optional with capability signalling  Candidate value set for (X, Y):  {(7, 3),  (4, 3) and (7, 3),  (2, 2) and (4, 3) and (7, 3)} |
| 3-6 | Dynamic SFI monitoring | Adjust periodic and semi-persistent signal reception and transmission in response to detected dynamic UL/DL configuration |  | *dynamicSFI* | *Phy-ParametersXDD-Diff*  *Phy-ParametersFRX-Diff* | Yes | Yes |  | Optional with capability signalling |
| 3-7 | Precoder-granularity of CORESET size | Precoder-granularity of CORESET size |  | *precoderGranularityCORESET* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 3-8 | Up to 10 search spaces in a SCell | Up to 10 search spaces in a slot in an SCell per BWP |  | *maxNumberSearchSpaces* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 4. UL control channel and procedure | 4-1 | Basic UL control channel | 1) PUCCH format 0 over 1 OFDM symbols once per slot  2) PUCCH format 0 over 2 OFDM symbols once per slot with frequency hopping as "enabled"  3) PUCCH format 1 over 4 – 14 OFDM symbols once per slot with intra-slot frequency hopping as "enabled"  5) One SR configuration per PUCCH group  6) HARQ-ACK transmission once per slot with its resource/timing determined by using the DCI  7)  SR/HARQ multiplexing once per slot using a PUCCH when SR/HARQ-ACK are supposed to be sent by overlapping PUCCH resources with the same starting symbols in a slot  8) HARQ-ACK piggyback on PUSCH with/without aperiodic CSI once per slot when the starting OFDM symbol of the PUSCH is the same as the starting OFDM symbols of the PUCCH resource that HARQ-ACK would have been transmitted on  9) Semi-static beta-offset configuration for HARQ-ACK  10) Single group of overlapping PUCCH/PUCCH and overlapping PUCCH/PUSCH s per slot per PUCCH cell group for control multiplexing |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 4-2 | 2 PUCCH of format 0 or 2 in consecutive symbols | 1) 2 PUCCH format 0/2 in different symbols and once per slot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per slot for SR  3) 2 PUCCH format 2 in different symbols and once per slot for CSI over two consecutive OFDM symbols |  | *twoPUCCH-F0-2-ConsecSymbols* | *Phy-ParametersXDD-Diff*  *Phy-ParametersFRX-Diff* | Yes | Yes |  | Optional with capability signalling |
| 4-3 | PUCCH format 2 over 1 – 2 OFDM symbols once per slot with frequency hopping as "enabled" | PUCCH format 2 over 1 – 2 OFDM symbols once per slot with frequency hopping as "enabled" |  | *pucch-F2-WithFH* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling which shall be set to '1' |
| 4-4 | PUCCH format 3 over 4 – 14 OFDM symbols once per slot with frequency hopping as "enabled" | PUCCH format 3 over 4 – 14 OFDM symbols once per slot with frequency hopping as "enabled" |  | *pucch-F3-WithFH* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling which shall be set to '1' |
| 4-5 | PUCCH format 4 over 4 – 14 OFDM symbols once per slot with frequency hopping as "enabled" | PUCCH format 4 over 4 – 14 OFDM symbols once per slot with frequency hopping as "enabled" |  | *pucch-F4-WithFH* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 4-6 | Non-frequency hopping for PUCCH formats 0 and 2 with frequency hopping as "disabled" | Non-frequency hopping for PUCCH formats 0 and 2 with frequency hopping as "disabled" |  | *freqHoppingPUCCH-F0-2* | *Phy-ParametersFRX-Diff* | No | Yes | The value indicated by this field is "*notSupported*". | Mandatory with capability signalling |
| 4-7 | Non-frequency hopping for PUCCH format 1, 3, and 4 with frequency hopping as "disabled" | Non-frequency hopping for PUCCH format 1, 3, and 4 with frequency hopping as "disabled" |  | *freqHoppingPUCCH-F1-3-4* | *Phy-ParametersFRX-Diff* | No | Yes | The value indicated by this field is "*notSupported*". | Mandatory with capability signalling |
| 4-10 | Dynamic HARQ-ACK codebook | Dynamic HARQ-ACK codebook |  | *dynamicHARQ-ACK-Codebook* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signaling which shall be set to '1' |
| 4-11 | Semi-static HARQ-ACK codebook | Semi-static HARQ-ACK codebook |  | *semiStaticHARQ-ACK-Codebook* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signalling |
| 4-12 | HARQ-ACK spatial bundling for PUCCH or PUSCH per PUCCH group | HARQ-ACK spatial bundling for PUCCH or PUSCH per PUCCH group |  | *spatialBundlingHARQ-ACK* | *Phy-ParametersCommon* | No | No | Applicable to UE supporting more than 4 layers | Mandatory with capability signalling |
| 4-13 | More than one SR configurations per PUCCH group | More than one SR configurations per PUCCH group |  | *multipleSR-Configurations* | *MAC-ParametersXDD-Diff* | Yes | No |  | Optional with capability signalling |
| 4-19 | SR/HARQ-ACK/CSI multiplexing once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with the same starting symbol on the PUCCH resources in a slot | SR/HARQ-ACK/CSI multiplexing once per slot, where overlapping PUCCH resources have the same starting symbols on the PUCCH resources in a slot while precluding the case of SR/HARQ-ACK by overlapping PUCCH resources with the same starting symbols on the PUCCH resources in a slot |  | *sameSymbol* in *mux-SR-HARQ-ACK-CSI-PUCCH-OncePerSlot* | *Phy-ParametersFRX-Diff* | No | Yes | If FG4-28 is not included or not supported, HARQ-ACK/CSI piggyback on PUSCH once per slot when the starting OFDM symbol of the PUSCH is the same as the starting OFDM symbols of the PUCCH resource(s) that would have been transmitted on  If FG4-28 is included and supported, HARQ-ACK/CSI piggyback on PUSCH once per slot for which case the starting OFDM symbol of the PUSCH is the different from the starting OFDM symbols of the PUCCH resource(s) that would have been transmitted on | Mandatory with capability signalling |
| 4-19a | SR/HARQ-ACK multiplexing once per slot using a PUCCH (or HARQ-ACK piggybacked on a PUSCH) when SR/HARQ-ACK are supposed to be sent with different starting symbols in a slot | Overlapping PUCCH resources have different starting symbols in a slot | 4-19 | *mux-SR-HARQ-ACK-PUCCH* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 4-19b | SR/HARQ-ACK/CSI multiplexing more than once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with the same or different starting symbol in a slot | Overlapping PUCCH resources have same or different starting symbols in a slot | 4-19c | *mux-SR-HARQ-ACK-CSI-PUCCH-MultiPerSlot* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 4-19c | SR/HARQ-ACK/CSI multiplexing once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with different starting symbols in a slot | Overlapping PUCCH resources have different starting symbols in a slot | 4-19a | *diffSymbol* in *mux-SR-HARQ-ACK-CSI-PUCCH-OncePerSlot* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 4-20 | UCI code-block segmentation | UCI code-block segmentation |  | *uci-CodeBlockSegmentation* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 4-21 | Dynamic beta-offset configuration and indication for HARQ-ACK and/or CSI | Dynamic beta-offset configuration and indication for HARQ-ACK and/or CSI |  | *dynamicBetaOffsetInd-HARQ-ACK-CSI* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 4-22 | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3, or 4 in the same slot | 1 PUCCH format 0 or 2and 1 PUCCH format 1, 3, and 4 in the same slot |  | *onePUCCH-LongAndShortFormat* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 4-22a | 2 PUCCH transmissions in the same slot which are not covered by 4-22 and 4-2 | 2 PUCCH transmissions in the same slot which are not covered by 4-22 and 4-2 |  | *twoPUCCH-AnyOthersInSlot* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 4-23 | Repetitions for PUCCH format 1, 3, and 4 over multiple slots with K = 2, 4, 8 | Repetitions for PUCCH format 1, 3, and 4 over multiple slots with K = 2, 4, 8 |  | *pucch-Repetition-F1-3-4* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signalling |
| 4-24 | PUCCH-spatialrelationinfo indication by a MAC CE per PUCCH resource | PUCCH-spatialrelationinfo indication by a MAC CE per PUCCH resource |  | *pucch-SpatialRelInfoMAC-CE* | *BandNR* | n/a | n/a |  | Mandatory with capability signalling for FR2  Optional with capability signalling for FR1 |
| 4-25 | Parallel SRS and PUCCH/PUSCH transmission across CCs in inter-band CA | Parallel SRS and PUCCH/PUSCH transmission across CCs in inter-band CA | 2-52, 4-1, 2-12, 6-6 | *parallelTxSRS-PUCCH-PUSCH* | *CA-ParametersNR* | n/a | n/a | This feature is supported only in inter-band CA. | Optional with capability signalling |
| 4-26 | Parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA | Parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA | 1-1, 2-52, 4-1, 2-12, 6-6 | *parallelTxPRACH-SRS-PUCCH-PUSCH* | *CA-ParametersNR* | n/a | n/a | This feature is supported only in inter-band CA. | Optional with capability signalling |
| 4-27 | More than one group of overlapping channels for control multiplexing | More than one group of overlapping PUCCHs and PUSCHs per slot per PUCCH cell group for control multiplexing |  | *mux-MultipleGroupCtrlCH-Overlap* | *Phy-ParametersFRX-Diff* | No | Yes | If a UE does not indicate supporting any of 4-2, 4-22, and 4-22a, the UE is not expected to be scheduled with more than one group of overlapping PUCCHs without PUSCH in each of the groups | Optional with capability signalling |
| 4-28 | HARQ-ACK multiplexing on PUSCH with different PUCCH/PUSCH starting OFDM symbols | HARQ-ACK piggyback on a PUSCH with/without aperiodic CSI once per slot when the starting OFDM symbol of the PUSCH is different from the starting OFDM symbols of the PUCCH resource that HARQ-ACK would have been transmitted on | 4-1 | *mux-HARQ-ACK-PUSCH-DiffSymbol* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 5. Scheduling/HARQ operation | 5-1 | Basic scheduling/HARQ operation | 1) Frequency-domain resource allocation  - RA Type 0 only and Type 1 only for PDSCH without interleaving  - RA Type 1 for PUSCH without interleaving  2) Time-domain resource allocation  - 1-14 OFDM symbols for PUSCH once per slot  - One unicast PDSCH per slot  - Starting symbol, and duration are determined by using the DCI  - PDSCH mapping type A with 7-14 OFDM symbols  - PUSCH mapping type A and type B  - For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, PDSCH mapping type A with {4-14} OFDM symbols and type B with {2, 4, 7} OFDM symbols  3) TBS determination  4) Nominal UE processing time for N1 and N2 (Capability #1)  5) HARQ process operation with configurable number of DL HARQ processes of up to 16  6) Cell specific RRC configured UL/DL assignment for TDD  7) Dynamic UL/DL determination based on L1 scheduling DCI with/without cell specific RRC configured UL/DL assignment  8) Intra-slot frequency-hopping for PUSCH scheduled by Type 1 CSS before RRC connection  9) In TDD support at most one switch point per slot for actual DL/UL transmission(s)  10) DL scheduling slot offset K0=0  11) DL scheduling slot offset K0=1 for type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS  12) UL scheduling slot offset K2<=12  For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, interleaving for VRB-to-PRB mapping for PDSCH |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 5-1a | UE specific RRC configure UL/DL assignment | Dynamic UL/DL determination based on L1 scheduling DCI with cell-specific and UE specific RRC configured UL/DL assignment |  | *ue-SpecificUL-DL-Assignment* | *FeatureSetDownlink* | n/a | n/a |  | Optional with capability signalling |
| 5-1b | More than one DL/UL switch point in a slot | In TDD support more than one switch points in a slot for actual DL/UL transmission(s) |  | *tdd-MultiDL-UL-SwitchPerSlot* | *Phy-ParametersFRX-Diff* | TDD only | Yes |  | Optional with capability signalling |
| 5-2 | RA Type 0 for PUSCH | RA Type 0 for PUSCH |  | *ra-Type0-PUSCH* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-3 | Dynamic switching between RA Type 0 and RA Type 1 for PDSCH | Dynamic switching between RA Type 0 and RA Type 1 for PDSCH |  | *dynamicSwitchRA-Type0-1-PDSCH* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-4 | Dynamic switching between RA Type 0 and RA Type 1 for PUSCH | Dynamic switching between RA Type 0 and RA Type 1 for PUSCH | 5-2 | *dynamicSwitchRA-Type0-1-PUSCH* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-5a | UE PDSCH processing capability #2 | UE can report values 'X' and 'Fallback', and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology  - When configured with less than or equal to X DL CCs, the UE may expect to be scheduled with up to 1 PDSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled, otherwise  - If Fallback = 'SC', UE supports Capability #2 processing time on lowest cell index among the configured carriers in the band where the value is reported  - If Fallback = 'Cap1-only', UE supports only Capability #1, in the band where the value is reported  2) No scheduling limitation  3) N1 based on Table 5.3-2 of TS 38.214 for given SCS from {15, 30, 60} kHz |  | *pdsch-ProcessingType2* | *FeatureSetDownlink-v1540* | n/a | Applicable to FR1 only | This capability is necessary for each SCS (15kHz, 30kHz, 60kHz)  More than one set of per SCS per band reports can be signaled for a given band combination | Optional with capability signaling  Candidate values for Component 1:  X in {1, ..., 16},  Fallback {'SC','Cap1-only'} |
| 5-5b | UE PDSCH processing capability #2 with scheduling limitation for 30kHz-SCS | Capability #2 supported only if 1 carrier configured in the band (independent of #carriers configured in other bands)  2) Max PDSCH BW of 136 PRBs on the configured serving cell which processingType2Enabled is configured and set to enabled  3) N1 based on Table 5.3-2 of TS 38.214 for 30 kHz SCS  4) UE reports the number of unicast PDSCH per slot for different TBs |  | *pdsch-ProcessingType2-Limited* | *FeatureSetDownlink-v1540* | n/a | Applicable to FR1 only | This capability is applicable to 30kHz-SCS only | Optional with capability signaling  Component 4) the value ranges {1, 2, 4, 7} |
| 5-5c | UE PUSCH processing capability #2 | UE can report values 'X' and 'Fallback', and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology  - When configured with less than or equal to X UL CCs, the UE may expect to be scheduled with up to 1 PUSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled, otherwise  - If Fallback = 'SC', UE supports Capability #2 processing time on lowest cell index among the configured carriers in the band where the value is reported  - If Fallback = 'Cap1-only', UE supports only Capability #1, in the band where the value is reported  2) N2 based on Table 6.4-2 of TS 38.214 for given SCS from {15, 30, 60} kHz |  | *pusch-ProcessingType2* | *FeatureSetUplink-v1540* | n/a | Applicable to FR1 only | This capability is necessary for each SCS (15kHz, 30kHz, 60kHz)  More than one set of per SCS per band reports can be signaled for a given band combination | Optional with capability signaling  Candidate values for Component 1:  X in {1, …, 16},  Fallback {'SC','Cap1-only'} |
| 5-6 | PDSCH mapping type A with less than 7 OFDM symbols | or type 1 CSS with dedicated RRC configuration, for type 3 CSS and UE-SS, PDSCH mapping type A with less than 7 OFDM symbols |  | *pdsch-MappingTypeA* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signalling which shall be set to '1' |
| 5-6a | PDSCH mapping type B | PDSCH mapping type B |  | *pdsch-MappingTypeB* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signalling |
| 5-7 | Interleaving for VRB-to-PRB mapping for PDSCH | Interleaving for VRB-to-PRB mapping for PDSCH |  | *interleavingVRB-ToPRB-PDSCH* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signalling |
| 5-9 | Intra-slot frequency-hopping for PUSCH except for PUSCH scheduled by Type 1 CSS before RRC connection | Intra-slot frequency-hopping for PUSCH except for PUSCH scheduled by Type 1 CSS before RRC connection |  | *intraSlotFreqHopping-PUSCH* | *Phy-ParametersFRX-Diff* | No | Yes |  | Mandatory with capability signalling |
| 5-10 | Inter-slot frequency hopping for PUSCH | Inter-slot frequency hopping for PUSCH |  | *interSlotFreqHopping-PUSCH* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-11 | Up to 2 unicast PDSCHs per slot per CC for different TBs for UE processing time Capability 1 | Up to 2 unicast PDSCHs per slot per CC only in TDM is supported for Capability 1  1) PDSCH(s) for Msg. 4 is included |  | *pdsch-ProcessingType1-DifferentTB-PerSlot* | *FeatureSetDownlink* | n/a | n/a | This capability is necessary for each SCS. | Optional with capability signalling |
| 5-11a | Up to 7 unicast PDSCHs per slot per CC for different TBs for UE processing time Capability 1 | Up to 7 unicast PDSCHs per slot per CC only in TDM is supported for Capability 1  1) PDSCH(s) for Msg. 4 is included |  | n/a | n/a | This capability is necessary for each SCS. | Optional with capability signalling |
| 5-11b | Up to 4 unicast PDSCHs per slot per CC for different TBs for UE processing time Capability 1 | Up to 4 unicast PDSCHs per slot per CC only in TDM is supported for Capability 1  1) PDSCH(s) for Msg. 4 is included |  | n/a | n/a | This capability is necessary for each SCS. | Optional with capability signalling |
| 5-12 | Up to 2 PUSCHs per slot per CC for different TBs for UE processing time Capability 1 | Up to 2 unicast PUSCHs per slot per CC only in TDM is supported for Capability 1 |  | *pusch-ProcessingType1-DifferentTB-PerSlot* | *FeatureSetUplink* | n/a | n/a | This capability is necessary for each SCS. | Optional with capability signalling |
| 5-12a | Up to 7 PUSCHs per slot per CC for different TBs for UE processing time Capability 1 | Up to 7 unicast PUSCHs per slot per CC only in TDM is supported for Capability 1 |  | n/a | n/a | This capability is necessary for each SCS. | Optional with capability signalling |
| 5-12b | Up to 4 PUSCHs per slot per CC for different TBs for UE processing time Capability 1 | Up to 4 unicast PUSCHs per slot per CC only in TDM is supported for Capability 1 |  | n/a | n/a | This capability is necessary for each SCS. | Optional with capability signalling |
| 5-13 | Up to 2 unicast PDSCHs per slot per CC for different TBs for UE processing time Capability 2 | Up to 2 unicast PDSCHs per slot per CC only in TDM is supported for Capability 2  UE can report values 'X' and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology  - When configured with less than or equal to X DL CCs, the UE may expect to be scheduled with up to 2 PDSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled  2) No scheduling limitation  3) N1 based on Table 5.3-2 of TS 38.214 for given SCS from {15, 30, 60} kHz | 5-5a | *pdsch-ProcessingType2* | *FeatureSetDownlink* | n/a | n/a | This capability is necessary for each SCS  More than one set of per SCS per band reports can be signalled for a given band combination | Optional with capability signalling  Candidate values for Component 1:  X in {1, …, 16}, |
| 5-13a | Up to 7 unicast PDSCHs per slot per CC for different TBs for UE processing time Capability 2 | Up to 7 unicast PDSCHs per slot per CC only in TDM is supported for Capability 2  UE can report values 'X' and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology  - When configured with less than or equal to X DL CCs, the UE may expect to be scheduled with up to 7 PDSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled  2) No scheduling limitation  3) N1 based on Table 5.3-2 of TS 38.214 for given SCS from {15, 30, 60} kHz | 5-5a | n/a | n//a | This capability is necessary for each SCS  More than one set of per SCS per band reports can be signalled for a given band combination | Optional with capability signalling  Candidate values for Component 1:  X in {1, …, 16}, |
| 5-13c | Up to 4 unicast PDSCHs per slot per CC for different TBs for UE processing time Capability 2 | Up to 4 unicast PDSCHs per slot per CC only in TDM is supported for Capability 2  UE can report values 'X' and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology  - When configured with less than or equal to X DL CCs, the UE may expect to be scheduled with up to 4 PDSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled  2) No scheduling limitation  3) N1 based on Table 5.3-2 of TS 38.214 for given SCS from {15, 30, 60} kHz | 5-5a | n/a | n/a | This capability is necessary for each SCS  More than one set of per SCS per band reports can be signalled for a given band combination | Optional with capability signalling  Candidate values for Component 1:  X in {1, …, 16}, |
| 5-13d | Up to 2 PUSCHs per slot per CC for different TBs for UE processing time Capability 2 | Up to 2 unicast PUSCHs per slot per CC only in TDM is supported for Capability 2  UE can report values 'X' and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology  - When configured with less than or equal to X UL CCs, the UE may expect to be scheduled with up to 2 PUSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled  2) N2 based on Table 6.4-2 of TS 38.214 for given SCS from {15, 30, 60} kHz | 5-5c | *pusch-ProcessingType2* | *FeatureSetUplink* | n/a | n/a | This capability is necessary for each SCS  More than one set of per SCS per band reports can be signalled for a given band combination | Optional with capability signalling  Candidate values for Component 1:  X in {1, …, 16}, |
| 5-13e | Up to 7 PUSCHs per slot per CC for different TBs for UE processing time Capability 2 | Up to 7 unicast PUSCHs per slot per CC only in TDM is supported for Capability 2  UE can report values 'X' and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology  - When configured with less than or equal to X UL CCs, the UE may expect to be scheduled with up to 7 PUSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled  2) N2 based on Table 6.4-2 of TS 38.214 for given SCS from {15, 30, 60} kHz | 5-5c | n/a | n/a | This capability is necessary for each SCS  More than one set of per SCS per band reports can be signalled for a given band combination | Optional with capability signalling  Candidate values for Component 1:  X in {1, …, 16}, |
| 5-13f | Up to 4 PUSCHs per slot per CC for different TBs for UE processing time Capability 2 | Up to 4 unicast PUSCHs per slot per CC only in TDM is supported for Capability 2  UE can report values 'X' and supports the following operation, only when all carriers are self-scheduled and all Capability #2 carriers in a band are of the same numerology  - When configured with less than or equal to X UL CCs, the UE may expect to be scheduled with up to 4 PUSCHs per slot with Capability #2 on all of the configured serving cells for which processingType2Enabled is configured and set to enabled  2) N2 based on Table 6.4-2 of TS 38.214 for given SCS from {15, 30, 60} kHz | 5-5c | n/a | n/a | This capability is necessary for each SCS  More than one set of per SCS per band reports can be signalled for a given band combination | Optional with capability signalling  Candidate values for Component 1:  X in {1, …, 16}, |
| 5-14 | Type 1 configured PUSCH repetitions over multiple slots | K = 2, 4, 8 times repetitions with RV sequences |  | *type1-PUSCH-RepetitionMultiSlots* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-16 | Type 2 configured PUSCH repetitions over multiple slots | K = 2, 4, 8 times repetitions with RV sequences |  | *type2-PUSCH-RepetitionMultiSlots* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-17 | PUSCH repetitions over multiple slots | K = 2, 4, 8 times repetitions |  | *pusch-RepetitionMultiSlots* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signalling |
| 5-17a | PDSCH repetitions over multiple slots | K = 2, 4, 8 times repetitions |  | *pdsch-RepetitionMultiSlots* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-18 | DL SPS | DL SPS |  | *downlinkSPS* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-19 | Type 1 Configured UL grant | K = 1 |  | *configuredUL-GrantType1* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-20 | Type 2 Configured UL grant | K = 1 |  | *configuredUL-GrantType2* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-21 | Pre-emption indication for DL | Pre-emption indication for DL |  | *pre-EmptIndication-DL* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-22 | CBG-based re-transmission for DL using CBGTI | CBG-based re-transmission for DL using CBGTI |  | *cbg-TransIndication-DL* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-23 | CBGFI for CBG-based re-transmission for DL | CBGFI for CBG-based re-transmission for DL | 5-22 | *cbg-FlushIndication-DL* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-24 | Dynamic HARQ-ACK codebook using sub-codebooks for CBG-based re-transmission for DL | Dynamic HARQ-ACK codebook using sub-codebooks for CBG-based re-transmission for DL |  | *dynamicHARQ-ACK-CodeB-CBG-Retx-DL* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-25 | CBG-based re-transmission for UL using CBGTI | CBG-based re-transmission for UL using CBGTI |  | *cbg-TransIndication-UL* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-26 | Semi-static rate-matching resource set configuration for DL | 1) Bitmap 1/2/3  2) controlResourceSet |  | *rateMatchingResrcSetSemi-Static* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signalling |
| 5-27 | Dynamic rate-matching resource set configuration for DL | Bitmap 1/2/3 |  | *rateMatchingResrcSetDynamic* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 5-27a | Dynamic rate-matching control resource set for DL | Dynamic rate-matching control resource set for DL |  | *rateMatchingCtrlResrcSetDynamic* | *Phy-ParametersCommon* | No | No |  | Mandatory with capability signalling |
| 5-28 | Rate-matching around LTE CRS | Rate-matching around LTE CRS |  | *rateMatchingLTE-CRS* | *BandNR* | n/a | n/a |  | Mandatory with capability signalling |
| 5-29 | LBRM for PUSCH | Limited buffer rate matching in UL |  | *pusch-LBRM* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 5-30 | DL scheduling slot offset greater than zero for PDSCH mapping type A | Support of DL scheduling slot offset (K0) greater than zero for PDSCH mapping type A |  | *dl-SchedulingOffset-PDSCH-TypeA* | *Phy-ParametersXDD-Diff*  *Phy-ParametersFRX-Diff* | Yes | Yes |  | Mandatory with capability signalling |
| 5-30a | DL scheduling slot offset greater than zero for PDSCH mapping type B | Support of DL scheduling slot offset (K0) greater than zero for PDSCH mapping type B |  | *dl-SchedulingOffset-PDSCH-TypeB* | *Phy-ParametersXDD-Diff*  *Phy-ParametersFRX-Diff* | Yes | Yes |  | Mandatory with capability signalling |
| 5-31 | UL scheduling slot offset greater than 12 | Support of UL scheduling slot offset (K2) greater than 12 |  | *ul-SchedulingOffset* | *Phy-ParametersXDD-Diff*  *Phy-ParametersFRX-Diff* | Yes | Yes |  | Mandatory with capability signalling |
| 5-32 | Separation of two unicast PDSCHs with a gap | For any two consecutive slots n and n+1, if there are more than 1 unicast PDSCH in either slot, the minimum time separation between starting time of any two unicast PDSCHs within the duration of these slots is  4 OFDM symbol for 30kHz and 7 OFDM symbol for 60kHz | 5-11, 5-11b, 5-13, or 5-13c | *pdsch-SeparationWithGap* | *FeatureSetDownlink-v1540* | No | No | This feature only applies to SCS 30kHz and 60kHz | Optional with capability signalling |
| 5-33 | Separation of two unicast PUSCHs with a gap | For any two consecutive slots n and n+1, if there are more than 1 unicast PUSCH in either slot, the minimum time separation between starting time of any two unicast PUSCHs within the duration of these slots is  2OFDM symbols for 15kHz, 4 OFDM symbols for 30kHz and 7 OFDM symbols for 60kHz | 5-12, 5-12b, 5-13d, or 5-13f | *pusch-SeparationWithGap* | *FeatureSetUplink-v1540* | No | No | This feature only applies to SCS 15kHz, 30kHz and 60kHz | Optional with capability signalling |
| 5-34 | New 64QAM MCS table for PDSCH | New 64QAM MCS table for PDSCH |  | *dl-64QAM-MCS-TableAlt* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 5-34a | New 64QAM MCS table for PUSCH | New 64QAM MCS tables for PUSCH with and without transform precoding respectively |  | *ul-64QAM-MCS-TableAlt* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 5-34b | Dynamic indication of MCS table with MCS-C-RNTI for PDSCH | Dynamic indication of MCS table using MCS-C-RNTI for PDSCH | 5-34 | *dl-MCS-TableAlt-DynamicIndication* | *FeatureSetDownlink-v1540* | n/a | n/a |  | Optional with capability signalling |
| 5-34c | Dynamic indication of MCS tables with MCS-C-RNTI for PUSCH | Dynamic indication of MCS tables using MCS-C-RNTI for PUSCH | 5-34a | *ul-MCS-TableAlt-DynamicIndication* | *FeatureSetUplink-v1540* | n/a | n/a |  | Optional with capability signalling |
| 6. CA/DC, BWP, SUL | 6-1 | Basic BWP operation with restriction | 1) 1 UE-specific RRC configured DL BWP per carrier  2) 1 UE-specific RRC configured UL BWP per carrier  3) RRC reconfiguration of any parameters related to BWP  4) BW of a UE-specific RRC configured BWP includes BW of CORESET#0 (if CORESET#0 is present) and SSB for PCell/PSCell (if configured) and BW of the UE-specific RRC configured BWP includes SSB for SCell if there is SSB on SCell |  | n/a | n/a | n/a | n/a | This feature should be mandatory without capability signalling for at least BWPs which is the same as the set of specified channel BW  UE-specific RRC configured DL/UL BWP can have the same or different numerology from the initial active DL/UL BWP | Mandatory without capability signalling |
| 6-1a | BWP operation without restriction on BW of BWP(s) | BW of UE-specific RRC configured BWP may not include BW of the CORESET#0 (if CORESET#0 is present) and SSB for PCell/PSCell (if configured) and BW of the UE-specific RRC configured BWP may not include SSB for SCell | 6-1, 6-2, 6-3, or 6-4 | *bwp-WithoutRestriction* | *BandNR* | n/a | n/a | 6-1a is applicable to 6-1, 6-2, 6-3, or 6-4. | Optional with capability signalling |
| 6-2 | Type A BWP adaptation with same numerology | 1) Up to 2 UE-specific RRC configured DL BWPs per carrier  2) Up to 2 UE-specific RRC configured UL BWPs per carrier  3) Active BWP switching by DCI and timer  4) Same numerology for all the UE-specific RRC configured BWPs per carrier  5) BW of a UE-specific RRC configured BWP includes BW of the CORESET#0 (if CORESET#0 is present) and SSB for PCell/PSCell (if configured) and BW of the UE-specific RRC configured BWP includes SSB for SCell if there is SSB on SCell | 6-1 | *upto2* in *bwp-SameNumerology* | *BandNR* | n/a | n/a |  | Optional with capability signalling |
| 6-3 | Type B BWP adaptation with same numerology | 1) Up to 4 UE-specific RRC configured DL BWPs per carrier  2) Up to 4 UE-specific RRC configured UL BWPs per carrier  3) Active BWP switching by DCI and timer  4) Same numerology for all the UE-specific RRC configured BWPs per carrier  5) BW of a UE-specific RRC configured BWP includes BW of the CORESET#0 (if CORESET#0 is present) and SSB for PCell/PSCell (if configured) and BW of the UE-specific RRC configured BWP includes SSB for SCell if there is SSB on SCell | 6-1 | *upto4* in *bwp-SameNumerology* | *BandNR* | n/a | n/a |  | Optional with capability signalling |
| 6-4 | BWP adaptation with different numerologies | 1) Up to 4 UE-specific RRC configured DL BWPs per carrier  2) Up to 4 UE-specific RRC configured UL BWPs per carrier  3) Active BWP switching by DCI and timer  4) More than one numerologies for the UE-specific RRC configured BWPs per carrier  5) Same numerology between DL and UL per cell except for SUL at a given time  6) BW of a UE-specific RRC configured BWP includes BW of the CORESET#0 (if CORESET#0 is present) and SSB for PCell/PSCell (if configured) and BW of the UE-specific RRC configured BWP includes SSB for SCell if there is SSB on SCell | 6-1 | *upto4* in *bwp-DiffNumerology* | *BandNR* | n/a | n/a |  | Optional with capability signalling |
| 6-5 | Basic DL NR-NR CA operation | 1) Up to16 DL carriers  2) Same numerology across carrier for data/control channel at a given time |  | *supportedBandCombinationList* | *RF-Parameters* | n/a | n/a | This is conditioned on the support of DL CA band combination(s). | Optional with capability signalling |
| 6-5a | PDCCH blind detection capability for CA | 1) More than 4 DL CCs  2) Reporting value is one of integer from 4 to 16 | 6-5 | *pdcch-BlindDetectionCA* | *Phy-ParametersFRX-Diff* | No | Yes | If UE supports CA with more than 4 DL CCs, UE should report this capability | {4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16} |
| 6-6 | Basic UL NR-NR CA operation | 1) Up to16 UL carriers  2) Same numerology across carrier for data/control channel at a given time  3) One PUCCH group  4) Single TAG | 6-5 | *supportedBandCombinationList* | *RF-Parameters* | n/a | n/a | This is conditioned on the support of UL CA band combination(s).  The terminology 'carrier' in the components in this FG does not refer to 'SUL'. | Optional with capability signalling |
| 6-7 | Two NR PUCCH group with same numerology | 1) For NR CA UE, same numerology across NR carriers for data/control channel at a given time  2) For EN-DC UE, same numerology across NR carriers for data/control channel at a given time, wherein an NR PUCCH group is configured in FR1 and another NR PUCCH group is configured in FR2 | 6-5, 6-6 | *twoPUCCH-Group* | *FeatureSetUplink* | n/a | n/a |  | Optional with capability signalling |
| 6-8 | Different numerology across NR PUCCH groups | For both NR CA UE and EN-DC UE, different numerology between two NR PUCCH groups for data/control channel at a given time | 6-5, 6-7 | *diffNumerologyAcrossPUCCH-Group* | *CA-ParametersNR* | n/a | n/a |  | Optional with capability signalling |
| 6-9 | Different numerologies across NR carriers within the same NR PUCCH group, with PUCCH on a carrier of smaller SCS | 1) For both NR CA UE, EN-DC/NE-DC UE and NR-DC UEs, same numerology between DL and UL per carrier for data/control channel at a given time  2) For both NR CA UE and EN-DC/NE-DC UE with one NR PUCCH group, different numerologies across NR carriers within the same NR PUCCH groups up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with smaller SCS for data/control channel at a given time  3-1) For NR CA UE with two NR PUCCH groups, different numerologies across NR carriers up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with smaller SCS for data/control channel at a given time  3-2) For EN-DC/NE-DC UE with two NR PUCCH groups, different numerologies across NR carriers up to two different numerologies within an NR PUCCH group in FR1 wherein NR PUCCH is sent on the carrier with smaller SCS, and same numerology across NR carriers within another NR PUCCH group in FR2 for data/control channel at a given time  4) For NR DC UE, different numerologies across NR carriers within the same NR PUCCH group in MCG (in FR1) and up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with smaller SCS for data/control channel at a given time; and same numerology across NR carriers in SCG (in FR2). | 6-5 | *diffNumerologyWithinPUCCH-GroupSmallerSCS* | *CA-ParametersNR* | n/a | n/a | The terminologies 'UL' and 'carrier' in this FG do not refer to 'SUL'.  NR PUCCH is sent on a carrier with SCS not larger than SCS of any DL carriers corresponding to the NR PUCCH group.  The case with PUCCH on UL carrier with different numerologies within SCG is not supported for NR-DC. | Optional with capability signalling |
| 6-9a | Different numerologies across NR carriers within the same NR PUCCH group, with PUCCH on a carrier of larger SCS | 1) For both NR CA UE, EN-DC/NE-DC UE and NR DC UEs, same numerology between DL and UL per carrier for data/control channel at a given time  2) For both NR CA UE and EN-DC/NE-DC UE with one NR PUCCH group, different numerologies across NR carriers within the same NR PUCCH groups up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is on the carrier with larger SCS for data/control channel at a given time  3-1) For NR CA UE with two NR PUCCH groups, different numerologies across NR carriers up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with larger SCS for data/control channel at a given time  3-2) For EN-DC/NE-DC UE with two NR PUCCH groups, different numerologies across NR carriers up to two different numerologies within an NR PUCCH group in FR1 wherein NR PUCCH is sent on the carrier with larger SCS, and same numerology across NR carriers within another NR PUCCH group in FR2 for data/control channel at a given time  4) For NR DC UE, different numerologies across NR carriers within the same NR PUCCH group in MCG (in FR1) and up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with larger SCS for data/control channel at a given time; and same numerology across NR carriers in SCG (in FR2). | 6-5 | *diffNumerologyWithinPUCCH-GroupLargerSCS* | *CA-ParametersNR-v1560* | n/a | n/a | The terminologies 'UL' and 'carrier' in this FG do not refer to 'SUL'.  NR PUCCH is sent on a carrier with SCS not smaller than SCS of any DL carriers corresponding to the NR PUCCH group.  The case with PUCCH on UL carrier with different numerologies within SCG is not supported for NR-DC. | Optional with capability signalling |
| 6-10 | Cross carrier scheduling for the same numerology | Cross carrier scheduling for the same numerology with CIF where numerologies for scheduling cell and scheduled cell are same | 6-5, 6-6 | *crossCarrierScheduling-SameSCS* | *BandNR* | n/a | n/a |  |  |
| 6-10a | Cross carrier scheduling for different numerologies | Cross carrier scheduling for the different numerologies with CIF where numerologies for scheduling cell and scheduled cell are different | 6-10 | *crossCarrierScheduling-OtherSCS* | *FeatureSetDownlink*  *FeatureSetUplink* | n/a | n/a | This is not supported in Rel-15 |  |
| 6-11 | Number of supported TAGs | Need of multiple capability question about the resolution here |  | *supportedNumberTAG* | *CA-ParametersNR* | n/a | n/a | This feature group is applied to NR-NR CA and EN-DC. For EN-DC, the feature group indicates number of TAGs only for NR CG.  The number of TAGs for the LTE MCG is signalled by existing LTE TAG capability signalling | {1, 2, 3, 4} |
| 6-12 | Support 2 simultaneous UL transmissions for problematic cases | Support 2 simultaneous UL transmissions for problematic cases |  | *singleUL-Transmission* | *MRDC-Parameters* | n/a | n/a | This is a UE feature for LTE for a LTE/NR dual connectivity UE | Optional with capability signalling |
| 6-13 | Case 1 Single Tx UL LTE-NR DC | 1) Case 1: DL-reference UL/DL configuration defined for LTE-FDD-SCell in LTE-TDD-FDD CA with LTE-TDD-PCell  2) HARQ subframe offset |  | *tdm-Pattern*  NOTE: This capability bit also indicates support of the feature 8-2, i.e. Operation A with single UL Tx case 1. | *MRDC-Parameters* | Yes | Yes | This is a UE feature for LTE for a LTE/NR dual connectivity UE | Mandatory with capability signalling conditional on the UE not supporting simultaneous dual-Tx operation in the band combination; optional if the UE supports simultaneous dual-Tx operation in the band combination |
| 6-16 | Supplemental uplink | 1) RACH, PUSCH, PUCCH, SRS operations in a band combination including SUL  2) Supplemental uplink with same numerology between SUL and non SUL carriers | 6-15 | *supportedBandCombinationList* | *RF-Parameters* | n/a | n/a | This is conditioned on the support of SUL band combination(s). | Optional with capability signalling |
| 6-17 | Supplemental uplink with different numerologies between SUL and non SUL carriers | Different numerologies between SUL and non SUL | 6-16 | *supportedBandCombinationList* | *RF-Parameters* | n/a | n/a | This is conditioned on the support of SUL band combination(s). | Mandatory with capability signalling |
| 6-18 | Supplemental uplink with dynamic switch | DCI based selection of PUSCH carrier | 6-16 | *dynamicSwitchSUL* | *FeatureSetUplink* | n/a | n/a | his is conditioned on the support of SUL band combination(s). | Optional with capability signalling |
| 6-19 | Simultaneous transmission of SRS on an SUL/non-SUL carrier and PUSCH/PUCCH/SRS on the other UL carrier in the same cell | Simultaneous transmission of SRS on an SUL/non-SUL carrier and PUSCH/PUCCH/SRS on the other UL carrier in the same cell | 6-16 | *simultaneousTxSUL-NonSUL* | *FeatureSetUplink* | n/a | n/a |  | Optional with capability signalling |
| 6-21 | DL search space sharing for CA | DL search space sharing for CA | 6-10 or 6-10a | *searchSpaceSharingCA-DL* | *FeatureSetDownlink* | n/a | n/a |  | Optional with capability signalling |
| 6-22 | UL search space sharing for CA | UL search space sharing for CA | 6-10 or 6-10a | *searchSpaceSharingCA-UL* | *FeatureSetUplink* | n/a | n/a |  | Optional with capability signalling |
| 6-23 | Incapability motivated by impacts of PA phase discontinuity with overlapping transmissions with non-aligned starting or ending times or hop boundaries across carriers for intra-band EN-DC, intra-band CA, and FDM based ULSUP | Incapability motivated by impacts of PA phase discontinuity with overlapping transmissions with non-aligned starting or ending times or hop boundaries across carriers for intra-band EN-DC, intra-band CA, and FDM based ULSUP |  | *pa-PhaseDiscontinuityImpacts* | *FeatureSetUplink-v1540* | n/a | n/a | See LS (R1-1809992) | Optional with capability signalling |
| 6-24 | Applying the same UL timing between NR and LTE | Applying the same UL timing between NR and LTE for dynamic power sharing capable UE operating in intra-band contiguous synchronous EN-DC | 8-1 | *ul-TimingAlignmentEUTRA-NR* | *MRDC-Parameters* | n/a | n/a | UEs that set this bit to 0 should be able to operate with a timing difference up to applicable MTTD requirements when operating in a synchronous intra-band contiguous EN-DC network. | Optional with capability signalling |
| 6-25 | Support of synchronous NR-NR DC operation only wherein MCG is only in FR1 and SCG is only in FR2 | Support of synchronous NR-NR DC operation only wherein MCG is only in FR1 and SCG is only in FR2 |  | *ca-ParametersNRDC* | *BandCombination-v1560* | n/a | n/a | This is conditioned on the support of DC band combination(s).  UE reports a set of supported band partitionings corresponding to MCG in FR1 and to SCG in FR2. | Optional with capability signalling |
| 6-25a | PDCCH blind detection capability for MCG and for SCG in synchronous NR-NR DC | RRC parameters *pdcch-BlindDetectionMCG-UE* and *pdcch-BlindDetectionSCG-UE* for optional new UE capability signalling that informs the maximum values for *pdcch-BlindDetectionMCG* and *pdcch-BlindDetectionSCG*, respectively | 6-5, 6-25 | *pdcch-BlindDetectionMCG-UE*  *pdcch-BlindDetectionSCG-UE* | *Phy-ParametersFRX-Diff* | No | Yes | *pdcch-BlindDetectionMCG-UE* and *pdcch-BlindDetectionSCG-UE* are per UE capability signalling.  The value range of *pdcch-BlindDetectionMCG-UE* and *pdcch-BlindDetectionSCG-UE* is  - [1, …, *pdcch-BlindDetectionCA*-1] and *pdcch-BlindDetectionMCG-UE* + *pdcch-BlindDetectionSCG-UE* >= *pdcch-BlindDetectionCA* if the UE reports *pdcch-BlindDetectionCA*, and  - [1, 2, 3] and *pdcch-BlindDetectionMCG-UE* + *pdcch-BlindDetectionSCG-UE* >= the maximum number of DL serving cells over CGs that UE can support if the UE does not report *pdcch-BlindDetectionCA*.  If the UE does not report *pdcch-BlindDetectionMCG-UE* and *pdcch-BlindDetectionSCG-UE*,  - *pdcch-BlindDetectionCA* for NR-CA is re-used as the UE capability signalling for NR-DC to determine BD/CCE limit across serving cells over CGs if the UE reports *pdcch-BlindDetectionCA*, and  - the number of configured DL serving cells over CGs is used to determine BD/CCE limit across serving cells over CGs if the UE does not report *pdcch-BlindDetectionCA*.  If the UE reports *pdcch-BlindDetectionMCG-UE* or *pdcch-BlindDetectionSCG-UE*, both of them are reported (i.e., not either of them). | Optional with capability signalling |
| 7. Channel coding | 7-1 | Channel coding | 1) LDPC encoding and associated functions for data on DL and UL  2) Polar encoding and associated functions for PBCH, DCI, and UCI  3) Coding for very small blocks |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 8. UL TPC | 8-1 | Dynamic power sharing for LTE-NR DC | When total transmission power exceeds Pcmax, UE scales NR transmission power. | EN-DC | *dynamicPowerSharing* | *MRDC-Parameters* | n/a | n/a | RP-172833 | Mandatory with capability signalling |
| 8-2 | Operation A with single UL Tx case 1 | Operation A with single UL Tx case 1 | EN-DC | *tdm-Pattern*  NOTE: This capability bit also indicates support of the feature 6-13, i.e. Case 1 Single Tx UL LTE-NR DC. | *MRDC-Parameters* | Yes | Yes | RP-172833 | Mandatory with capability signalling conditioned that UE does not support dynamic power sharing, i.e., UE indicate "0" as non-support for 8-1, optional for UEs supporting dynamic power sharing |
| 8-3 | Basic power control operation | 1) Accumulated power control mode for closed loop  2) 1 TPC command loop for PUSCH, PUCCH respectively  3) One or multiple DL RS configured for pathloss estimation  4) One or multiple p0-alpha values configured for open loop PC  5) PUSCH power control  6) PUCCH power control  7) PRACH power control  8) SRS power control  9) PHR |  | n/a | n/a | No | No |  | Mandatory without capability signalling |
| 8-4 | TPC-PUSCH-RNTI | Specific group DCI message for TPC commands for PUSCH |  | *tpc-PUSCH-RNTI* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 8-5 | TPC-PUCCH-RNTI | Specific group DCI message for TPC commands for PUCCH |  | *tpc-PUCCH-RNTI* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 8-6 | TPC-SRS-RNTI | Specific group DCI message for TPC commands for SRS |  | *tpc-SRS-RNTI* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 8-7 | Absolute TPC command mode | Absolute TPC command mode |  | *absoluteTPC-Command* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 8-8 | UL power control with 2 PUSCH closed loops | Two different TPC loops |  | *twoDifferentTPC-Loop-PUSCH* | *Phy-ParametersXDD-Diff*  *Phy-ParametersFRX-Diff* | Yes | Yes |  | Mandatory with capability signalling |
| 8-9 | UL power control with 2 PUCCH closed loops | Two different TPC loops |  | *twoDifferentTPC-Loop-PUCCH* | *Phy-ParametersXDD-Diff*  *Phy-ParametersFRX-Diff* | Yes | Yes |  | Mandatory with capability signalling |

## 4.2 Layer-2 and Layer-3 features

Table 4.2-1 provides the list of Layer-2 and Layer-3 features, as shown in [4] and the corresponding UE capability field name, as specified in TS 38.331 [2].

Table 4.2-1: Layer-2 and Layer-3 feature list

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 0. General (including supported bearer types) | 0-0 | Basic EN-DC procedures | 1) MCG DRB with LTE/NR PDCP  2) SCG DRB with NR PDCP  3) SN addition, modification, and release via RRC connection reconfiguration  4) Joint processing on the combined RRC messages  5) Failure handling (including both MN and SN) |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 0-1 | Access stratum release | Access stratum release |  | *accessStratumRelease* | *UE-NR-Capability* | No | No |  | Optional with capability signalling and candidate value set is {Rel-15, spare7, … , spare1} |
| 0-2 | SRB | 1) Split SRB with one UL path  2) SRB3 |  | 1) *splitSRB-WithOneUL-Path*  2) *srb3* | *GeneralParametersMRDC-XDD-Diff* | No | No | 2) Not applied to NE-DC. | 1) Optional with capability signalling  2) Mandatory with capability signalling |
| 0-3 | DRB | 1) Maximum number of DRBs  2) Split DRB with one UL path  3) Split DRB with both UL MCG and SCG paths |  | 1), 2) n/a  3) *splitDRB-withUL-Both-MCG-SCG* | 1), 2) n/a  3) *GeneralParametersMRDC-XDD-Diff* | No | No | 2) 8 DRBs are supported regardless of bearer types | 1, 2) Mandatory without UE capability signalling  3) Mandatory with capability signalling |
| 0-4 | Direct SN addition in the first RRC connection reconfiguration after RRC connection establishment | Direct SN addition in the first RRC connection reconfiguration after RRC connection establishment |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 0-5 | IMS voice | 1) IMS voice over NR  2) Fallback HO to LTE for IMS voice  3) 5GC VoLTE  4) IMS voice over SCG bearer of NE-DC |  | 1) *voiceOverNR*  3) *voiceOverEUTRA-5GC*  4) *voiceOverSCG-BearerEUTRA-5GC* | 1) *IMS-ParametersFRX-Diff*  3), 4) *IMS-ParametersCommon* | 1), 3), 4) No | 1) Yes  3), 4) No | 1), 2), 3) SA only  4): NE-DC only | 1) Mandatory with capability signalling if UE is IMS voice capable in NR SA. Otherwise optional with capability signalling.  2) No need for a separate capability signalling.  3) Optional with capability signalling  4) Optional with capability signalling |
| 0-6 | Delay budget reporting | Delay budget reporting |  | *delayBudgetReporting* | *UE-NR-Capability-v1530* | No | No | SA only | Optional with capability signalling |
| 0-7 | PCell operation | 1) PCell operation on FR2 |  | *pCell-FR2* | *Phy-ParametersFR2* | No | No | SA only | Mandatory with capability signalling |
| 0-8 | Overheating | 1) Overheating assistance information |  | *overheatingInd* | *UE-NR-Capability-v1540* | No | No | SA only | Optional with capability signalling |
| 0-9 | V2X | 1) Support of EUTRA V2X |  | *v2x-EUTRA* | *GeneralParametersMRDC-XDD-Diff* | Yes | No | Only applied to EN-DC | Optional with capability signalling |
| 1. PDCP | 1-0 | Basic PDCP procedures | 1) (de)Ciphering on DRB/SRB  2) Integrity protection on SRB  3) Timer based SDU discard  4) Re-ordering and in-order delivery  5) Status reporting  6) Duplicate discarding  7) 18bits SN |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 1-1 | ROHC context | 1) Maximum number of ROHC context sessions  2) Supported ROHC profiles |  | 1) *maxNumberROHC-ContextSessions*  2) *supportedROHC-Profiles* | *PDCP-Parameters* | No | No |  | Optional with capability signaling and candidate value set is:  1) {cs2, cs4, cs8, cs12, cs16, cs24, cs32, cs48, cs64, cs128, cs256, cs512, cs1024, cs16384, spare2, spare1}  2) {0x0000, 0x0001, 0x0002, 0x0003, 0x0004, 0x0006, 0x0101, 0x0102, 0x0103, 0x0104} |
| 1-2 | ROHC context continuation operation | ROHC context continuation operation |  | *continueROHC-Context* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 1-3 | Uplink only ROHC profiles | Uplink only ROHC profiles |  | *uplinkOnlyROHC-Profiles* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 1-4 | Out of order delivery | Out of order delivery |  | *outOfOrderDelivery* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 1-5 | Short SN | Short SN |  | *shortSN* | *PDCP-Parameters* | No | No |  | Mandatory with capability signalling |
| 1-6 | PDCP duplication | 1) PDCP duplication for split SRB1/2  2) PDCP duplication for SRB1/2 and/or SRB3  3) PDCP duplication for MCG or SCG DRB  4) PDCP duplication for split DRB |  | 1) *pdcp-DuplicationSplitSRB*  2) *pdcp-DuplicationSRB*  3) *pdcp-DuplicationMCG-OrSCG-DRB*  4) *pdcp-DuplicationSplitDRB* | 1), 4) *PDCP-ParametersMRDC*  2), 3) *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 1-7 | DRB IP data rate | 1) DRB IP data rate in DL  2) DRB IP data rate in UL |  | n/a | n/a | n/a | n/a |  | Optional capability is signalled by NAS signalling defined in 24.501 |
| 2. RLC | 2-0 | Basic RLC procedures | 1) RLC TM  2) RLC AM with 18bits SN\*  3) SDU discard |  | n/a | n/a | n/a | n/a | No separate feature is considered for t-PollRetransmit, t-Reassembly and t-StatusProhibit | Mandatory without capability signalling |
| 2-1 | RLC AM with short SN | RLC AM with short SN |  | *am-WithShortSN* | *RLC-Parameters* | No | No |  | Mandatory with capability signalling |
| 2-2 | RLC UM with short SN | RLC UM with short SN |  | *um-WithShortSN* | *RLC-Parameters* | No | No |  | Mandatory with capability signalling |
| 2-3 | RLC UM with long SN | RLC UM with long SN |  | *um-WithLongSN* | *RLC-Parameters* | No | No |  | Mandatory with capability signalling |
| 2-4 | NR RLC SN size for SRB | NR RLC SN size for SRB |  | n/a | n/a | n/a | n/a |  | RAN2 decided only short RLC SN is used for SRB. |
| 3. MAC | 3-0 | Basic MAC procedures | 1) RA procedure on PCell or PSCell (in case of EN-DC)  2) UE initiated RA procedure (including for beam recovery purpose)  3) NW initiated RA procedure (i.e. based on PDCCH)  4) Support of ssb-Threshold and association between preamble/PRACH occasion and SSB  5) Preamble grouping  6) UL single TA maintenance  7) HARQ operation for DL and UL  8) LCH prioritization  9) Prioritized bit rate  10) Multiplexing  11) SR with single SR configuration  12) BSR  13) PHR  14) 8bits and 16bits L field |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signallling |
| 3-1 | LCP restriction | 1) LCP restriction  2) LCP restriction to SCell(s) |  | 1) *lcp-Restriction*  2) *lch-ToSCellRestriction* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 3-2 | LCH SR delay timer | LCH SR delay timer |  | *logicalChannelSR-DelayTimer* | *MAC-ParametersXDD-Diff* | Yes | No |  | Optional with capability signalling |
| 3-3 | DRX | 1) DRX with long DRX cycle  2) DRX with short DRX cycle |  | 1) *longDRX-Cycle*  2) *shortDRX-Cycle* | *MAC-ParametersXDD-Diff* | Yes | No |  | Mandatory with capability signalling |
| 3-4 | Configured grants | Maximum number of configured grant configurations per cell group |  | *multipleConfiguredGrants* | *MAC-ParametersXDD-Diff* | Yes | No |  | Optional with capability signalling |
| 3-5 | SR | Multiple SR configurations |  | *multipleSR-Configurations* | *MAC-ParametersXDD-Diff* | Yes | No |  | Optional with capability signalling |
| 3-6 | Skipping UL transmission | 1) Skipping UL transmission for dynamic UL grant  2) Skipping UL transmission for configured UL grant |  | 1) *skipUplinkTxDynamic* | *MAC-ParametersXDD-Diff* | 1) Yes  2) No | No |  | 1) Optional with capability signalling. Mandatory with capability signalling from Rel-16  2) Conditional mandatory if the UE supports configured grant |
| 3-7 | Codec adaptation | 1) Bit rate recommendation message  1) Bit rate recommendation query message |  | 1) *recommendedBitRate*  2) *recommendedBitRateQuery* | *MAC-ParametersCommon* | No | No | SA only | Optional with capability signalling |
| 4. Measurements | 4-1 | Intra-NR measurements and reports | 1) Intra-frequency and inter-frequency measurements and reports  2) Event A-based measurement and measurement report |  | 1) *intraAndInterF-MeasAndReport*  2) *eventA-MeasAndReport* | *MeasAndMobParametersXDD-Diff* | Yes | No |  | Mandatory with capability signalling when EN-DC is configured. Mandatory without capability signalling for NR SA. |
| 4-2 | Inter-NR measurement and reports while in LTE connected | 1) NR measurement and reports while in LTE connected  2) Event B1-based measurement and reports while in LTE connected |  | n/a | n/a | n/a | n/a |  | Mandatory without capability signalling |
| 4-3 | SFTD measurements | 1) SFTD measurements between PCell and PSCell  2) SFTD measurements between PCell and NR Cell |  | 1) *sftd-MeasPSCell*  2) *sftd-MeasNR-Cell* | *MeasAndMobParametersMRDC-XDD-Diff* | Yes | No |  | Optional with capability signalling |
| 4-4 | Measurement gaps | Additional measurement gap configurations |  | *supportedGapPattern* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling and candidate value set is:  BIT STRING (SIZE (22)) |
| 4-5 | ANR | 1) CGI reporting of EUTRA cell when EN-DC is not configured  2) CGI reporting of NR cell when EN-DC is not configured  3) CGI reporting of NR cell when EN-DC is configured |  | 1) *eutra-CGI-Reporting*  2) *nr-CGI-Reporting*  3) *nr-CGI-Reporting-ENDC* | *MeasAndMobParametersCommon* | No | No | 1) and 2) SA only  3) EN-DC only  Autonomous gap is not supported when ANR (towards NR neighbour cells) configured by NR PCell in NR SA and when ANR (towards NR neighbouring cells) configured by NR PSCell in EN-DC. | Mandatory with capability signalling |
| 4-6 | LTE measurement and reporting while in NR connected | 1) Periodic measurement and reporting while NR connected.  2) Event B#N-based measurement and reporting while NR connected |  | 1) *periodicEUTRA-MeasAndReport*  2) *eventB-MeasAndReport* | *MeasAndMobParametersCommon* | No | No |  | Mandatory with capability signalling if the UE supports LTE |
| 5. SDAP | 5-1 | QoS | 1) Flow-based QoS  2) Multiple flows to 1 DRB mapping  3) AS reflective QoS |  | 3) *as-ReflectiveQoS* | *SDAP-Parameters* | No | No | SA only | 1), 2) Mandatory without capability signalling  3) Optional with capability signalling |
| 5-2 | HD format | 1) DL SDAP HD  2) UL SDAP HD  3) SDAP End-marker |  | n/a | n/a | n/a | n/a | SA only | 1) Conditional mandatory if either NAS reflective QoS or AS reflective QoS is supported. No capability signalling is needed.  2), 3) Mandatory without capability signalling |
| 6. Inactive | 6-1 | RRC inactive | RRC inactive |  | *inactiveState* | *UE-NR-Capability-v1530* | No | No | SA only | Mandatory with capability signalling |
| 7. Mobility | 7-1 | Handover | 1) Intra-frequency HO  2) Inter-frequency HO  3) HO between TDD and FDD  4) HO from NR to LTE  5) HO from NR to LTE with 5GC  6) HO between FR1 and FR2 |  | 2) *handoverInterF*  3) *handoverFDD-TDD*  4) *handoverLTE-EPC*  5) *handover-LTE-5GC*  6) *handoverFR1-FR2* | 3), 6) *MeasAndMobParametersCommon*  2), 4), 5) *MeasAndMobParametersXDD-Diff* and *MeasAndMobParametersFRX-Diff* | 1), 3), 6) No  2), 4), 5) Yes | 1), 3), 6) No  2), 4), 5) Yes | SA only | 1) Mandatory without capability signalling  2) Mandatory with capability signalling  3) Mandatory with capability signalling if the UE supports both TDD and FDD.  4) and 5) Mandatory with capability signalling if the UE supports the associated RAT.  6) Mandatory with capability signalling if the UE supports both FR1 and FR2. |
| 8. Idle/inactive UE procedures | 8-1 | System information acquisition | 1) Msg.1 based on-demand SI provisioning  2) Msg.3 based on-demand SI provisioning |  | n/a | n/a | n/a | n/a | SA only | Mandatory without capability signalling |
| 9. RRC | 9-1 | RRC buffer size | Maximum overall RRC configuration size |  | n/a | n/a | n/a | n/a |  | 45 Kbytes |
| 9-2 | RRC processing time | 1) RRC connection establishment  2) RRC connection resume without SCell addition/release and SCG establishment/modification/release  3) RRC connection reconfiguration without SCell addition/release and SCG establishment/modification/release  4) RRC connection re-establishment.  5) RRC connection reconfiguration with sync procedure  6) RRC connection reconfiguration with SCell addition/release or SCG establishment/modification/release  7) RRC connection resume  8) Initial security activation  9) Counter check  10) UE capability transfer |  | n/a | n/a | n/a | n/a |  | 1) to 3) 10ms  4) 10ms  5): 10ms + additional delay (cell search time and synchronization) defined in TS 38.133  6) and 7) 16ms  7) 10 or 6ms  (See details in 12, TS 38.331)  8) and 9) 5ms  10) 80ms |
| 10. Architecture options | 10-1 | NE-DC | Support of NE-DC |  | *ne-DC* | *EUTRA-ParametersCommon* | No | No | Only applied to NE-DC. Note for EN-DC, it is included in EUTRA side. | Optional with capability signalling |
| *ne- DC-BC* | *BandCombination-v1560* |
| 10-2 | NR-DC | Support of NR-DC |  | *ca-ParametersNRDC* | *BandCombination-v1560* | No | No |  | Optional with capability signalling |

## 4.3 RF and RRM features

Table 4.3-1 provides the list of RF and RRM features, as shown in [5] and the corresponding UE capability field name, as specified in TS 38.331 [2].

Table 4.3-1: RF and RRM feature list

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 1. System parameter | 1-1 | 60kHz of subcarrier spacing for FR1 | 60kHz subcarrier spacing for data channel in FR1 |  | *scs-60kHz* | *Phy-ParametersFR1* | No | Applicable only to FR1 |  | Optional with capability signalling |
| 1-2 | 64QAM modulation for FR2 PDSCH | 64QAM modulation for FR2 PDSCH |  | n/a | n/a | No | Applicable only to FR2 | Capability can be discussed in future, e.g. when low cost device (e.g. IoT) and/or higher frequency band in FR2 are introduced | Mandatory without capability signalling |
| 1-3 | 64QAM for PUSCH | 64QAM for PUSCH |  | n/a | n/a | No | No | Capability can be discussed in future, e.g. when low cost device (e.g. IoT) and/or higher frequency band in FR2 are introduced | Mandatory without capability signalling |
| 1-4 | 256QAM for PDSCH | 256QAM for PDSCH |  | *pdsch-256QAM-FR1* | *Phy-ParametersFR1* | No | Yes | For FR1, it can be revisited in the future whether the 256QAM is mandated in all UE types or categories | Mandatory with capability signalling for FR1 |
| *pdsch-256QAM-FR2* | *BandNR* | For FR2, RAN4 agreed that no BS and UE requirements will be introduced in Rel.15. | Optional with capability signalling for FR2 |
| 1-5 | 256QAM for PUSCH | 256QAM for PUSCH |  | *pusch-256QAM* | *BandNR* | No | Yes | For FR1, RAN4 can further discuss to mandate 256QAM for PUSCH for FR1 in future release.  For FR2, RAN4 agreed that no BS and UE requirements will be introduced in Rel.15. | Optional with capability signalling (for both FR1 and FR2) |
| 1-6 | pi/2-BPSK for PUSCH | pi/2-BPSK for PUSCH |  | *pusch-HalfPi-BPSK* | *Phy-ParametersFRX-Diff* | No | Yes | RAN4 will define the same minimum requirements for pulse-shaped pi/2 BPSK and non-pulse shaped pi/2 BPSK for FR2. | Optional with capability signalling for FR1  Mandatory with capability signalling for FR2 |
| 1-7 | pi/2-BPSK for PUCCH format 3/4 | pi/2-BPSK for PUCCH format 3/4 |  | *pucch-F3-4-HalfPi-BPSK* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling for FR1  Mandatory with capability signalling for FR2 |
| 1-8 | Active BWP switching delay | Support of active BWP switching delay specified in TS38.133, candidate values set: {type1, type2} |  | *bwp-SwitchingDelay* | *Phy-ParametersCommon* | No | No | For this feature, RAN4 also sent another LS (R4-1803283).  Network cannot configure the shorter delay for certain UE type. | Mandatory to support either type 1 or type 2 with capability signalling |
| 1-9 | Support of EN-DC with LTE-NR coexistence in UL sharing from UE perspective | 1) LTE and NR UL Transmission in the shared carrier via TDM only  2) LTE and NR UL Transmission in the shared carrier via FDM only  3) LTE and NR UL transmission in the shared carrier via FDM or TDM |  | *ul-SharingEUTRA-NR* | *MRDC-Parameters* | No | Applicable only to FR1 |  | Optional with capability signalling |
| 1-10 | Switching time between LTE UL and NR UL for EN-DC with LTE-NR coexistence in UL sharing from UE perspective | Support of switching type between LTE UL and NR UL for EN-DC with LTE-NR coexistence in UL sharing from UE perspective.  Type 1: <0.5us  Type 2: <20us | 1-9 | *ul-SwitchingTimeEUTRA-NR* | *MRDC-Parameters* | No | Applicable only to FR1 | This feature is the switching time between LTE UL and NR UL in the same carrier  Per band combination signalling  UE Capability signalling elements.  1: <0.5us switching type.  2: <20us switching type. | Mandatory to support either type 1 or type 2 with capability signalling if UE reports its capability in 1-10 as 1) LTE and NR UL Transmission in the shared carrier via TDM only, or 3) LTE and NR UL transmission in the shared carrier via FDM or TDM |
| 1-11 | 7.5kHz UL raster shift | 7.5kHz UL raster shift |  | n/a | n/a | No | No |  | Mandatory in the SUL bands with uplink sharing either from UE perspective or from network perspective  7.5KHz raster shift as mandatory without capability signalling. 7.5kHz UL raster shift is mandatory for the bands described in clause 5.4.2.1 of Release 15 TS 38.101-1. RAN4 can revisit the above bands in the future release. 7.5KHz raster shift is not mandatory for other LTE refarming band except the bands which were agreed to support 7.5kHz UL raster shift as mandatory |
| 2. UE RF | 2-1 | Maximum channel bandwidth supported in each band for DL and UL separately and for each SCS that UE supports within a single CC | 1) FR1 channel bandwidths in TS38.101-1 Table 5.3.5-1  2) FR2 channel bandwidths in TS38.101-2 Table 5.3.5-1 |  | *channelBWs-DL*  *channelBWs-UL* | *BandNR* | No | No | UE capability signalling shall follow RP-172832 (Per-band capability signalling, separately for DL and UL and for each SCS)  Whether a bandwidth newly introduced in future is mandatory for UE shall be discussed case by case. | For FR1, all the bandwidths listed in TS38.101-1 v15.0.0 Table 5.3.5-1 for each band shall be mandatory with a single CC. The bandwidths listed in the slide #3 of R4-1805985 are mandatory with a single CC. 90MHz is optional for n41, n77, n78.  For FR2, the set of mandatory CBW is 50, 100, 200 MHz. |
| *supportedBandwidthDL*  *channelBW-90mhz* | *FeatureSetDownlinkPerCC* |
| *supportedBandwidthUL*  *channelBW-90mhz* | *FeatureSetUplinkPerCC* |
| 2-2 | Simultaneous reception or transmission with same or different numerologies in CA | Support of simultaneous reception or transmission with same or different numerologies in CA |  | *supportedSubcarrierSpacingDL* | *FeatureSetDownlinkPerCC* | No | No | From RAN4 perspective UE shall be able to signal the supported SCS per CC for each band combination  Same numerology for intra-band NR CA including both continuous and non-continuous is mandatory support for Rel15  The capability of supporting SCS within the single carrier in the CA configuration will be signalled separately, i.e., there is no need to mandatory UE to support mixed numerologies in CA case  If a UE supports inter-band NR CA including both FR1 band(s) and FR2 band(s), the UE shall support two mixed numerologies between FR1 band(s) and FR2 band(s) in DL and UL with capability signalling. | Same numerology for intra-band NR CA including both continuous and non-continuous is mandatory with capability in both FR1 and FR2. Two mixed numerologies between FR1 band(s) and FR2 band(s) in DL and UL are mandatory with capability if UE supports inter-band NR CA including both FR1 band(s) and FR2 band(s). Optional for other cases. |
| *supportedSubcarrierSpacingUL* | *FeatureSetUplinkPerCC* |
| 2-3 | Non-contiguous intra-band CA frequency separation class for FR2 | 1) Support of frequency separation classes to handle the total frequency span for DL for intra-band non-contiguous CA  2) Support of frequency separation classes to handle the total frequency span for UL for intra-band non-contiguous CA |  | *intraBandFreqSeparationDL* | *FeatureSetDownlink* | No | Applicable only to FR2 | UE signals the supported Frequency separation classes with per band granularity (Type 1) based on R4-1803363  Separate Frequency separation classes can be signalled for DL and UL | Mandatory to support a frequency separation class within {I, II, III} specified in TS38.101-2 with capability if UE supports non-contiguous CA in FR2 |
| *intraBandFreqSeparationUL* | *FeatureSetUplink* |
| 2-4 | Simultaneous reception and transmission for inter-band EN-DC (TDD-TDD or TDD-FDD) | Simultaneous reception and transmission for inter-band EN-DC (TDD-TDD or TDD-FDD) |  | *simultaneousRxTxInterBandENDC* | *MRDC-Parameters* | No | No | For TDD-FDD and TDD-TDD band combinations for which simultaneous RxTx capability is agreed to be supported, corresponding capability indication must be set to "supported".  Band combinations for which simultaneous RxTx capability is mandatory EN-DC combinations (Both FR1 LTE – FR1 NR and FR1 LTE- FR2 NR) are captured in TS 38.101-3. | Mandatory/Optional support depends on band combination and captured in TS 38.101-3 |
| 2-5 | Simultaneous reception and transmission for inter band CA (TDD-TDD or TDD-FDD) | Simultaneous reception and transmission for inter band CA (TDD-TDD or TDD-FDD) |  | *simultaneousRxTxInterBandCA* | *CA-ParametersNR* | No | No | For TDD-FDD and TDD-TDD band combinations for which simultaneous RxTx capability is agreed to be supported, corresponding capability indication must be set to "supported".  Band combinations for which simultaneous RxTx capability is mandatory are captured in TS 38.101-1, TS 38.101-2 and TS 38.101-3. | Mandatory/Optional support depends on band combination and captured in TS 38.101-1, TS 38.101-2 and TS 38.101-3 |
| 2-6 | Asynchronous FDD-FDD intra-band EN-DC DC | Asynchronous FDD-FDD intra-band EN-DC |  | *asyncIntraBandENDC* | *MRDC-Parameters* | Applicable only to FDD | Applicable only to FR1 |  | Optional with capability signalling |
| 2-7 | Almost contiguous UL CP-OFDM | Support of almost contiguous UL CP-OFDM transmissions |  | *almostContiguousCP-OFDM-UL* | *Phy-ParametersFRX-Diff* | No | Yes | RAN4 had defined the requirements for "Almost contiguous UL CP-OFDM" in Rel-15. | Optional with capability signalling |
| 2-8 | UE power class | 1) Support of FR1 UE power class  2) Support of FR2 UE power class  3) Support of FR1 UE power class for EN-DC  4) Support of FR1 UE power class for NR-CA |  | *ue-PowerClass* | *BandNR* | No | No | Capability signalling  - FR1 UE power class (per band)  - FR2 UE power class (per band)  - FR1 UE power class for EN-DC (per band combination)  - FR1 UE power class for NR CA (per band combination)  Default power class for each component is indicated in TS38.101-1/2/3. If the default power class is not indicated, UE shall report supported power class. The component 2) is also used as power class for intra-band NR-CA in FR2 | Mandatory to support at least one power class with capability. The capability signalling is absent if UE supports only default power class |
| *powerClass* | *BandCombination* |
| 2-9 | Simultaneous reception and transmission for SA SUL band combinations | Simultaneous reception and transmission for SA SUL band combinations |  | *simultaneousRxTxSUL* | *CA-ParametersNR* | No | No |  | Mandatory/Optional support depends on band combination and captured in TS 38.101-1 |
| 2-10 | Multiple frequency band indication | Multiple frequency band indication |  | n/a | n/a | No | No | Per UE capability | Mandatory without capability signalling |
| 2-11 | Modified MPR behaviour | Modified MPR behaviour |  | *modifiedMPR-Behaviour* | *BandNR* | No | No | Per band capability | Optional with capability signalling |
| 2-12 | Multiple NS/P-Max | Multiple NS/P-Max |  | n/a | n/a | No | No | Per UE capability | Mandatory without capability signalling |
| 2-13 | Maximum uplink duty cycle for FR1 power class 2 UE | Maximum percentage of uplink symbols can be scheduled within a certain evaluation period provided by regulatory bodies. The value range is {60%, 70%, 80%, 90%, 100%}. If the field is absent, 50% shall be applied. |  | *maxUplinkDutyCycle-PC2-FR1* | *BandNR* | No | Applicable only to FR1 | Per band capability.  If this capability is absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than 50%, or this capability is not absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than this capability, apply all requirements for the default power class. The evaluation period is up to UE implementation, no less than one radio frame.  UE do not need to do UL duty cycle calculation when it's transmit power is below 23dBm and all the UL/DL configurations can be scheduled. | Optional with capability signalling. The capability signalling is absent if UE supports 50% |
| 2-14 | Power boosting for Pi/2 BPSK for power class 3 UE | Power boosting for Pi/2 BPSK for power class 3 UE in TDD bands n40, n77, n78 and n79 with duty cycle less than 40% | 1-6, 1-7 | *powerBoosting-pi2BPSK* | *BandNR* | Applicable only to TDD | Applicable only to FR1 | Per band capability | Optional with capability signalling |
| 2-15 | Maximum uplink duty cycle for FR2 | 1) Maximum percentage of uplink transmission time that can be scheduled within 1s time window in order to ensure compliance with applicable electromagnetic power density exposure requirements provided by regulatory bodies. The value range is {15%, 20%, 25%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%}. |  | *maxUplinkDutyCycle-FR2* | *BandNR* | No | Applicable only to FR2 | Per band capability.  If the field of UE capability is present and the percentage of uplink symbols transmitted within any 1 s evaluation period is larger than this capability, the UE follows the uplink scheduling and can apply P-MPR as in TS38.101-2. If the field of UE capability is absent, the compliance to electromagnetic power density exposure requirements are ensured by means of scaling down the power density or by other means.  This capability is applicable for all power classes in FR2 | Optional with capability signalling |
| 2-16 | PA architectures for intra-band EN-DC | Support of dual PA |  | *dualPA-Architecture* | *MRDC-Parameters* | No | No | Per band per band combination capability  Single PA is default architecture  The following requirements are involved by this capability  - A-MPR/MPR and MSD values for dual uplink. Whether two sets of requirements will be introduced in RAN4 can be further discussed for each specific band combination  - Switching time between LTE UL and NR UL in single switched UL operation mode for intra-band EN-DC | Mandatory to support either single or dual PA architectures with capability if UE supports intra-band EN-DC configuration in uplink. The capability signalling is absent if UE supports single PA architecture. |
| 2-17 | PA architectures for intra-band UL CA | Support of dual PA |  | *dualPA-Architecture* | *CA-ParametersNR-v1540* | No | No | Per band per band combination capability  Single PA is default architecture  The following requirements are involved by this capability  - A-MPR/MPR and MSD values for dual uplink. Whether two sets of requirements will be introduced in RAN4 can be further discussed for each specific band combination | Mandatory to support either single or dual PA architectures with capability if UE supports intra-band CA configuration in uplink. The capability signalling is absent if UE supports single PA architecture |
| 3. Baseband | 3-1 | Independent measurement gap configurations for FR1 and FR2 | Measurement gaps for FR1 and FR2 are configured independently. |  | *independentGapConfig* | *MeasAndMobParametersMRDC-Common* | No | No |  | Optional with capability signalling |
| 3-2 | Simultaneous reception of data and SS block with different numerologies when UE conducts the serving cell measurement or intra-frequency measurement | Simultaneous reception of data and SS block with different numerologies when UE conducts the serving cell measurement or intra-frequency measurement |  | *simultaneousRxDataSSB-DiffNumerology* | *MeasAndMobParametersFRX-Diff*  *MeasAndMobParametersMRDC-FRX-Diff* | No | Yes |  | Optional with capability signalling |
| 3-3 | Short measurement gap | Measurement gap patterns with short MGL (gap pattern#2, 3, 6, 7, 8, 10) are supported for E-UTRAN measurement. Gap patterns #6, 7, 8, 10 only apply to E-UTRAN measurement when MO includes both E-UTRAN and NR. |  | *supportedGapPattern* | *MeasAndMobParametersCommon* | No | No | Per UE capability  This capability is signalled as a part of *supportedGapPattern* in TS38.306. | Optional with capability signalling |
| 3-4 | SU-MIMO Interference Mitigation advanced receiver | 1) R-ML (reduced complexity ML) receivers with enhanced inter-stream interference suppression for SU-MIMO transmissions with rank 2 with 2 RX antennas.  2) R-ML (reduced complexity ML) receivers with enhanced inter-stream interference suppression for SU-MIMO transmissions with rank 2, 3, and 4 with 4 RX antennas. |  | n/a | n/a | No | No | UE supporting the feature is required to meet the Enhanced Receiver Type requirements in TS 38.101-4 | Optional without capability signalling |

# 5 Release 16 UE feature list

## 5.1 Layer-1 UE features

### 5.1.0 General

Tables 5.1.1-1 to 5.1.15-1 provide the list of Layer-1 features, as shown in [6] and the corresponding UE capability field name, as specified in TS 38.331 [2].

### 5.1.1 NR\_2step\_RACH

Table 5.1.1-1: Layer-1 feature list for NR\_2step\_RACH

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | **Parent IE in TS 38.331 [2]** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 9. NR\_2step\_RACH | 9-1 | Basic channel structure and procedure of 2-step RACH | 1. Fallback procedures from 2-step RACH to 4-step RACH  2. msgA PRACH resource and format determination  3. msgA PUSCH configuration  4. Validation and transmission of MsgA PRACH and PUSCH  5. Mapping between preamble of MsgA PRACH and PUSCH occasion with DMRS resource of MsgA PUSCH  6. msgB monitoring and decoding  7. PUCCH transmission for HARQ-ACK feedback to a msgB  8. Power control for msgA PRACH, msgA PUSCH and PUCCH carrying HARQ-ACK feedback to msgB |  | *twoStepRACH-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 9-3 | Parallel MsgA and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA | Parallel MsgA and SRS/PUCCH/PUSCH transmissions across CCs in inter-band CA with msgA in PCell/PScell | 4-26, 9-1 | *parallelTxMsgA-SRS-PUCCH-PUSCH-r16* | *CA-ParametersNR-v1610* | n/a | n/a |  | Optional with capability signalling |
| 9-4 | MsgA operation in a band combination including SUL | MsgA operations in a band combination including SUL | 9-1, 6-16 | *msgA-SUL-r16* | *CA-ParametersNR-v1610* | n/a | n/a |  | Optional with capability signalling |

### 5.1.2 NR-unlicensed

Table 5.1.2-1: Layer-1 feature list for NR-unlicensed

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | **Parent IE in TS 38.331 [2]** | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 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 |  | *ul-DynamicChAccess-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2, B, C, D and E with dynamic channel access mode |
| 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 |  | *ul-Semi-StaticChAccess-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2, B, C, D and E with semi-static channel access mode |
| 10-2 | SSB-based RRM for dynamic channel access mode | 1. SSB-based RRM with Q for dynamic channel access mode |  | *ssb-RRM-DynamicChAccess-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A1, A2, B, C, D and E with 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, when SMTC window is no longer than the fixed frame period |  | *ssb-RRM-Semi-StaticChAccess-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A1, A2, B, C, D and E with semi-static channel access mode |
| 10-2b | MIB reading on unlicensed cell | 1. MIB reading on unlicensed cell for PCell and PSCell |  | *mib-Acquisition-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario B, C, D and E |
|  | 10-2c | SSB-based RLM for dynamic channel access mode | 1. SSB-based RLM with Q for dynamic channel access mode |  | *ssb-RLM-DynamicChAccess-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-3 applies to licensed band operation only, and functionalities of FG1-3 is covered by FG10-2c/2d in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario B, C, D and E with 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, when DRS window is no longer than the fixed frame period |  | *ssb-RLM-Semi-StaticChAccess-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-3 applies to licensed band operation only, and functionalities of FG1-3 is covered by FG10-2c/2d in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario B, C, D and E with semi-static channel access mode |
|  | 10-2e | SIB1 reception on unlicensed cell | 1. SIB1 reception on unlicensed cell for PCell |  | *sib1-Acquisition-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario C and D |
|  | 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 |  | *extRA-ResponseWindow-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-2g | SSB-based BFD/CBD for dynamic channel access mode | SSB-based BFD/CBD with Q for dynamic channel access mode |  | *ssb-BFD-CBD-dynamicChannelAccess-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-2h | SSB-based BFD/CBD for semi-static channel access mode | SSB-based BFD/CBD with Q for semi-static channel access mode |  | *ssb-BFD-CBD-semi-staticChannelAccess-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Q indicates the value of RAN1 parameter  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-2i | CSI-RS-based BFD/CBD for operation with shared spectrum channel access | CSI-RS-based BFD/CBD for operation with shared spectrum channel access |  | *csi-RS-BFD-CBD-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-7 | UL channel access for 10 MHz SCell | 10 MHz LBT bandwidth | one of {10-1, 10-1a} | *ul-ChannelBW-SCell-10mhz-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-10 | RSSI and channel occupancy measurement and reporting | 1. RSSI measurement  Channel occupancy reporting |  | *rssi-ChannelOccupancyReporting-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-11 | SRS starting position at any OFDM symbol in a slot | 2. Support transmitting SRS starting in all symbols (0,…,13) of a slot |  | *srs-StartAnyOFDM-Symbol-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a |  | Optional with capability signaling |
|  | 10-20 | Support search space set configuration with freqMonitorLocation-r16 | 3. Maximum number of frequency domain locations for a search space set configuration with freqMonitorLocations-r16 |  | *searchSpaceFreqMonitorLocation-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Candidate values of component 1: {1, 2, ,3, 4, 5}  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-20a | Support coreset configuration with rb-Offset | 4. Support coreset configuration with rb-Offset |  | *coreset-RB-Offset-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a |  | Optional with capability signaling |
|  | 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 |  | *cgi-Acquisition-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Support reading RMSI from an unlicensed cell for ANR  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-25 | Enable configured UL transmissions when SFI field in DCI 2\_0 is configured but DCI 2\_0 is not detected | 1. Support configuration of enableConfiguredUL-r16 and enable transmission of higher-layer configured UL \*SRS, PUCCH, CG-PUSCH etc) when SFI field in DCI 2\_0 is configured but DCI 2\_0 is not detected |  | *configuredUL-Tx-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-27 | Wideband PRACH | Enhanced PRACH design for operation with shared spectrum channel access by adopting a single long ZC sequence, with ZC sequence = 1151 for 15kHz and ZC sequence = 571 for 30kHz |  | *prach-Wideband-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-29 | Support available RB set indicator field in DCI 2\_0 | Support monitoring DCI 2\_0 to read availableRB-Sets-r16 |  | *dci-AvailableRB-Set-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-30 | Support channel occupancy duration indicator field in DCI 2\_0 | Support monitoring DCI 2\_0 to read COT duration |  | *dci-ChOccupancyDuration-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 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 | *typeB-PDSCH-length-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Note length 9/10 with DMRS shift due to CRS collision are already covered by 14-2 | Optional with capability signalling |
|  | 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 |  | *searchSpaceSwitchWithDCI-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | 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.  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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 |  | *searchSpaceSwitchWithoutDCI-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | 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.  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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} | *jointSearchSpaceGroupSwitchingAcrossCells-r16* | *CA-ParametersNR-v1610* | n/a | n/a | Without this capability, the UE will switch search space set groups for different cells independently  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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} | *searchSpaceSetGroupSwitchingcapability2-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | 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  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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 |  | *non-numericalPDSCH-HARQ-timing-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | If non-numerical K1 value is supported  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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) |  | *enhancedDynamicHARQ-codebook-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Enhanced dynamic HARQ codebook supporting grouping of HARQ ACK and triggering the retransmission of HARQ ACK in each group | Optional with capability signalling |
|  | 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 |  | *oneShotHARQ-feedback-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | 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 |
|  | 10-17 | Multi-PUSCH UL grant | 1. Support of scheduling up to 8 PUSCH with a single DCI 0\_1 |  | *multiPUSCH-UL-grant-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a |  | Optional with capability signalling |
|  | 10-26 | CSI-RS based RLM for operation with shared spectrum channel access | CSI-RS based RLM for operation with shared spectrum channel access |  | *csi-RS-RLM-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-7 applies to licensed band operation only, and functionalities of FG1-7 is covered by FG10-26 in unlicensed band operation. | Optional with capability signalling |
|  | 10-26a |  |  |  |  |  |  |  | RAN1 respectfully ask RAN2 to make the capability bit for this FG as dummy. |  |
|  | 10-26b | CSI-RS based RRM measurement with associated SS-block for operation with shared spectrum channel access | 1) CSI-RSRP measurement for operation with shared spectrum channel access  2) CSI-RSRQ measurement for operation with shared spectrum channel access |  | *csi-RSRP-AndRSRQ-MeasWithSSB-r16* | *SharedSpectrumChAccessParamsPerBand-v1640* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-4 applies to licensed band operation only, and functionalities of FG1-4 is covered by FG10-26b in unlicensed band operation. | Optional with capability signalling |
|  | 10-26c | CSI-RS based RRM measurement without associated SS-block for operation with shared spectrum channel access | 1) CSI-RSRP measurement for operation with shared spectrum channel access  2) CSI-RSRQ measurement for operation with shared spectrum channel access  3) There is SS-block in the target frequency on which the RRM measurement is performed for operation with shared spectrum channel access |  | *csi-RSRP-AndRSRQ-MeasWithoutSSB-r16* | *SharedSpectrumChAccessParamsPerBand-v1640* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-5 applies to licensed band operation only, and functionalities of FG1-5 is covered by FG10-26c in unlicensed band operation. | Optional with capability signalling |
|  | 10-26d | CSI-RS based RS-SINR measurement for operation with shared spectrum channel access | CSI-SINR measurements for operation with shared spectrum channel access | 10-26b | *csi-SINR-Meas-r16* | *SharedSpectrumChAccessParamsPerBand-v1640* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-6 applies to licensed band operation only, and functionalities of FG1-6 is covered by FG10-26d in unlicensed band operation. | Optional with capability signalling |
|  | 10-26e | RLM based on a mix of SS block and CSI-RS signals within active BWP for operation with shared spectrum channel access | RLM based on a mix of SS block and CSI-RS signals within active BWP for operation with shared spectrum channel access | 10-26, one of {10-2c, 10-2d} | *ssb-AndCSI-RS-RLM-r16* | *SharedSpectrumChAccessParamsPerBand-v1640* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-8 applies to licensed band operation only, and functionalities of FG1-8 is covered by FG10-26e in unlicensed band operation. | Optional with capability signalling |
|  | 10-26f | CSI-RS based contention free RA for HO for operation with shared spectrum channel access | CSI-RS based contention free RA for HO for operation with shared spectrum channel access | One of {10-26b, 10-26c} | *csi-RS-CFRA-ForHO-r16* | *SharedSpectrumChAccessParamsPerBand-v1640* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used  Note: Rel-15 FG1-9 applies to licensed band operation only, and functionalities of FG1-9 is covered by FG10-26f in unlicensed band operation. | Optional with capability signalling |
|  | 10-31 | Support of P/SP-CSI-RS reception with CSI-RS-ValidationWith-DCI-r16 configured | 1. Validate P/SP-CSI-RS reception when receiving a DCI granting a PDSCH over the same set of symbols  2. Validate P/SP-CSI-RS reception when receiving a DCI triggering a A-CSI-RS over the same set of symbols |  | *periodicAndSemi-PersistentCSI-RS-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | If UE does not signal capability for FG 10-31, the UE cannot be configured with CSI-RS-ValidationWith-DCI-r16.  If none of the RRC parameters CO-DurationPerCell-r16, SlotFormatIndicator, and CSI-RS-ValidationWith-DCI-r16 is configured on a cell with shared spectrum access, and P/SP CSI-RS is configured, for reception/cancellation of SP/P CSI-RS the behavior in 11.1 of TS38.213 applies as per agreement.  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-3 | PRB interlace mapping for PUSCH | 1. PRB interlace frequency domain resource allocation for PUSCH |  | *pusch-PRB-interlace-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Support of PRB interlace PUSCH  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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 |  | *pucch-F0-F1-PRB-Interlace-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Support of PRB interlace PUCCH format 0/1  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 10-12 | OCC for PRB interlace mapping for PF2 and PF3 | 1. OCC2  2. OCC4 | 10-3a | *occ-PRB-PF2-PF3-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | UE OCC capability for EPF2/EFP3  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 10-13a | Extended CP range of more than one symbol for CG-PUSCH | UE supports generating a CP extension of length longer than 1 symbol for Configured Grant PUSCH transmission | One or both of {5-19, 5-20} | *extCP-rangeCG-PUSCH-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | How long a UE can generate the CP extension beyond 1 symbol for CG-PUSCH  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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 or both of {5-19, 5-20} | *configuredGrantWithReTx-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | Support configured grant with retransmission in configured grant resource  the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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 channel access for scheduled UL to share COT with gNB for DL  2. Use ULtoDL-CO-SharingED-Threshold-r16 for Type 1 channel access for CG-PUSCH to share COT with gNB for DL  3. Indicate in CG-UCI the COT sharing information | 10-1 | *ed-Threshold-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 10-21b | Support UL to DL COT sharing | 1. Support Type 1 LBT for scheduled UL to share COT with gNB for DL without ULtoDL-CO-SharingED-Threshold-r16  2. Support Type 1 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 | 10-1 | *ul-DL-COT-Sharing-r16* | *SharedSpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
|  | 10-24 | CG-UCI multiplexing with HARQ ACK | 1. Support multiplexing CG-UCI with HARQ ACK | 10-18 | *mux-CG-UCI-HARQ-ACK-r16* | *SpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 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 or both of {5-19, 5-20} | *cg-resourceConfig-r16* | *SpectrumChAccessParamsPerBand-r16* | n/a | n/a | the signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signalling |
|  | 10-32 | SS block based SINR measurement (SS-SINR) for unlicensed spectrum | SS-SINR measurement for unlicensed spectrum |  | *ss-SINR-Meas-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG1-2 applies to licensed band operation only, and functionalities of FG1-2 is covered by FG10-32 in unlicensed band operation. | Optional with capability signaling |
|  | 10-33 | Semi-persistent CSI report on PUCCH for unlicensed spectrum | 1) Support report on PUCCH formats over 1 – 2 OFDM symbols once per slot (or piggybacked on a PUSCH) for unlicensed spectrum  2) Support report on PUCCH formats over 4 – 14 OFDM symbols once per slot (or piggybacked on a PUSCH) for unlicensed spectrum |  | *sp-CSI-ReportPUCCH-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG2-32a applies to licensed band operation only, and functionalities of FG2-32a is covered by FG10-33 in unlicensed band operation. | Optional with capability signaling |
|  | 10-33a | Semi-persistent CSI report on PUSCH for unlicensed spectrum | Support semi-persistent CSI report on PUSCH for unlicensed spectrum |  | *sp-CSI-ReportPUSCH-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG2-32b applies to licensed band operation only, and functionalities of FG2-32b is covered by FG10-33a in unlicensed band operation. | Optional with capability signaling |
|  | 10-34 | Dynamic SFI monitoring for unlicensed spectrum | Adjust periodic and semi-persistent signal reception and transmission in response to detected dynamic UL/DL configuration for unlicensed spectrum |  | *dynamicSFI-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG3-6 applies to licensed band operation only, and functionalities of FG3-6 is covered by FG10-34 in unlicensed band operation.  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of the FG10-34 is based on both the support of this capability for the band of the scheduled/triggered/indicated cell and the support of this capability for the band of the scheduling/triggering/indicating cell. | Optional with capability signaling |
|  | 10-35 | SR/HARQ-ACK/CSI multiplexing once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with the same starting symbol on the PUCCH resources in a slot for unlicensed spectrum | SR/HARQ-ACK/CSI multiplexing once per slot, where overlapping PUCCH resources have the same starting symbols on the PUCCH resources in a slot while precluding the case of SR/HARQ-ACK by overlapping PUCCH resources with the same starting symbols on the PUCCH resources in a slot for unlicensed spectrum |  | *mux-SR-HARQ-ACK-CSI-PUCCH-OncePerSlot-r16*  *{*  *sameSymbol-r16,*  *diffSymbol-r16*  *}* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG4-19 applies to licensed band operation only, and functionalities of FG4-19 is covered by FG10-35 in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2, B, C, D and E |
|  | 10-35a | SR/HARQ-ACK multiplexing once per slot using a PUCCH (or HARQ-ACK piggybacked on a PUSCH) when SR/HARQ-ACK are supposed to be sent with different starting symbols in a slot for unlicensed spectrum | Overlapping PUCCH resources have different starting symbols in a slot for unlicensed spectrum | 10-35 | *mux-SR-HARQ-ACK-PUCCH-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG4-19a applies to licensed band operation only, and functionalities of FG4-19a is covered by FG10-35a in unlicensed band operation. | Optional with capability signaling |
|  | 10-35b | SR/HARQ-ACK/CSI multiplexing more than once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with the same or different starting symbol in a slot for unlicensed spectrum | Overlapping PUCCH resources have same or different starting symbols in a slot for unlicensed spectrum | 10-35c | *mux-SR-HARQ-ACK-CSI-PUCCH-MultiPerSlot-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG4-19b applies to licensed band operation only, and functionalities of FG4-19b is covered by FG10-35b in unlicensed band operation. | Optional with capability signaling |
|  | 10-35c | SR/HARQ-ACK/CSI multiplexing once per slot using a PUCCH (or HARQ-ACK/CSI piggybacked on a PUSCH) when SR/HARQ-ACK/CSI are supposed to be sent with different starting symbols in a slot for unlicensed spectrum | Overlapping PUCCH resources have different starting symbols in a slot for unlicensed spectrum | 10-35a | *mux-SR-HARQ-ACK-CSI-PUCCH-OncePerSlot-r16*  *{*  *sameSymbol-r16,*  *diffSymbol-r16*  *}* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG4-19c applies to licensed band operation only, and functionalities of FG4-19c is covered by FG10-35c in unlicensed band operation. | Optional with capability signaling |
|  | 10-36 | HARQ-ACK multiplexing on PUSCH with different PUCCH/PUSCH starting OFDM symbols for unlicensed spectrum | HARQ-ACK piggyback on a PUSCH with/without aperiodic CSI once per slot when the starting OFDM symbol of the PUSCH is different from the starting OFDM symbols of the PUCCH resource that HARQ-ACK would have been transmitted on for unlicensed spectrum |  | *mux-HARQ-ACK-PUSCH-DiffSymbol-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG4-28 applies to licensed band operation only, and functionalities of FG4-28 is covered by FG10-36 in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2, B, C, D and E |
|  | 10-37 | Repetitions for PUCCH format 1, 3, and 4 over multiple slots with K = 2, 4, 8 for unlicensed spectrum | Repetitions for PUCCH format 1, 3, and 4 over multiple slots with K = 2, 4, 8 for unlicensed spectrum |  | *pucch-Repetition-F1-3-4-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG4-23 applies to licensed band operation only, and functionalities of FG4-23 is covered by FG10-37 in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2 (whenever PUCCH is supported on NR-U cell), B, C, D and E |
|  | 10-38 | Type 1 configured PUSCH repetitions over multiple slots for unlicensed spectrum | K = 2, 4, 8 times repetitions with RV sequences for unlicensed spectrum |  | *type1-PUSCH-RepetitionMultiSlots-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG5-14 applies to licensed band operation only, and functionalities of FG5-14 is covered by FG10-38 in unlicensed band operation. | Optional with capability signaling |
|  | 10-39 | Type 2 configured PUSCH repetitions over multiple slots for unlicensed spectrum | K = 2, 4, 8 times repetitions with RV sequences for unlicensed spectrum |  | *type2-PUSCH-RepetitionMultiSlots-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG5-16 applies to licensed band operation only, and functionalities of FG5-16 is covered by FG10-39 in unlicensed band operation. | Optional with capability signaling |
|  | 10-40 | PUSCH repetitions over multiple slots for unlicensed spectrum | K = 2, 4, 8 times repetitions for unlicensed spectrum |  | *pusch-RepetitionMultiSlots-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG5-17 applies to licensed band operation only, and functionalities of FG5-17 is covered by FG10-40 in unlicensed band operation. | Optional with capability signaling  This FG is a part of basic operation for following scenarios defined in TS38.300  Scenario A2, B, C, D and E |
|  | 10-40a | PDSCH repetitions over multiple slots for unlicensed spectrum | K = 2, 4, 8 times repetitions for unlicensed spectrum |  | *pdsch-RepetitionMultiSlots-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG5-17a applies to licensed band operation only, and functionalities of FG5-17a is covered by FG10-40a in unlicensed band operation. | Optional with capability signaling |
|  | 10-41 | DL SPS for unlicensed spectrum | DL SPS for unlicensed spectrum |  | *downlinkSPS-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG5-18 applies to licensed band operation only, and functionalities of FG5-18 is covered by FG10-41 in unlicensed band operation. | Optional with capability signaling |
|  | 10-42 | Type 1 Configured UL grant for unlicensed spectrum | K = 1 for unlicensed spectrum |  | *configuredUL-GrantType1-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG5-19 applies to licensed band operation only, and functionalities of FG5-19 is covered by FG10-42 in unlicensed band operation. | Optional with capability signaling |
|  | 10-43 | Type 2 Configured UL grant for unlicensed spectrum | K = 1 for unlicensed spectrum |  | *configuredUL-GrantType2-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG5-20 applies to licensed band operation only, and functionalities of FG5-20 is covered by FG10-43 in unlicensed band operation. | Optional with capability signaling |
|  | 10-44 | Pre-emption indication for DL for unlicensed spectrum | Pre-emption indication for DL for unlicensed spectrum |  | *pre-EmptIndication-DL-r16* | *Phy-ParametersSharedChAccess-r16* | No | No | Note: Rel-15 FG5-21 applies to licensed band operation only, and functionalities of FG5-21 is covered by FG10-44 in unlicensed band operation. | Optional with capability signaling |

### 5.1.3 NR\_L1enh\_URLLC

Table 5.1.3-1: Layer-1 feature list for NR\_L1enh\_URLLC

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 11.  NR\_L1enh\_URLLC | 11-1 | Monitoring DCI format 1\_2 and DCI format 0\_2 | Supports monitoring DCI format 1\_2 for DL scheduling  Supports monitoring DCI format 0\_2 for UL scheduling |  | *dci-Format1-2And0-2-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 11-1a | Monitoring both DCI format 0\_1/1\_1 and DCI format 0\_2/1\_2 in the same search space | Supports monitoring both DCI format 0\_1/1\_1 and DCI format 0\_2/1\_2 in the same search space | 11-1 | *monitoringDCI-SameSearchSpace-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 11-1b | Type 1 HARQ-ACK codebook support for relative TDRA for DL | Support Type 1 HARQ-ACK codebook for TDRA using the starting symbol of the PDCCH monitoring occasion in which the DL assignment is detected as the reference of the SLIV | 11-1 | *type1-HARQ-ACK-Codebook-r16* | *Phy-ParametersFRX-Diff* | No | Yes  Note: Differentiation is from the perspective of the scheduled carrier |  | Optional with capability signalling |
| 11-2 | Rel-16 PDCCH monitoring capability | 1. Supported combination(s) of (X, Y, m). For each reported combination, the UE supports the limit C on the maximum number of non-overlapped CCEs for channel estimation per PDCCH monitoring span and the limit M on the maximum number of monitored PDCCH candidates per PDCCH monitoring span  2. Maximum number of DL and UL unicast DCI formats in a span  For the set of monitoring occasions which are within the same span:  - Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for FDD  - Processing one unicast DCI scheduling DL and two unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD  - Processing two unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD |  | *pdcch-Monitoring-r16 {*  *pdsch-ProcessingType1-r16{*  *scs-15kHz-r16*  *PDCCH-MonitoringOccasions-r16,*  *scs-30kHz-r16*  *PDCCH-MonitoringOccasions-r16*  *},*  *pdsch-ProcessingType2-r16 {*  *scs-15kHz-r16*  *PDCCH-MonitoringOccasions-r16,*  *scs-30kHz-r16*  *PDCCH-MonitoringOccasions-r16*  *}* | *FeatureSetDownlink-v1610* | n/a | n/a | This capability is signalled for SCS 15 kHz and 30 kHz.  For m=0 and 1, candidate value set for (X, Y, m): {(7, 3, m), (4, 3, m), (2, 2, m)}  For component 1, a list of separate UE capabilities (X, Y, m)for processing capability #1;  For component 1, a list of separate UE capabilities (X, Y, m)for processing capability #2; | Optional with capability signalling |
| 11-2a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells | 1. Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells  - Candidate value for the component: {2, 3, …, 16)  2. Supported span arrangement for CA  - Candidate value for the component: {aligned spans only, aligned spans and non-aligned spans} | 11-2 | *pdcch-MonitoringCA-r16 {*  *maxNumberOfMonitoringCC-r16 ,*  *supportedSpanArrangement-r16*  *}* | *interFreqDAPS-r16* | n/a | n/a |  | Optional with capability signalling |
|  | 11-2b | Mix of Rel. 16 PDCCH monitoring capability and Rel. 15 PDCCH monitoring capability on different carriers | Support Rel-15 monitoring capability and Rel-16 monitoring capability on different serving cells | 11-2 | *pdcch-MonitoringMixed-r16* | *FeatureSetDownlink-v1610* | n/a | n/a |  | Optional with capability signalling |
|  | 11-2c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16)  - Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15  - Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15  2. Supported span arrangement for CA  - Candidate value for the component: {aligned spans only, aligned spans and non-aligned spans} | 11-2b | *pdcch-BlindDetectionCA-Mixed-r16 {*  *pdcch-BlindDetectionCA1-r16,*  *pdcch-BlindDetectionCA2-r16,*  *supportedSpanArrangement-r16*  *}*  *PDCCH-BlindDetectionMixedList-r16::= SEQUENCE {*  *pdcch-BlindDetectionCA-MixedExt-r16*  *CHOICE*  *{*  *pdcch-BlindDetectionCA-Mixed-v16a0,*  *pdcch-BlindDetectionCA-Mixed-NonAlignedSpan-v16a0*  *}*  *PDCCH-BlindDetectionCA-MixedExt-r16 ::=*  *{*  *pdcch-BlindDetectionCA1-r16 ,*  *pdcch-BlindDetectionCA2-r16*  *}* | *CA-ParametersNR-v1610*  *CA-ParametersNR-v16a0* | n/a | n/a | The minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability and the capability on the number of CCs with Rel-16 PDCCH monitoring capability is 3 | Optional with capability signalling |
|  | 11-2d | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span for MCG and for SCG when configured for NR-DC operation with Rel-16 PDCCH monitoring capability on all the serving cells | Supported combination of (*pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16*) | 11-2 | *pdcch-BlindDetectionMCG-UE-r16 ,*  *pdcch-BlindDetectionSCG-UE-r16* | *CA-ParametersNR-v1610* | n/a | n/a | If the UE reports pdcch-BlindDetectionCA-r16,  - Candidate values for pdcch-BlindDetectionMCG-UE-r16 is 1 to pdcch-BlindDetectionCA-r16-1  - Candidate values for pdcch-BlindDetectionSCG-UE-r16 is 1 to pdcch-BlindDetectionCA-r16-1  - - pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16 >= pdcch-BlindDetectionCA-r16  Otherwise, if N\_(NR-DC,max,r16)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r16 = r16monitoringcapability and the UE is configured on both the MCG and the SCG for NR-DC as indicated in UE-NR-Capability  - the value of pdcch-BlindDetectionMCG-UE-r16 or of pdcch-BlindDetectionSCG-UE-r16 is 1,  - pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16 >= N\_(NR-DC,max,r16)^(DL,cells)  Note: If a UE supports FG 11-2a or FG 11-2f, then the capability defined by FG 11-2a or FG 11-2f is applied to FG 11-2d. | Optional with capability signalling |
|  | 11-2e | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (*pdcch-BlindDetectionMCG-UE-r15*, *pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16*, *pdcch-BlindDetectionSCG-UE-r16*) | 11-2b | *pdcch-BlindDetectionMCG-UE-Mixed-r16 {*  *pdcch-BlindDetectionMCG-UE1-r16*  *pdcch-BlindDetectionMCG-UE2-r16*  *}*  *pdcch-BlindDetectionSCG-UE-Mixed-r16 {*  *pdcch-BlindDetectionSCG-UE1-r16,*  *pdcch-BlindDetectionSCG-UE2-r16*  *}*  *pdcch-BlindDetectionCG-UE-MixedExt-r16*  *{*  *pdcch-BlindDetectionMCG-UE-Mixed-v16a0*  *pdcch-BlindDetectionSCG-UE-Mixed-v16a0*  *}*  *PDCCH-BlindDetectionCG-UE-MixedExt-r16*  *{*  *pdcch-BlindDetectionCG-UE1-r16,*  *pdcch-BlindDetectionCG-UE2-r16*  *}* | *CA-ParametersNR-v1610*  *CA-ParametersNR-v16a0* | n/a | n/a | One combination of (*pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16*) corresponds to one combination of (*pdcch-BlindDetectionCA-r15, pdcch-BlindDetectionCA-r16*)  If the UE reports pdcch-BlindDetectionCA-r15,  - Candidate values for pdcch-BlindDetectionMCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15  - Candidate values for pdcch-BlindDetectionSCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15  - pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15>= pdcch-BlindDetectionCA-r15  Otherwise, if N\_(NR-DC,max,r15)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r16 = r15monitoringcapability  - Candidate values for pdcch-BlindDetectionMCG-UE-r15 is [0, 1, 2]  - Candidate values for pdcch-BlindDetectionSCG-UE-r15 is [0, 1, 2]  - pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15 >= N\_(NR-DC,max,r15)^(DL,cells)  If the UE reports pdcch-BlindDetectionCA-r16,  - Candidate values for pdcch-BlindDetectionMCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16  - Candidate values for pdcch-BlindDetectionSCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16  - pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16>= pdcch-BlindDetectionCA-r16  Otherwise, if N\_(NR-DC,max,r16)^(DL,cells) is a maximum total number of downlink cells for which the UE is provided monitoringCapabilityConfig-r16 = r16monitoringcapability  - Candidate values for pdcch-BlindDetectionMCG-UE-r16 is [0, 1]  - Candidate values for pdcch-BlindDetectionSCG-UE-r16 is [0, 1]  - pdcch-BlindDetectionMCG-UE-r16 + pdcch-BlindDetectionSCG-UE-r16 >= N\_(NR-DC,max,r16)^(DL,cells)  Note: If a UE supports FG 11-2c or FG 11-2g, then the capability defined by FG 11-2c or FG 11-2g is applied to FG 11-2e. | Optional with capability signalling |
|  | 11-2f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells with restriction for non-aligned span case | 1. Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells  - Candidate value for the component: {2, 3, …, 16}  2. UE supports aligned span and non-aligned span  In case of non-aligned span when the configured number of cells with Rel-16 PDCCH monitoring is larger than the UE reported value, PDCCH monitoring occasion(s) should be configured only on same symbol(s) every slot | 11-2 | *pdcch-MonitoringCA-NonAlignedSpan-r16* | *CA-ParametersNR-v1640* | n/a | n/a |  | Optional with capability signalling |
|  | 11-2g | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers with restriction for non-aligned span case | 1. Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16)  - Candidate values for pdcch-BlindDetectionCA-R15 is 1 to 15  - Candidate values for pdcch-BlindDetectionCA-R16 is 1 to 15  2. UE supports aligned span and non-aligned span  In case of non-aligned span when the configured number of cells with Rel-16 PDCCH monitoring is larger than the UE reported value, PDCCH monitoring occasion(s) should be configured only on same symbol(s) every slot | 11-2b | *pdcch-BlindDetectionCA-Mixed-NonAlignedSpan-r16*  *{*  *pdcch-BlindDetectionCA1-r16,*  *pdcch-BlindDetectionCA2-r16*  *}*  *PDCCH-BlindDetectionMixedList-r16::= SEQUENCE {*  *pdcch-BlindDetectionCA-MixedExt-r16*  *CHOICE*  *{*  *pdcch-BlindDetectionCA-Mixed-v16a0,*  *pdcch-BlindDetectionCA-Mixed-NonAlignedSpan-v16a0*  *}* | *CA-ParametersNR-v1640*  *CA-ParametersNR-v16a0* | n/a | n/a | The minimum of the summation of capability on the number of CCs with Rel-15 PDCCH monitoring capability and the capability on the number of CCs with Rel-16 PDCCH monitoring capability is 3 | Optional with capability signalling |
|  | 11-3 | More than one PUCCH for HARQ-ACK transmission within a slot | 1. Supports sub-slot based HARQ-ACK feedback procedure.  - A UL slot consists of a number of sub-slots. No more than one transmitted PUCCH carrying HARQ-ACKs starts in a sub-slot.  - At least one sub-slot configuration for PUCCH can be UE specifically configured to a UE.  - Supports a single configuration for PUCCH resource for all sub-slots in a slot. The starting symbol of a PUCCH resource is defined with respect to the first symbol of sub-slot. Any sub-slot PUCCH resource is not across sub-slot boundaries.  2. Supported sub-slot configuration |  | *multiPUCCH-r16 {*  *sub-SlotConfig-NCP-r16,*  *sub-SlotConfig-ECP-r16*  *}* | *FeatureSetUplink-v1610* | n/a | n/a | Candidate value set for component 2:  { 7-symbol\*2, 2-symbol\*7 and 7-symbol\*2} for NCP or { 6-symbol\*2, 2-symbol\*6 and 6-symbol\*2} for ECP  The number of PUCCHs for CSI reporting per slot is not impacted compared with Rel-15 by introducing the new HARQ-ACK CBs  A UE supporting 11-3 is also expected to support FGs 4-1, 4-3, 4-4, 4-5, and 4-19 with a "slot" being replaced by a sub-slot of length 2 or 7 symbols for NCP and (2 and 6 symbols for ECP) for the PUCCH formats that can be accommodated in the corresponding sub-slot durations | Optional with capability signalling |
|  | 11-3c | 2 PUCCH of format 0 or 2 in the same subslot for a single 7\*2-symbol subslot based HARQ-ACK codebook | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot for SR | 11-3 | *twoPUCCH-Type1-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, "7" is replaced by "6" | Optional with capability signalling |
|  | 11-3d | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for a single 2\*7-symbol subslot based HARQ-ACK codebook | 1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot for SR | 11-3 | *twoPUCCH-Type2-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, "7 symbols" is replaced by "6 symbols" | Optional with capability signalling |
|  | 11-3e | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for a single 2\*7-symbol HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:  1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot | 11-3 | *twoPUCCH-Type3-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, "7 symbols" is replaced by "6 symbols" | Optional with capability signalling |
|  | 11-3f | 2 PUCCH transmissions in the same subslot for a single 2\*7-symbol HARQ-ACK codebook which are not covered by 11-3d and 11-3e | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:  2 PUCCH transmissions in the same subslot for a single 2\*7-symbol HARQ-ACK codebooks which are not covered by 11-3d and 11-3e | 11-3 | *twoPUCCH-Type4-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, "7 symbols" is replaced by "6 symbols" | Optional with capability signalling |
|  | 11-3g | SR/HARQ-ACK multiplexing once per subslot using a PUCCH (or HARQ-ACK piggybacked on a PUSCH) when SR/HARQ-ACK are supposed to be sent with different starting symbols in a subslot | If a UE supports a subslot based HARQ-ACK codebook, the UE also supports:  Overlapping PUCCH resources with different starting symbols in a subslot | 11-3 | *mux-SR-HARQ-ACK-r16* | *FeatureSetUplink-v1610* | n/a | n/a |  | Optional with capability signalling |
|  | 11-4 | Two HARQ-ACK codebooks with up to one sub-slot based HARQ-ACK codebook (i.e. slot-based + slot-based, or slot-based + sub-slot based) simultaneously constructed for supporting HARQ-ACK codebooks with different priorities at a UE. | 1. Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed with the restriction up to one sub-slot based HARQ-ACK codebook.  2. Supports separate PUCCH configuration for different HARQ-ACK codebooks.  3. Supports 2-level priority of HARQ-ACK for dynamically scheduled PDSCH and SPS PDSCH.  4. Supports a DCI format (from the formats 1\_1/1\_2) scheduling PDSCH with different HARQ-ACK priorities when only DCI format 0\_1/1\_1 is configured or only DCI format 0\_2/1\_2 is configured per BWP.  5. Supports separate configuration of parameters PDSCH-HARQ-ACK-Codebook, UCI-OnPUSCH and 'codeBlockGroupTransmission" for different HARQ-ACK codebooks.  6. Supported maximum number of actual PUCCH transmissions for HARQ-ACK within a slot  Candidate values for the component 6 of FG11-4 is: For NCP, {4, 5, 6, 7} for 2-symbol\*7 sub-slot configuration; For ECP, the candidate value is {4,5,6} for 2-symbol\*6 sub-slot configuration  7. Support intra-UE multiplexing/prioritization of UL overlapping channels/signals with two priority levels for HARQ-ACK |  | *twoHARQ-ACK-Codebook-type1-r16* | *FeatureSetUplink-v1640* | n/a | n/a | If a UE reports both 11-3 and 11-4, it can support two slot-based HARQ-ACK codebooks, and one slot-based and one-sub-slot-based HARQ-ACK codebooks. If a UE reports 11-4 but not 11-3, it can only support two slot-based HARQ-ACK codebooks.  The number of PUCCHs for CSI reporting per slot is not impacted compared with Rel-15 by introducing the new HARQ-ACK CBs  Component 6 is applied to the sub-slot HARQ-ACK codebook. It is assumed that only 1 actual PUCCH transmission for HARQ-ACK within a slot for slot-based HARQ-ACK codebook.  - Component 6 is reported for 2-symbol\*7 sub-slot configuration. For 7-symbol\*2 sub-slot configuration, the value of component 6 is {2} for both NCP and ECP cases.  For component 6, maximum of 1 actual PUCCH transmission for HARQ-ACK within a slot for slot-based HARQ-ACK codebook. Thus value reported for component 6 has no meaning for "slot-based + slot based". | Optional with capability signalling |
|  | 11-4a | Two subslot based HARQ-ACK codebooks simultaneously constructed for supporting HARQ-ACK codebooks with different priorities at a UE. | 1. Supports two subslot based HARQ-ACK codebooks with different priorities to be simultaneously constructed.  2. Supports separate PUCCH configuration for different HARQ-ACK codebooks.  3. Supports 2-level priority of HARQ-ACK for dynamically scheduled PDSCH and SPS PDSCH.  4. Supports a DCI format (from the formats /1\_1/1\_2) scheduling PDSCH with different HARQ-ACK priorities when only DCI format 0\_1/1\_1 is configured or only DCI format 0\_2/1\_2 is configured in USS per BWP.  5. Supports separate configuration of parameters PDSCH-HARQ-ACK-Codebook, UCI-OnPUSCH and "codeBlockGroupTransmission" for different HARQ-ACK codebooks.  6. Supported maximum number of actual PUCCH transmissions for HARQ-ACK within a slot.  7. Candidate values for the component 6 of FG11-4a is: For NCP, {4, 5, 6, 7} for 2-symbol\*7 sub-slot configuration; For ECP, the candidate value is {4,5,6} for 2-symbol\*6 sub-slot configuration. | 11-3 and 11-4 | *twoHARQ-ACK-Codebook-type2-r16* | *FeatureSetUplink-v1640* | n/a | n/a | The number of PUCCHs for CSI reporting per slot is not impacted compared with Rel-15 by introducing the new HARQ-ACK CBs  Component 6 is applied to the two sub-slot HARQ-ACK codebooks, respectively.  Component 6 is reported for 2-symbol\*7 sub-slot configuration. For 7-symbol\*2 sub-slot configuration, the value of component 6 is {2} for both NCP and ECP cases. | Optional with capability signalling |
|  | 11-4b | DL priority indication in DCI with mixed DCI formats | Support of priority indicator field configured in DCI formats 1\_1 and 1\_2 in a BWP when configured to monitor both DCI formats 1\_1 and 1\_2 in the BWP | 11-1, 11-4 | *dci-DL-PriorityIndicator-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
|  | 11-4c | 2 PUCCH of format 0 or 2 for two HARQ-ACK codebooks with one 7\*2-symbol sub-slot based HARQ-ACK codebook and one slot-based HARQ-ACK codebook | If the UE supports a 7\*2-symbol subslot HARQ codebook, the UE also supports:  1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot for SR | 11-4 | *twoPUCCH-Type5-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-2  For ECP, "7" is replaced by "6" | Optional with capability signalling |
|  | 11-4d | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol sub-slot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ codebook, the UE also supports:  1) 2 PUCCH format 0/2 in different symbols and once per subslot for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot for SR | 11-4 | *twoPUCCH-Type6-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-2  For ECP, "7 symbols" is replaced by "6 symbols" | Optional with capability signalling |
|  | 11-4e | 2 PUCCH of format 0 or 2 in consecutive symbols in the same subslotfor two subslot based HARQ-ACK codebooks | If the UE supports two subslot HARQ codebooks, the UE also supports:  1) 2 PUCCH format 0/2 in different symbols and once per subslot per codebook for HARQ-ACK,  2) 2 PUCCH format 0 in different symbols and once per subslot per priority for SR | 11-4a | *twoPUCCH-Type7-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting. | Optional with capability signalling |
|  | 11-4f | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot based HARQ-ACK codebook and one slot based HARQ-ACK codebook | If the UE supports a 2\*7-symbol subslot HARQ-ACK codebook, the UE also supports:  1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot of the codebook | 11-4 | *twoPUCCH-Type8-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-22  For ECP, "7 symbols" is replaced by "6 symbols" | Optional with capability signalling |
|  | 11-4g | 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 or 4 in the same subslot for two subslot based HARQ-ACK codebooks | If the UE supports two subslot HARQ-ACK codebooks both configured with 2\*7-symbols, the UE also supports:  1) 1 PUCCH format 0 or 2 and 1 PUCCH format 1, 3 and 4 in the same subslot of a codebook | 11-4a | *twoPUCCH-Type9-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, "7 symbols" is replaced by "6 symbols" | Optional with capability signalling |
|  | 11-4h | 2 PUCCH transmissions in the same subslot for two HARQ-ACK codebooks with one 2\*7-symbol subslot and one slot based HARQ-ACK codebook which are not covered by 11-4d and 11-4f | If the UE supports two HARQ-ACK codebooks with one subslot based codebook with 2\*7-symbol configuration, the UE also supports:  1) 2PUCCH transmissions in the same subslot of the codebook which are not covered by 11-4d and 11-4f | 11-4 | *twoPUCCH-Type10-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For slot based + slot based case, the capability for each HARQ-ACK codebook is subjected to the capability reported by FG 4-22a  For ECP, "7 symbols" is replaced by "6 symbols" | Optional with capability signalling |
|  | 11-4i | 2 PUCCH transmissions in the same subslot for two subslot based HARQ-ACK codebooks which are not covered by 11-4e and 11-4g | If the UE supports two HARQ-ACK codebooks both with 2\*7-symbol configuration, the UE also supports:  1) 2PUCCH transmissions in the same subslot of a codebook which are not covered by 11-4e and 11-4g | 11-4a | *twoPUCCH-Type11-r16* | *FeatureSetUplink-v1610* | n/a | n/a | This FG covers any PUCCH transmission and not only those for HARQ-ACK reporting.  For ECP, "7 symbols" is replaced by "6 symbols" | Optional with capability signalling |
|  | 11-5 | PUSCH repetition Type B | 1. For a transport block, one dynamic UL grant or one configured grant schedules two or more PUSCH repetitions that can be in one slot, or across slot boundary in consecutive available slots.  2. Dynamic indication of the nominal number of repetitions in the DCI scheduling dynamic PUSCH.  3. The time window within which valid symbols are used for transmission is L\*K, starting from the first symbol indicated by the SLIV in TDRA field.  4. PUSCH repetition type B is supported for DCI format 0\_1 and DCI format 0\_2 (for DG and type 2 CG).  5. S and L are separately indicated (4-bit for S and 4-bit for L). L <= 14.  6. Handling of interaction with DL/UL directions depending on whether dynamic SFI is configured or not, including both cases with and without higher layer parameter InvalidSymbolPattern configured.  7. Supported maximum number of PUSCH transmissions within a slot for all TB(s), where each actual repetition for PUSCH repetition type B is counted as 1 PUSCH transmission, separately reported for UE processing capability 1 and for UE processing capability 2 if UE supports both processing capabilities.  Note: Number of TBs are based on reported Rel-15 capability on number of TBs, and reported value for component 7 cannot be smaller than the reported value of the number of TBs  Supported PUSCH hopping scheme |  | *pusch-RepetitionTypeB-r16*  *{*  *maxNumberPUSCH-Tx-r16,*  *hoppingScheme-r16*  *}* | *FeatureSetUplink-v1610* | n/a | n/a | Candidate value for component 7: {2, 3, 4, 7, 8, 12}  Candidate value for component 8: {Inter-slot hopping, Inter-repetition hopping, both Inter-slot hopping and Inter-repetition hopping}  PUSCH repetition type B with configured grant is applied only if UE reports the support of FG 5-19 or FG 5-20, and subjected to the capability of FG 5-19 and FG 5-20  The case that both dynamic SFI and InvalidSymbolPattern are configured is applied only if UE reports the support of FG3-6 | Optional with capability signalling |
|  | 11-6 | PUSCH repetition Type A | PUSCH transmission with Rel-15 behavior with or without slot aggregation.  - With slot aggregation, the number of repetitions can be dynamically indicated (as agreed for Rel-16).  - When dynamically indicated, the number of repetitions is jointly coded with SLIV in TDRA table, by adding an additional column for the number of repetitions in the TDRA table. | One of {5-16, 5-17] | *pusch-RepetitionTypeA-r16* {  *sharedSpectrumChAccess-r16,*  *non-SharedSpectrumChAccess-r16*  } | *Phy-ParametersCommon* | No | No | Note: RAN1 agreed it should be possible to separately indicate support of this FG based on whether the UE is operated with or without shared spectrum access. It is left to RAN2 how to implement this while leaving the type as"per UE" | Optional with capability signalling |
|  | 11-7 | UL cancelation scheme for self-carrier | 1. Supports group common DCI (i.e. DCI format 2\_4) for cancellation indication on the same DL CC as that scheduling PUSCH or SRS  2. UL cancelation for PUSCH  - Cancellation is applied to each PUSCH repetition individually in case of PUSCH repetitions  3. UL cancellation for SRS symbols that overlap with the cancelled symbols |  | *ul-CancellationSelfCarrier-r16* | *FeatureSetUplink-v1610* | n/a | n/a | More than one monitoring occasion for DCI format 2\_4 per slot is applied only if the UE reports to support FG 3-5 or FG 3-5a or FG 3-5b or 11-2 or 11-2a | Optional with capability signalling |
|  | 11-7a | UL cancelation scheme for cross-carrier | 1. Supports group common DCI (i.e. DCI format 2\_4) for cancellation indication on a different DL CC than that scheduling PUSCH or SRS  2. UL cancelation for PUSCH  - Cancellation is applied to each PUSCH repetition individually in case of PUSCH repetitions  3. UL cancellation for SRS symbols that overlap with the cancelled symbols |  | *ul-CancellationCrossCarrier-r16* | *FeatureSetUplink-v1610* | n/a | n/a | More than one monitoring occasion for DCI format 2\_4 per slot is applied only if the UE reports to support FG 3-5 or FG 3-5a or FG 3-5b or 11-2 or 11-2a  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 11-7a is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell | Optional with capability signalling |
|  | 11-7b | Independent cancellation of the overlapping PUSCHs in an intra-band UL CA | For a UE indicating the capability of pa-PhaseDiscontinuityImpacts, and if the PUSCH on at least one serving cell is cancelled, the UE may cancel the (repetition of the) PUSCHs transmission on all other intra-band serving cell(s). The cancellation of the (repetition of the) PUSCH transmission on the set of intra-band serving cell(s) includes all symbols from the earliest symbol that is overlapping with the first cancelled symbol of the PUSCH on the serving cell for which the DCI format 2\_4 is applicable to. | 6-23, 11-7 | *cancelOverlappingPUSCH-r16* | *BandNR* | n/a | n/a | If UE indicates 6-23 but does not support this FG, UE is not expected to be scheduled simultaneous PUSCHs on multiple carriers but receiving UL CI only for subset of carriers in intra-band carriers | Optional with capability signaling |
|  | 11-8 | Enhanced UL power control scheme | For DG-PUSCH, one bit (separately from SRI) in UL grant is used to indicate the P0 value if SRI is present in the UL grant, and 1 or 2 bits is used to indicate the P0 value if SRI is not present in the UL grant |  | *enhancedPowerControl-r16* | *Phy-ParametersFRX-Diff* | No | Yes  Note: Differentiation is from the perspective of the scheduled carrier |  | Optional with capability signaling |
|  | 11-9 | Multiple active configured grant configurations for a BWP of a serving cell | 1. Supports up to 12 configured/active configured grant configurations in a BWP of a serving cell.  - Separate RRC parameters for different configured grant configurations  - Separate activation for different configured grant Type 2 configurations  - Separate release for different configured grant Type 2 configurations  2. Supported maximum number of configured/active configured grant configurations in a BWP of a serving cell  Candidate values for component 2: {1, 2, 4, 8, 12}  3. Supported maximum number of configured/active configured grant configurations across all serving cells, and across MCG and SCG in case of NR-DC  Candidate values for component 3: {2, …, 32} | One of {5-19, 5-20} | *activeConfiguredGrant-r16 {*  *maxNumberConfigsPerBWP-r16,*  *maxNumberConfigsAllCC-r16*  *}* | *BandNR* | n/a | n/a | -For all the reported bands in FR1, a same X1 value is reported for component 3. For all the reported bands in FR2, a same X2 value is reported for component 3.  -The total number of configured/active configured grant configurations across all serving cells in FR1 is no greater than X1.  -The total number of configured/active configured grant configurations across all serving cells in FR2 is no greater than X2.  -If there are some serving cell(s) in FR1 and some serving cell(s) in FR2, the total number of configured/active configured grant configurations across all serving cells is no greater than max(X1, X2).  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of FG11-9 is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | Optional with capability signalling |
|  | 11-9a | Joint release in a DCI for two or more configured grant Type 2 configurations for a given BWP of a serving cell | M<=4 bits indication in the Release DCI is used for indicating which CG configuration(s) is/are released, where the association between each state indicated by the indication and the CG configuration(s) is  - Up to 2^M states are higher layer configurable, where each of the state can be mapped to a single or multiple CG configurations to be released  - In case of no higher layer configured state(s), separate release is used where the release corresponds to the CG configuration index indicated by the indication | 11-9 | *jointReleaseConfiguredGrantType2-r16* | *BandNR* | n/a | n/a | Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of FG11-9a is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | Optional with capability signalling |
|  | 11-10 | Type 2 configured grant release by DCI format 0\_1 | Support of type 2 configured grant release by DCI format 0\_1 | 5-20 | *type2-CG-ReleaseDCI-0-1-r16* | *Phy-ParametersCommon* | No | No | A UE supporting this feature and 11-1 (DCI format 0\_2/1\_2) shall also support 11-11 (Type 2 configured grant release by DCI format 0\_2). | Optional with capability signalling |
|  | 11-11 | Type 2 configured grant release by DCI format 0\_2 | Support of type 2 configured grant release by DCI format 0\_2 | 5-20, 11-1 | *type2-CG-ReleaseDCI-0-2-r16* | *Phy-ParametersCommon* | No | No | A UE supporting this feature shall also support 11-10 (Type 2 configured grant release by DCI format 0\_1). | Optional with capability signalling |
|  | 11-12 | CBG-based re-transmission for UL using CBGTI with only in-order CBG-based re-transmission(s) for cancelled initial PUSCH transmission | 1. Support of CBG-based PUSCH re-transmission(s) of a TB using CGBTI in case the initial PUSCH transmission was not cancelled due to gNB scheduling/indication/configuration.  2. Support of CBG-based PUSCH re-transmission(s) of a TB using CGBTI in case the initial PUSCH transmission was cancelled due to gNB scheduling/indication/configuration and the following condition is satisfied: the UE is scheduled for a re-transmission of a CBG #N in a given TB when CBG #N-1 has been transmitted before or is scheduled in the same UL grant that includes CBG#N. |  | *cbg-TransInOrderPUSCH-UL-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signaling |

### 5.1.4 NR\_IIOT

Table 5.1.4-1: Layer-1 feature list for NR\_IIOT

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 | Parent IE in TS 38.331 | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 12. NR\_IIOT | 12-1 | UL intra-UE multiplexing/prioritization of overlapping channel/signals with two priority levels in physical layer | Support intra-UE multiplexing/prioritization of overlapping PUCCH/PUCCH and PUCCH/PUSCH with two priority levels in physical layer (PHY)  1) Configuration of PHY priority level for CG PUSCH and SR, and dynamic indication of priority level for dynamic PUSCH with a single DCI format  2) Multiplexing/prioritization between UL channels/signals with the same PHY priority level  3) Prioritization between UL channels/signals with different PHY priority levels  4) Additional number of symbols (d1) needed beyond the PUSCH preparation time for cancelling a low priority UL transmission.  5) Additional number of symbols (d2) of the preparation time needed for the high priority UL transmission that cancels a low priority UL transmission |  | *ul-IntraUE-Mux-r16{*  *pusch-PreparationLowPriority-r16,*  *pusch-PreparationHighPriority-r16}* | *FeatureSetUplink-v1610* | n/a | n/a | Candidate value set for component 4: {0, 1, 2}  Candidate value set for component 5: {0, 1, 2}  The relationship between this feature and the feature of up to two HARQ-ACK codebooks of 11-4 and 11-4xshould be further discussed. | Optional with capability signaling |
| 12. NR\_IIOT | 12-1a | UL priority indication in DCI with mixed DCI formats | Support of priority indicator field configured in DCI formats 0\_1 and 0\_2 in a BWP when configured to monitor both DCI formats 0\_1 and 0\_2 in the BWP | 12-1 and 11-1 | *dci-UL-PriorityIndicator-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 12. NR\_IIOT | 12-2 | Multiple SPS configurations | 1) Support of up to 8 configured SPS configurations in a BWP of a serving cell and up to 32 configured SPS configurations in a cell group, including separate RRC parameters and separate activation/release for different SPS configurations  2) The max number of active SPS configurations in a BWP of a serving cell  3) The max number of active SPS configurations across all serving cells, and across MCG and SCG in case of NR-DC  4) The related HARQ-ACK enhancements to support multiple active SPS configurations | 5-18 DL SPS | *sps-r16 {*  *maxNumberConfigsPerBWP-r16,*  *maxNumberConfigsAllCC-r16*  *}* | *BandNR* | n/a | n/a | Component-2, candidate value set is {1, 2, …, 8}  Component-3, candidate value set is {2, …, 32}  Component-2, candidate value set is {1, 2, …, 8}  Component-3, candidate value set is {2, …, 32}  -For all the reported bands in FR1, a same X1 value is reported for component 3. For all the reported bands in FR2, a same X2 value is reported for component 3.  -The total number of active SPS configurations across all serving cells in FR1 is no greater than X1.  -The total number of active SPS configurations across all serving cells in FR2 is no greater than X2.  -If there are some serving cell(s) in FR1 and some serving cell(s) in FR2, the total number of active SPS configurations across all serving cells is no greater than max(X1, X2).  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of FG12-2 is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | Optional with capability signaling |
| 12. NR\_IIOT | 12-2a | Joint release in a DCI for two or more SPS configurations for a given BWP of a serving cell | 1. M<=4 bits indication in the Release DCI is used for indicating which SPS configuration(s) is/are released, where the association between each state indicated by the indication and the SPS configuration(s) is  - Up to 2^M states are higher layer configurable, where each of the state can be mapped to a single or multiple SPS configurations to be released  - n case of no higher layer configured state(s), separate release is used where the release corresponds to the SPS configuration index indicated by the indication  2. The related HARQ-ACK enhancements to support joint release | 12-2 | *jointReleaseSPS-r16* | *BandNR* | n/a | n/a | Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of FG12-2a is based on the support of this capability for the band of the scheduled/triggered/indicated cell only | Optional with capability signaling |
| 12. NR\_IIOT | 12-3 | SPS release by DCI format 1\_1 | Support of SPS release by DCI format 1\_1 | 5-18 DL SPS | *sps-ReleaseDCI-1-1-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signaling |
| 12. NR\_IIOT | 12-3a | SPS release by DCI format 1\_2 | Support of SPS release by DCI format 1\_2 | 5-18 DL SPS and 11-1 | *sps-ReleaseDCI-1-2-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signaling |
| 12. NR\_IIOT | 12-5 | Configuration of aggregation factor per SPS configuration | Support of configurable PDSCH aggregation factor ({1, 2, 4, 8}) per DL SPS configuration | 5-18 DL SPS | *aggregationFactorSPS-DL-r16* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signaling |
| 12. NR\_IIOT | 12-6 | Support of SPS periodicity shorter than 10 ms | Support of SPS periodicity shorter than 10 ms | 5-18 DL SPS | *extendedSPS-Periodicities-r16* | *Phy-ParametersCommon* | No | Yes |  | Optional with capability signalling |

### 5.1.5 NR positioning

Table 5.1.5-1: Layer-1 feature list for NR positioning

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 | Parent IE in TS 38.331 | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 13. NR Positioning | 13-1 | Common DL PRS Processing Capability | 1. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  a) FR1 bands: {5, 10, 20, 40, 50, 80, 100}  b) FR2 bands: {50, 100, 200, 400}  2. DL PRS buffering capability: Type 1 or Type 2  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  3. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE.  a) T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  b) N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  4. Max number of DL PRS resources that UE can process in a slot under it  a) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Note: The above parameters are reported assuming a configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than 30%. |  | *1 supportedBandwidthPRS-r16*  *2 dl-PRS-BufferType-r16*  *3 durationOfPRS-Processing-r16*  *4 maxNumOfDL-PRS-ResProcessedPerSlot-r16* | *PRS-ProcessingCapabilityPerBand-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported.  Notes for component 3:  a.UE reports one combination of (N, T) values per band, where N is a duration of DL PRS symbols in ms processed every T ms for a given maximum bandwidth (B) in MHz supported by UE  b.UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth value  c.UE DL PRS processing capability is defined for a single positioning frequency layer. UE capability for simultaneous DL PRS processing across positioning frequency layers is not supported in Rel.16 (i.e. for a UE supporting multiple positioning frequency layers, a UE is expected to process one frequency layer at a time)  d.UE DL PRS processing capability is agnostic to DL PRS comb factor configuration  e.The reporting of (N, T) values for maximum BW in MHz is not dependent on SCS  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support PRS processing in this band or band combination. | Optional with capability signaling |
|  | 13-1a | Max number of positioning frequency layers UE supports across all positioning methods across all bands | Max number of positioning frequency layers UE supports across all positioning methods across all bands  Values: {1, 2, 3, 4} |  | *maxSupportedFreqLayers-r16* | *NR-DL-PRS-ProcessingCapability-r16*  *LPP* | No | No | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-2 | DL PRS Resources for DL AoD | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.  Values = {1, 2}  2. Max number of TRPs across all positioning frequency layers per UE.  Values = {4, 6, 12, 16, 24, 32, 64, 128, 256}  3. Max number of positioning frequency layers UE supports  Values = {1, 2, 3, 4} | 13-1 | *1 maxNrOfDL-PRS-ResourceSetPerTrpPerFrequencyLayer-r16*  *2 maxNrOfTRP-AcrossFreqs-r16*  *3 maxNrOfPosLayer-r16* | *NR-DL-PRS-ResourcesCapability-r16*  *LPP* | No | No | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-2a | DL PRS Resources for DL AoD on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set  Values = {2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands  2. Max number of DL PRS Resources per positioning frequency layer.  Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | *1 maxNrOfDL-PRS-ResourcesPerResourceSet-r16*  *2 maxNrOfDL-PRS-ResourcesPerPositioningFrequencylayer-r16* | *DL-PRS-ResourcesCapabilityPerBand-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-2b | DL PRS Resources for DL AoD on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.  Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC.  2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.  Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.  Values = {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.  Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16*  *2 fr2-Only-r16*  *3 fr1-r16/ fr1-FR2Mix-r16*  *4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/*  *DL-PRS-ResourcesBandCombination-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported.  the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-3 | DL PRS Resources for DL-TDOA | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.  Values = {1, 2}  2. Max number of TRPs across all positioning frequency layers per UE.  Values = {4, 6, 12, 16, 24, 32, 64, 128, 256}  3. Max number of positioning frequency layers UE supports  Values = {1, 2, 3, 4} | 13-1 | *1 maxNrOfDL-PRS-ResourceSetPerTrpPerFrequencyLayer-r16*  *2 maxNrOfTRP-AcrossFreqs-r16*  *3 maxNrOfPosLayer-r16* | *NR-DL-PRS-ResourcesCapability-r16*  *LPP* | No | No | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-3a | DL PRS Resources for DL-TDOA on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set  Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands  2. Max number of DL PRS Resources per positioning frequency layer.  Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | *1 maxNrOfDL-PRS-ResourcesPerResourceSet-r16*  *2 maxNrOfDL-PRS-ResourcesPerPositioningFrequencylayer-r16* | *DL-PRS-ResourcesCapabilityPerBand-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-3b | DL PRS Resources for DL-TDOA on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.  Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC.  2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.  Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.  Values = {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.  Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16*  *2 fr2-Only-r16*  *3 fr1-r16/ fr1-FR2Mix-r16*  *4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/*  *DL-PRS-ResourcesBandCombination-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported.  the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-4 | DL PRS Resources for Multi-RTT | 1. Max number of DL PRS Resource Sets per TRP per frequency layer supported by UE.  Values = {1, 2}  2. Max number of TRPs across all positioning frequency layers per UE.  Values = {4, 6, 12, 16, 24, 32, 64, 128, 256}  3. Max number of positioning frequency layers UE supports  Values = {1, 2, 3, 4} | 13-1 | *1 maxNrOfDL-PRS-ResourceSetPerTrpPerFrequencyLayer-r16*  *2 maxNrOfTRP-AcrossFreqs-r16*  *3 maxNrOfPosLayer-r16* | *NR-DL-PRS-ResourcesCapability-r16*  *LPP* | No | No | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-4a | DL PRS Resources for Multi-RTT on a band | 1. Max number of DL PRS Resources per DL PRS Resource Set  Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands  2. Max number of DL PRS Resources per positioning frequency layer.  Values = {6, 24, 32, 64, 96, 128, 256, 512, 1024}  Note: 6 is only applicable to FR1 bands | 13-1 | *1 maxNrOfDL-PRS-ResourcesPerResourceSet-r16*  *2 maxNrOfDL-PRS-ResourcesPerPositioningFrequencylayer-r16* | *DL-PRS-ResourcesCapabilityPerBand-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported.  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-4b | DL PRS Resources for Multi-RTT on a band combination | 1. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1-only.  Values = {6, 24, 64, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR1 only BC.  2. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2-only.  Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for FR2 only BC  3. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR1 in FR1/FR2 mixed operation.  Values = {6, 24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands  4. Max number of DL PRS Resources supported by UE across all frequency layers, TRPs and DL PRS Resource Sets for FR2 in FR1/FR2 mixed operation.  Values = {24, 64, 96, 128, 192, 256, 512, 1024, 2048}  Note this is reported for BC containing FR1 and FR2 bands | 13-1 | *1 fr1-Only-r16*  *2 fr2-Only-r16*  *3 fr1-r16/ fr1-FR2Mix-r16*  *4 fr2-r16/ fr1-FR2Mix-r16* | *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16/*  *DL-PRS-ResourcesBandCombination-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported.  the reported value is the total number across all bands in the corresponding BC  Note: if the UE does not indicate this capability for a band or band combination, the UE does not support this positioning method in this band or band combination. | Optional with capability signaling |
|  | 13-5 | DL PRS Measurement Report for DL-AoD | 1. Max number of DL PRS RSRP measurements on different PRS resources from the same TRP supported by the UE  Values = {1, 2, 3, 4, 5, 6, 7, 8} | 13-2, | *maxDL-PRS-RSRP-MeasurementFR1-r16*  *maxDL-PRS-RSRP-MeasurementFR2-r16* | *NR-DL-AoD-MeasurementCapability*  *LPP* | No | Yes | Need for location server to know if the feature is supported.  the number of RSRP measurement on a particular band is also upper bounded by the number of resources per set supported by UE reported per band | Optional with capability signaling |
|  | 13-6 | DL PRS Measurement Report for DL-TDOA | 1. DL RSTD measurements per pair of TRPs. Values = {1, 2, 3, 4}  2. Support DL PRS-RSRP measurements. Values = {0, 1} | 13-3 | *dl-RSTD-MeasurementPerPairOfTRP-FR1-r16*  *dl-RSTD-MeasurementPerPairOfTRP-FR2-r16* | *NR-DL-TDOA-MeasurementCapability-r16*  *LPP* | No | Yes | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-7 | Support of SSB from neighbour cell as QCL source of a DL PRS | 1. Support of SSB from neighbour cell as QCL source of a DL PRS  2. Support of reuse SSB measurement from RRM for receiving PRS  Note: Refers to Type-C for FR1 and Type-C & Type-D support for FR2 | 13-1 | *ssb-FromNeighCellAsQCL-r16* | *DL-PRS-QCL-ProcessingCapabilityPerBand-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-7a | Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS | 1. Support of DL PRS from serving/neighbour cell as QCL source of a DL PRS  Note 1: Refers to Type-D support for FR2  Note 2: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | 13-1 | *prs-FromServNeighCellAsQCL-r16* | *DL-PRS-QCL-ProcessingCapabilityPerBand-r16*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported.  DL PRSs are in the same band | Optional with capability signaling |
|  | 13-8 | SRS Resources for Positioning | 1. Max number of SRS Resource Sets for positioning supported by UE per BWP.  Values = {1, 2, 4, 8, 12, 16}.  2. Max number of P/SP/AP SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64}  3. Max number of P/SP/AP SRS Resources including the SRS resources for positioning per BWP per slot.  Values = {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Note: Max number of P/SP/AP SRS Resources in Component 3 include both SRS resources configured by SRS-Resource and SRS resources configured by SRS-PosResource-r16 supported by UE  4. Max number of periodic SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64}  5. Max number of periodic SRS Resources for positioning per BWP per slot.  Values = {1,2,3,4,5,6,8,10,12,14}  OLPC for SRS for positioning based on SSB from serving cell is part of FG13-8  Note: no dedicated capability signaling is intended for this component |  | *RRC*  *1 maxNumberSRS-PosResourceSetPerBWP-r16*  *2 maxNumberSRS-PosResourcesPerBWP-r16*  *3 maxNumberSRS-ResourcesPerBWP-PerSlot-r16*  *4 maxNumberPeriodicSRS-PosResourcesPerBWP-r16*  *5 maxNumberPeriodicSRS-PosResourcesPerBWP-PerSlot-r16* | *RRC*  *SRS-AllPosResources-r16 /SRS-AllPosResources-r16* | n/a | n/a | Note: if the UE does not indicate this capability for a band in a band combination, the UE does not support SRS for Positioning in this band in the band combination.  - UE not supporting FG13-8 does not support FG13-8a or FG13-8b in the band in the band combination.  - The same approach is applicable to FG13-8c, FG13-8d, and FG13-8e. | Optional with capability signaling |
|  | 13-8a | Support of Aperiodic SRS Resources for positioning | 1. Max number of aperiodic SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64}  2. Max number of aperiodic SRS Resources for positioning per BWP per slot.  Values = {1,2,3,4,5,6,8,10,12,14} | 13-8 | *RRC*  *1 maxNumberAP-SRS-PosResourcesPerBWP-r16*  *2 maxNumberAP-SRS-PosResourcesPerBWP-PerSlot-r16* | *RRC*  *SRS-PosResourceAP-r16 /SRS-AllPosResources-r16* | n/a | n/a |  | Optional with capability signaling |
|  | 13-8b | Support of Semi-persistent SRS Resources for positioning | 1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP.  Values = {1,2,4,8,16,32,64}  2. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP per slot.  Values = {1,2,3,4,5,6,8,10,12,14} | 13-8 | *RRC*  *1 maxNumberSP-SRS-PosResourcesPerBWP-r16*  *2 maxNumberSP-SRS-PosResourcesPerBWP-PerSlot-r16* | *RRC*  *SRS-PosResourceSP-r16 /SRS-AllPosResources-r16* | n/a | n/a |  | Optional with capability signaling |
|  | 13-8c | SRS Resources for Positioning | 1. Max number of SRS Resource Sets for positioning supported by UE per BWP.  Values = {1, 2, 4, 8, 12, 16}.  2. Max number of P/SP/AP SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64}  3. Max number of periodic SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64} | 13-8 | *LPP*  *1 maxNumberSRS-PosResourceSetsPerBWP-r16*  *2 maxNumberSRS-PosResourcesPerBWP-r16*  *3maxNumberPeriodicSRS-PosResourcesPerBWP-r16* | *LPP*  *SRS-PosResourcesPerBand-r16* | n/a | n/a | Need for location server to know if the feature is supported  UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling |
|  | 13-8d | Support of Aperiodic SRS Resources for positioning | 1. Max number of aperiodic SRS Resources for positioning per BWP.  Values = {1,2,4,8,16,32,64} | 13-8a, 13-8c | *LPP*  *1 maxNumberAP-SRS-PosResourcesPerBWP-r16* | *LPP*  *SRS-PosResourcesPerBand-r16* | n/a | n/a | Need for location server to know if the feature is supported.  UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling |
|  | 13-8e | Support of Semi-persistent SRS Resources for positioning | 1. Max number of semi-persistent SRS Resources for positioning supported by UE per BWP.  Values = {1,2,4,8,16,32,64} | 13-8b,13-8c | *LPP*  *1 maxNumberSP-SRS-PosResourcesPerBWP-r16* | *LPP*  *SRS-PosResourcesPerBand-r16* | n/a | n/a | Need for location server to know if the feature is supported.  UE only reports the number on bands for the current configured CA band combination. | Optional with capability signaling |
|  | 13-9 | OLPC for SRS for positioning based on PRS from the serving cell | 1. OLPC for SRS for positioning based on PRS from the serving cell in the same band | 13-1 and 13-8 | *LPP*  *olpc-SRS-PosBasedOnPRS-Serving-r16*  *RRC*  *olpc-SRS-PosBasedOnPRS-Serving-r16* | *LPP*  *OLPC-SRS-Pos-r16*  *RRC*  *OLPC-SRS-Pos-r16* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-9a | OLPC for SRS for positioning based on SSB from neighbouring cells | 1. OLPC for SRS for positioning based on SSB from neighbouring cells in the same band | 13-8 | *LPP*  *olpc-SRS-PosBasedOnSSB-Neigh-r16*  *RRC*  *olpc-SRS-PosBasedOnSSB-Neigh-r16* | *LPP*  *OLPC-SRS-Pos-r16*  *RRC*  *OLPC-SRS-Pos-r16* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-9b | OLPC for SRS for positioning based on PRS from the neighbouring cells | 1. OLPC for SRS for positioning based on PRS from the neighbouring cells in the same band  Note: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | 13-9 | *LPP*  *olpc-SRS-PosBasedOnPRS-Neigh-r16*  *RRC*  *olpc-SRS-PosBasedOnPRS-Neigh-r16* | *LPP*  *OLPC-SRS-Pos-r16*  *RRC*  *OLPC-SRS-Pos-r16* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-9e | PathLoss estimate maintenance per serving cell | 1. Max number of pathloss estimates that the UE can simultaneously maintain for all the SRS resource sets for positioning per serving cell in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions  Candidate values are {1, 4, 8, 16}  Note: SRS in "PUSCH/PUCCH/SRS" refers to SRS configured by SRS-Resource | One of {13-9, 13-9a, 13-9b, 13-9c} | *LPP*  *maxNumberPathLossEstimatePerServing-r16*  *RRC*  *maxNumberPathLossEstimatePerServing-r16* | *LPP*  *OLPC-SRS-Pos-r16*  *RRC*  *OLPC-SRS-Pos-r16* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported  SRS and SSB and/or PRS are in the same band  Note: if the UE does not indicate this capability for a band, the UE does not support any pathloss estimates in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions in that band. | Optional with capability signaling |
|  | 13-9f | PathLoss estimate maintenance across all cells | 1. Max number of pathloss estimates that the UE can simultaneously maintain for all the SRS resource sets for positioning across all cells in addition to the up to four pathloss estimates that the UE maintains per serving cell for the PUSCH/PUCCH/SRS transmissions"  Candidate values are {1, 4, 8, 16}  Note: SRS in "PUSCH/PUCCH/SRS" refers to SRS configured by SRS-Resource | One of {13-9, 13-9a, 13-9b, 13-9c} | *LPP*  *maxNumberSRS-PosPathLossEstimateAllServingCells-r16*  *RRC*  *maxNumberSRS-PosPathLossEstimateAllServingCells-r16* | *LPP*  *NR-UL-SRS-Capability-r16*  *RRC*  *Phy-ParametersCommon* | No | No | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported  SRS and SSB and/or PRS are in the same band | Optional with capability signaling |
|  | 13-10 | Spatial relation for SRS for positioning based on SSB from the serving cell | 1. Spatial relation for SRS for positioning based on SSB from the serving cell in the same band | 13-8 | *LPP*  *spatialRelation-SRS-PosBasedOnSSB-Serving-r16*  *RRC*  *spatialRelation-SRS-PosBasedOnSSB-Serving-r16* | *LPP*  *SpatialRelationsSRS-Pos-r16*  *RRC*  *SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-10a | Spatial relation for SRS for positioning based on CSI-RS from the serving cell | 1. Spatial relation for SRS for positioning based on CSI-RS from the serving cell in the same band | 13-10 | *LPP*  *spatialRelation-SRS-PosBasedOnCSI-RS-Serving-r16*  *RRC*  *spatialRelation-SRS-PosBasedOnCSI-RS-Serving-r16* | *LPP*  *SpatialRelationsSRS-Pos-r16*  *RRC*  *SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-10b | Spatial relation for SRS for positioning based on PRS from the serving cell | 1. Spatial relation for SRS for positioning based on PRS from the serving cell in the same band | One of  {13-2, 13-3, 13-4} and13-8 | *LPP*  *spatialRelation-SRS-PosBasedOnPRS-Serving-r16*  *RRC*  *spatialRelation-SRS-PosBasedOnPRS-Serving-r16* | *LPP*  *SpatialRelationsSRS-Pos-r16*  *RRC*  *SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-10c | Spatial relation for SRS for positioning based on SRS | 1. Spatial relation for SRS for positioning based on SRS in the same band | 13-8, | *LPP*  *spatialRelation-SRS-PosBasedOnSRS-r16*  *RRC*  *spatialRelation-SRS-PosBasedOnSRS-r16* | *LPP*  *SpatialRelationsSRS-Pos-r16*  *RRC*  *SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-10d | Spatial relation for SRS for positioning based on SSB from the neighbouring cell | 1. Spatial relation for SRS for positioning based on SSB from the neighbouring cell in the same band | 13-10 | *LPP*  *spatialRelation-SRS-PosBasedOnSSB-Neigh-r16*  *RRC*  *spatialRelation-SRS-PosBasedOnSSB-Neigh-r16* | *LPP*  *SpatialRelationsSRS-Pos-r16*  *RRC*  *SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-10e | Spatial relation for SRS for positioning based on PRS from the neighbouring cell | 1. Spatial relation for SRS for positioning based on PRS from the neighbouring cell in the same band  Note: A PRS from a PRS-only TP is treated as PRS from a non-serving cell | 13-10b | *LPP*  *spatialRelation-SRS-PosBasedOnPRS-Neigh-r16*  *RRC*  *spatialRelation-SRS-PosBasedOnPRS-Neigh-r16* | *LPP*  *SpatialRelationsSRS-Pos-r16*  *RRC*  *SpatialRelationsSRS-Pos-r16* | n/a | n/a (FR2 only) | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-10f | Spatial relation maintenance | 1. Max Number of maintained spatial relations for all the SRS resource sets for positioning across all serving cells in addition to the spatial relations maintained spatial relations per serving cell for the PUSCH/PUCCH/SRS transmissions.  Values = {0,1,2,4,8,16}  Note: component 1 is for all cells across all bands  Note: SRS in "PUSCH/PUCCH/SRS" refers to SRS configured by SRS-Resource | One of {13-10, 13-10a, 13-10b, 13-10d, 13-10e} | *LPP*  *maxNumberSRS-PosSpatialRelationsAllServingCells-r16*  *RRC*  *maxNumberSRS-PosSpatialRelationsAllServingCells-r16* | *LPP*  *NR-UL-SRS-Capability-r16*  *RRC*  *Phy-ParametersFR2* | No | No (FR2 only) | Need for location server to know if the feature is supported.  SRS and SSB and/or PRS are in the same band | Optional with capability signaling |
|  | 13-11a | Association between SRS for positioning and DL PRS for Multi-RTT | 1. Support of measurements derived on one or more DL PRS resource/resource sets which may be in different positioning frequency layers for SRS transmitted in a single CC.  Note: PRS and SRS may be in a different band | 13-4 and 13-8 | *LPP*  *srs-AssocPRS-MultiLayersFR1-r16*  *srs-AssocPRS-MultiLayersFR2-r16* | *LPP*  *NR-Multi-RTT-MeasurementCapability-r16* | No | Yes | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-11 | UE Rx-Tx Measurement Report for Multi-RTT | 1. Max number of UE Rx–Tx time difference measurements corresponding to a single SRS resource/resource set for positioning with each measurement corresponding to a single DL PRS resource/resource set.  Value for component 1: {1,2,3,4}  Note: DL PRS resource/sets are on the same frequency layer  Note: the number of UE Rx – Tx time difference measurements refers to the measurements for a single TRP  2. Support RSRP measurements. Values = {0, 1}  Note: If the UE reports value 1 for component 2, same number of RSRP measurements supported as UE Rx-Tx measurements for component 1 | 13-4 and 13-8 | *LPP*  *1 maxNrOfRx-TX-MeasFR1-r16*  *maxNrOfRx-TX-MeasFR2-r16*  *2 supportOfRSRP-MeasFR1-r16*  *supportOfRSRP-MeasFR2-r16* | *LPP*  *NR-Multi-RTT-MeasurementCapability-r16* | No | Yes | Need for location server to know if the feature is supported.  FG13-11 covers the case that SRS and DL PRS are on the same band | Optional with capability signaling |
|  | 13-12 | SS-RSRP RRM measurements for NR E-CID Positioning | 1. Support of cell-specific SS-RSRP RRM measurements with LPP report for NR E-CID Positioning  2. Support of beam-specific SS-RSRP RRM measurements with LPP report for NR E-CID Positioning | 1-1 | *nr-ECID-MeasSupported-r16 BIT STRING { ssrsrpSup(0),*  *ssrsrqSup(1),*  *csirsrpSup(2),*  *csirsrqSup(3)} (SIZE(1..8))* | *NR-ECID-ProvideCapabilities-r16*  *LPP* | No | No | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-12a | SS-RSRQ RRM measurements for NR E-CID Positioning | 1. Support of cell-specific SS-RSRQ RRM measurements with LPP report for NR E-CID Positioning  2. Support of beam-specific SS-RSRQ RRM measurements with LPP report for NR E-CID Positioning | 1-1 | *nr-ECID-MeasSupported-r16 BIT STRING { ssrsrpSup(0),*  *ssrsrqSup(1),*  *csirsrpSup(2),*  *csirsrqSup(3)} (SIZE(1..8))* | *NR-ECID-ProvideCapabilities-r16*  *LPP* | No | No | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-12b | CSI-RSRP RRM measurements for NR E-CID Positioning | 1. Support of cell-specific CSI-RSRP RRM measurements with LPP report for NR E-CID Positioning  2. Support of beam-specific CSI-RSRP RRM measurements with LPP report for NR E-CID Positioning | 1-4 | *nr-ECID-MeasSupported-r16 BIT STRING { ssrsrpSup(0),*  *ssrsrqSup(1),*  *csirsrpSup(2),*  *csirsrqSup(3)} (SIZE(1..8))* | *NR-ECID-ProvideCapabilities-r16*  *LPP* | No | No | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-12c | CSI-RSRQ RRM measurements for NR E-CID Positioning | 1. Support of cell-specific CSI-RSRQ RRM measurements with LPP report for NR E-CID Positioning  2. Support of beam-specific CSI-RSRQ RRM measurements with LPP report for NR E-CID Positioning | 1-4 | *nr-ECID-MeasSupported-r16 BIT STRING { ssrsrpSup(0),*  *ssrsrqSup(1),*  *csirsrpSup(2),*  *csirsrqSup(3)} (SIZE(1..8))* | *NR-ECID-ProvideCapabilities-r16*  *LPP* | No | No | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-13 | Simultaneous DL-AoD and DL-TDoA processing | 1. Support of simultaneous processing for DL AoD and DL TDoA measurements  If it is not indicated, a UE is not expected to perform simultaneously the processing for deriving DL AoD and DL TDoA measurements | 13-2 and 13-3 | *simul-NR-DL-AoD-DL-TDOA-r16* | *DL-AoD-MeasCapabilityPerBand*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-14 | Simultaneous DL-AoD and Multi-RTT processing | 1. Support of simultaneous processing for DL AoD and Multi-RTT measurements  If it is not indicated, a UE is not expected to perform simultaneously the processing for deriving DL AoD and M-RTT measurements | 13-2, 13-4 and 13-8 | *simul-NR-DL-AoD-Multi-RTT-r16* | *DL-AoD-MeasCapabilityPerBand*  *LPP* | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |
|  | 13-15 | Simultaneous SRS transmission within a band across multiple CCs | 1. The number of SRS resources for positioning on a symbol within a band  Candidate values {2}  Note: if the UE does not indicate this capability for a band, the UE does not support the feature in this band | 13-8 | *RRC*  *simulSRS-TransWithinBand-r16* | *RRC*  *BandNR* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-15a | Simultaneous SRS transmission for a given BC | 1. The number of SRS resources for positioning on a symbol for a given BC  Candidate values {2}  Note: For single-band BCs, it defines the capability for intra-band CA, and for BCs with at least two bands, it defines the capability for inter-band CA.  Note: if the UE does not indicate this capability for a band combination, the UE does not support the feature in this band combination | 13-8 | *RRC*  *simul-SRS-Trans-BC-r16* | *RRC*  *CA-ParametersNR-v1610* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-18 | Support of parallel processing of LTE PRS and NR PRS | 1. Support of parallel processing of LTE PRS and NR PRS |  | *simulLTE-NR-PRS-r16* | *NR-DL-PRS-ProcessingCapability-r16*  *LPP* | No | No | Need for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-19 | Simultaneous positioning SRS and MIMO SRS transmission within a band across multiple CCs | 1. The number of SRS resources for positioning and SRS resource for MIMO on a symbol within a band  Candidate values {2}  Note: SRS resource for MIMO refers to SRS resource configured by SRS-Resource.  Note: If UE reports 2 for the candidate value, it means both the number of SRS resource for positioning and SRS resource for MIMO equals to 1.  Note: if the UE does not indicate this capability for a band, the UE does not support the feature in this band | 13-8 | *RRC*  *simulSRS-MIMO-TransWithinBand-r16* | *RRC*  *BandNR* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |
|  | 13-19a | Simultaneous positioning SRS and MIMO SRS transmission for a given BC | 1. The number of SRS resources for positioning and SRS resource for MIMO on a symbol for a given BC  Candidate values {2}  Note: SRS resource for MIMO refers to SRS resource configured by SRS-Resource.  Note: If UE reports 2 for the candidate value, it means both the number of SRS resource for positioning and SRS resource for MIMO equals to 1.  Note: For single-band BCs, it defines the capability for intra-band CA, and for BCs with at least two bands, it defines the capability for inter-band CA.  Note: if the UE does not indicate this capability for a band combination, the UE does not support the feature in this band combination | 13-8 | *RRC*  *simul-SRS-MIMO-Trans-BC-r16* | *RRC*  *CA-ParametersNR-v1610* | n/a | n/a | RAN1 kindly requests RAN2 to decide on the necessity for location server to know if the feature is supported | Optional with capability signaling |

### 5.1.6 NR TEI

Table 5.1.6-1: Layer-1 feature list for NR TEI

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 | Parent IE in TS 38.331 | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 14. NR TEI | 14-1 | Multiple LTE-CRS rate matching patterns | 1) Maximum number of LTE-CRS rate matching patterns in total within a NR carrier using 15 kHz SCS  2) Maximum number of LTE-CRS non-overlapping rate matching patterns within a NR carrier using 15 kHz SCS | 5-28 (Rate-matching around LTE CRS) | *multipleRateMatchingEUTRA-CRS-r16 {*  *maxNumberPatterns-r16,*  *maxNumberNon-OverlapPatterns-r16}* | *BandNR* | n/a | n/a (FR1 only) | For DSS  The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot  UE reporting component 1 for 14-1 also reports component 2.  Reporting of values of Component 1 larger than two is only applicable when reporting values of Component 2 larger than one. | Optional with capability signalling  Component 1:{2, 3, 4, 5, 6}  Component 2: {1, 2, 3} |
|  | 14-1a | Two LTE-CRS overlapping rate matching patterns within a part of NR carrier using 15 kHz overlapping with a LTE carrier | 1. Support of two LTE-CRS overlapping rate matching patterns within a part of NR carrier using 15 kHz SCS overlapping with a LTE carrier | 14-1 | *overlapRateMatchingEUTRA-CRS-r16* | *BandNR* | n/a | n/a (FR1 only) | For DSS  The number of the additional CRS rate matching patterns reported in Rel-16 is accounted in the total number of rate matching pattern reported by the UE for Rel-15 by using pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot and pdsch-RE-MappingFR1-PerSymbol/pdsch-RE-MappingFR1-PerSlot | Optional with capability signaling |
|  | 14-2 | PDSCH Type B mapping of length 9 and 10 OFDM symbols | 1. support of PDSCH Type B scheduling of length 9 and 10 OFDM symbols  2. support of DMRS shift for length-10 symbols | 5-6a (PDSCH mapping type B) | *pdsch-MappingTypeB-Alt-r16* | *BandNR* | n/a | n/a (FR1 only) | For DSS  FG10-8 covers PDSCH type B mapping without DMRS shift due to CRS collision. | Optional with capability signaling |
|  | 14-3 | One slot periodic TRS configuration for FR1 | 1. UE can be configured with one-slot periodic TRS configuration only when no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated | 2-51 (CSI-RS for tracking) | *oneSlotPeriodicTRS-r16* | *BandNR* | n/a (TDD only) | n/a (FR1 only) | UE can be configured with one-slot periodic TRS configuration only when no two consecutive slots are indicated as downlink slots by tdd-UL-DL-ConfigurationCommon or tdd-UL-DL-ConfigDedicated.  This FG is not also applicable for the case that all slots are indicated as flexible | Optional with capability signalling |
|  | 14-4 | SRS Tx switch with allowing downgrading configuration | 1) Support SRS Tx port switch | 2-55 | *supportedSRS-TxPortSwitch-v1610* | *BandParameters-v1610* | n/a | n/a | Agreement:  - Rel-16 UE capability design for SRS antenna switching in conjunction with the existing Rel-15 UE capability should allow UE to indicate support of one of the following combinations  o{t1r1, t1r2}  o{t1r1, t1r2, t1r4}  o{t1r1, t1r2, t2r2, t2r4}  o{t1r1, t2r2}  o{t1r1, t2r2, t4r4}  o{t1r1, t1r2, t2r2, t1r4, t2r4}  Note: Detailed signaling design is up to RAN2 | Optional with capability signalling  Component 1: Candidate value set:  {  o{t1r1, t1r2}  o{t1r1, t1r2, t1r4}  o{t1r1, t1r2, t2r2, t2r4}  o{t1r1, t2r2}  o{t1r1, t2r2, t4r4}  o{t1r1, t1r2, t2r2, t1r4, t2r4}  }  Component2: Candidate value set: {yes, no}  Component 3: Candidate value set: {yes, no} |
|  | 14-5 | Half-duplex UE behaviour in TDD CA for same SCS | 1. Support for directional collision handling between reference and other cell(s) for half-duplex operation in CA with same SCS | 6-5 and simultaneousRxTxInterBandCA not supported | *half-DuplexTDD-CA-SameSCS-r16* | *CA-ParametersNR-v1610* | n/a (TDD only) | n/a | Half duplex UEs that do not indicate this capability should still be able to operate half-duplex TDD CA (i.e. simultaneousRxTxInterBandCA not supported) per Rel15 specifications if network ensures same transmission direction across all the serving cells | Optional with capability signaling |
|  | 14-6 | New RACH configuration for FR1 TDD | 1. new RACH configuration entries with subframe number 2 and/or 7 for RACH periodicity longer than 10 ms |  |  |  | n/a (TDD only) | n/a (FR1 only) | Agreement:  - A new UE capability is not introduced for this TEI, i.e., it is a mandatory UE feature for Rel-16. | Mandatory without capability signalling |
|  | 14-7 | New capability for beamSwitchTiming values of 224 and 336 | 1. Indicates the minimum number of required OFDM symbols {224, 336} between the DCI triggering aperiodic CSI-RS and the corresponding aperiodic CSI-RS transmission in a CSI-RS resource set configured with repetition 'ON'  - Candidate values: {224, 336} | 2-28 | *beamSwitchTiming-r16 {*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *MIMO-ParametersPerBand* | n/a | n/a (FR2 only) | Agreements:  - 48 is used as the beam switching threshold for Ues reporting 224 or 336  ØWhen using the higher values of the feature (sym224 and sym336), beamSwitchTiming indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission in a CSI-RS resource configured with repetition 'ON' to apply TCI indication in CSI-RS triggering DCI.  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 14-7 is based on the support of this capability for the band of the scheduled/ triggered/ indicated cell only | Optional with capability signaling |
| 14. NR TEI | 14-8 | CSI trigger states containing non-active BWP | 1. CSI trigger states containing non-active BWP |  | *csi-TriggerStateNon-ActiveBWP-r16* | *Phy-ParametersCommon* | No | No | Agreements:  - TEI – "CSI trigger states containing non-active BWP"  - When a UE is triggered with a CSI report for a DL BWP that is non-active, the UE is not expected to report the CSI for the non-active BWP and the CSI report associated with the BWP is omitted.  - When a UE is triggered with aperiodic CSI-RS in a DL BWP that is non-active, the UE is not expected to measure the aperiodic CSI-RS.  - The above non-active BWP is the non-active BWP when receiving the associated CSI-RS with the following relaxation for UE processing.  - In the CC of the associated CSI-RS, if the active BWP when receiving the CSI-RS is different from the active BWP when receiving the triggering DCI  - The last symbol of the PDCCH span of the DCI carrying the BWP switching shall be no later than the last symbol of the PDCCH span of the CSI trigger DCI, irrespective of whether they are in the same CC or not and irrespective of whether they are in the same SCS or not.  - The UE is not expected to have any other BWP switching in that CC after the last symbol of the PDCCH span covering CSI trigger DCI and before the first symbol of the triggered CSI-RS resource.  Note: the UE is not required to measure P/SP-CSI-RS in the non-active BWP per current specification | Optional with capability signaling |
| 14-9 (RAN2) | CSI-RS capabilities extension per codebook type | 1) Indicates the list of supported CSI-RS resources across all bands in a band combination by referring to *codebookVariantsList* as specified in TS 38.331 [2].  2) Indicates the list of *SupportedCSI-RS-Resource* as specified in TS 38.331 [2] applicable to the codebook types supported by the UE. | *codebookParameters* | *1) supportedCSI-RS-ResourceListAlt-r16*  *{*  *type1-SinglePanel-r16,*  *type1-MultiPanel-r16,*  *type2-r16,*  *type2-PortSelection-r16*  *}*  *2) codebookVariantsList-r16* | 1) *CodebookParameters-v1610*  2)*Phy-ParametersCommon* | No | No | For each codebook type, *supportedCSI-RS-ResourceListAlt-r16* shall be included in both *codebookParametersPerBC* and *codebookParametersPerBand*. | Optional with capability signaling |
|  | 14-10 (RAN2) | Supported TRS bandwidths | Indicates the UE supported TRS bandwidths, in addition to 52 RBs, for a 10MHz UE channel bandwidth. |  | *trs-AdditionalBandwidth-r16* | *BandNR* | FDD only | FR1 only |  | Optional with capability signalling |

### 5.1.7 5G\_V2X\_NRSL

Table 5.1.7-1: Layer-1 feature list for 5G\_V2X\_NRSL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331** | **Parent IE in TS 38.331** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 12. 5G\_V2X\_NRSL | 15-1 | Receiving NR sidelink | 1) UE can receive NR PSCCH/PSSCH. Up to a total of A sidelink HARQ processes across all links are supported.  2) UE can receive X PSCCH in a slot.  3) UE can attempt to decode Y= NRB non-overlapping RBs per slot  4) UE supports reception of PSSCH according to the 64QAM MCS table  5) UE supports PT-RS reception in FR2.  6) UE can receive using the subcarrier spacing and CP length defined for a given band in RAN4  7) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  8) UE can receive using 30 kHz subcarrier spacing with normal CP in FR1, 120 kHz subcarrier spacing with normal CP FR2 | None | *sl-Reception-r16 {*  *harq-RxProcessSidelink-r16,*  *pscch-RxSidelink-r16,*  *scs-CP-PatternRxSidelink-r16{*  *fr1-r16{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16},*  *fr2-r16{*  *scs-60kHz-r16,*  *scs-120kHz-r16}*  *},*  *extendedCP-RxSidelink-r16*  *}* | *BandSidelink-r16* | n/a | n/a | This is the basic FG for sidelink  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note:  NRB is the number of RBs defined per channel bandwidth by RAN4 in 38.101-1 Table 5.3.2-1 for FR1 and 38.101-2 Table 5.3.2.-1 for FR2  Note: Component 8 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 12 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Component-1 candidate value set: {16, 24, 32, 48, 64}  Component-2 candidate value set: {floor (NRB /10 RBs), 2\*floor (NRB /10 RBs)}  Component-8 candidate value set in FR1:  {{15 kHz}, {30 kHz}, {60 kHz}, {15, 30 kHz}, {30, 60 kHz}, {15, 60 kHz}, {15, 30, 60 kHz}}  Component-8 candidate value set in FR2:  {{60 kHz}, {120 kHz}, {60, 120 kHz}}  Component-8 candidate value set for CP length: {NCP,NCP and ECP}  (ECP only applies to SCS of 60 kHz) | Optional with capability signaling. For UE supports NR sidelink, UE must indicate this FG is supported. |
|  | 15-2 | Transmitting NR sidelink mode 1 scheduled by NR Uu | 1) UE can transmit PSCCH/PSSCH using dynamic scheduling or configured grant type 1 and 2 in NR sidelink mode 1 scheduled by NR Uu. Up to 8 configured grants can be configured for a UE. Up to C sidelink HARQ processes are supported including those for configured grants  2) UE can transmit PSSCH according to the normal 64QAM MCS OFDM table.  3) UE supports PT-RS transmission in FR2.  4) UE can monitor DCI format 3\_0 for NR sidelink dynamic scheduling and configured grant type 2 on the same carrier as sidelink.  5) UE can transmit using the subcarrier spacing and CP length it reports.  6) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to ~~{~~#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  7) Support downlink pathloss based open loop power control  11) UE can report sidelink HARQ-ACK to gNB via PUCCH and PUSCH when it is operating in NR sidelink mode 1 |  | *sl-TransmissionMode1-r16{*  *harq-TxProcessModeOneSidelink-r16,*  *scs-CP-PatternTxSidelinkModeOne-r16 {*  *fr1-r16{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16},*  *fr2-r16{*  *scs-60kHz-r16,*  *scs-120kHz-r16}*  *},*  *extendedCP-TxSidelink-r16,*  *harq-ReportOnPUCCH-r16*  *}* | *BandSidelink-r16* | n/a | n/a | Note: Random selection in the exceptional pool is supported.  This is the basic FG for sidelink in licensed spectrum where gNB is operating on or managing that spectrum and optional FG otherwise  Candidate values for C are {8,16}  Component-6 candidate value set in FR1:  {{15 kHz}, {30 kHz}, {60 kHz}, {15, 30 kHz}, {30, 60 kHz}, {15, 60 kHz}, {15, 30, 60 kHz}}  Component-6 candidate value set in FR2:  {{60 kHz}, {120 kHz}, {60, 120 kHz}}  Component-6 candidate value set for CP length: {NCP,NCP and ECP}  (ECP only applies to SCS of 60 kHz)  Note: For Component 6, if a band is not indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1, the reported numerology shall be the same for sidelink and uplink.  Component (9) is only required to be supported in a band not indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 11 is not required to be supported in a band indicated with the PC5 interface in 38.101-1 Table 5.2E.1-1  In a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1, the UE supports at least 30 kHz with normal CP in FR1, and at least 120 kHz with normal CP in FR2 | Optional with capability signalling  For UE supports NR sidelink in licensed spectrum where gNB is defined, UE must indicate this FG is supported. |
|  | 15-3 | Transmitting NR sidelink mode 2 | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 configured by NR Uu or preconfiguration. Up to B sidelink processes are supported.  2) UE can transmit PSSCH according to the normal 64QAM MCS table.  3) UE supports PT-RS transmission in FR2.  4) UE can perform mode 2 sensing and resource allocation operations  5) UE can transmit using the subcarrier spacing and CP length it reports for FG 15-1  6) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to ~~{~~#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  7) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR2  8) DL pathloss based open loop power control when mode 2 is configured by NR Uu | 15-1 | *sl-TransmissionMode2-r16{*  *harq-TxProcessModeTwoSidelink-r16,*  *scs-CP-PatternTxSidelinkModeTwo-r16,*  *dl-openLoopPC-Sidelink-r16*  *}* | *BandSidelink-r16* | n/a | n/a | Note: Random selection in the exceptional pool is supported.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  This is the basic FG for NR sidelink  Candidate values for B are {8,16}  Note: Component 6 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 10 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 11 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
|  | 15-4 | Synchronization sources for NR sidelink | 1) UE can receive S-SSB in NR sidelink if it supports 15-1.  2) UE can transmit S-SSB in NR sidelink if it supports 15-2 or 15-3.  3) UE supports GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to false.  4) UE can transmit or receive NR sidelink based on the synchronization to an gNB  5) UE additionally supports gNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb.  6) UE additionally supports gNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true. | At least one of 15-1, 15-2, 15-3 | *sync-Sidelink-r16*  *{*  *gNB-Sync-r16,*  *gNB-GNSS-UE-SyncWithPriorityOnGNB-ENB-r16,*  *gNB-GNSS-UE-SyncWithPriorityOnGNSS-r16*  *}* | *BandSidelink-r16* | n/a | n/a | This is the basic FG for sidelink.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 4 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 5 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 6 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
|  | 15-5 | Sidelink congestion control | 1) UE can report CBR measurement to gNB when operating in Mode 1 and mode 2  2) UE can adjust its radio parameters based on CBR measurement and CRlimit.  3) UE can process CBR and CR within the time it indicates | 15-1 and at least one of 15-2 and 15-3 | *congestionControlSidelink-r16 {*  *cbr-ReportSidelink-r16*  *cbr-CR-TimeLimitSidelink-r16*  *}* | *BandSidelink-r16* | n/a | n/a | This is the basic FG for NR sidelink  Note: component 1 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Component-3 candidate value set  {Congestion process time 1, Congestion process time 2} where  Congestion process time 1: 2, 2, 4, 8 slots for 15, 30, 60, 120 kHz subcarrier spacing.  Congestion process time 2: 2, 4, 8, 16 slots for 15, 30, 60, 120 kHz subcarrier spacing | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
|  | 15-6 | Short-term time-scale TDM for in-device coexistence | 1) Support prioritization between LTE sidelink transmission/reception and NR sidelink transmission/reception | At least one of 15-1, 15-2, 15-3  UE supports LTE V2X sidelink in the band combination | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
|  | 15-7 | Transmitting LTE sidelink mode 3 scheduled by NR Uu | 1) UE can be scheduled over NR Uu by DCI format 3\_1 for LTE sidelink mode 3 transmission..  2) UE reports a value 'X' for the minimum value it supports for the additional time indicated in the NR DCI scheduling LTE sidelink mode 3 | UE supports LTE V2X sidelink | *gnb-ScheduledMode3SidelinkEUTRA-r16{*  *gnb-ScheduledMode3DelaySidelinkEUTRA-r16}* | *BandSidelinkEUTRA-r16* | n/a | n/a | Component-2 candidate value set:  {0ms, 0.25ms, 0.5ms, 0.625ms, 0.75ms, 1ms, 1.25ms, 1.5ms,1.75ms, 2ms, 2.5ms, 3ms, 4ms, 5ms, 6ms, 8ms, 10ms, 20 ms } | Optional with capability signalling |
|  | 15-9 | Transmitting LTE sidelink mode 4 configured by NR Uu | 1) UE can be configured over NR Uu for LTE sidelink mode 4 operation | UE supports LTE V2X sidelink | *gnb-ScheduledMode4SidelinkEUTRA-r16* | *BandSidelinkEUTRA-r16* | n/a | n/a |  | Optional with capability signalling |
|  | 15-10 | 256QAM sidelink transmission | 1) UE can transmit PSSCH according to the 256QAM MCS table | At least one of 15-2, 15-3 | *sl-Tx-256QAM-r16* | *BandSidelink-r16* | n/a | FR1 only | Note: RAN4 to decide support for 256QAM transmission in an FR | Optional with capability signalling |
|  | 15-11 | PSFCH format 0 | 1) UE can transmit and receive NR PSFCH format 0  2) UE can receive up to N PSFCH(s) resources in a slot.  3) UE can transmit up to M PSFCH(s) resources in a slot | At least one of 15-1, 15-3 | *psfch-FormatZeroSidelink-r16*  *{*  *psfch-RxNumber,*  *psfch-TxNumber*  *}* | *BandSidelink-r16* | n/a | n/a | This is the basic FG for sidelink.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Candidate values for N are {5, 15, 25, 32, 35, 45, 50, 64}  Candidate values for M are {4, 8, 16} | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
|  | 15-12 | Low-spectral efficiency 64QAM MCS table | 1) UE can transmit and receive PSSCH according to the low-spectral efficiency 64QAM MCS table. | At least one of 15-1, 15-2, 15-3 | *lowSE-64QAM-MCS-TableSidelink-r16* | *BandSidelink-r16* | n/a | n/a |  | Optional with capability signalling |
|  | 15-14 | Sidelink CSI report | 1) UE can transmit and receive sidelink CSI-RS with up to P antenna port(s).  2) UE supports RI and CQI feedback on sidelink. | 15-1 and at least one of 15-2 and 15-3 | *csi-ReportSidelink-r16{*  *csi-RS-PortsSidelink-r16*  *}* | *BandSidelink-r16* | n/a | n/a | Note: Component 1 candidate values are P = {1,2}  Note: When P=1, UE reports RI=1  Note: P=2 is optional | Mandatory with capability signalling for UEs supporting NR sidelink |
|  | 15-15 | eNB type synchronization source for NR sidelink | 1) UE can transmit or receive NR sidelink based on the synchronization to an eNB.  2) If UE supports 15-4, UE additionally supports eNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb.  3) If UE supports 15-4, UE additionally supports eNB, GNSS and SyncRef UE as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true. | At least one of 15-1, 15-2, 15-3 | *enb-sync-Sidelink-r16* | *BandSidelink-r16* | n/a | n/a |  | Optional with capability signalling. |
|  | 15-16 | Simultaneous transmission of uplink and sidelink | 1) UE supports transmission of PC5 simultaneously with Uu uplink in a band combination for which the UE indicated simultaneous sidelink and uplink support in a band combination. | At least one of 15-2 and 15-3 | *supportedTxBandCombListPerBC-Sidelink-r16* | *BandCombination-v1630* | n/a | n/a |  | Optional with capability signalling. |
|  | 15-18 | Support of rank 2 transmission | 1) UE additionally supports rank 2 PSSCH transmission | 15-14 with P=2 | n/a | n/a | n/a | n/a | RAN1 does not see a need for the gNB to know if the feature is supported but would like to leave final decision to RAN2 | Optional without capability signalling |
|  | 15-19 | Support of rank 2 reception | 1) UE additionally supports rank 2 PSSCH reception | 15-1 | *rankTwoReception-r16* | *BandSidelink-r16* | n/a | n/a | RAN1 does not see a need for the gNB to know if the feature is supported but would like to leave final decision to RAN2 | Optional with capability signalling |
|  | 15-22 | Support of fewer than 14 consecutive sidelink symbols in a slot | 1) UE additionally supports transmission/reception of SL slot configured with 7, 8, 9, 10, 11, 12, 13 consecutive symbols and all the corresponding DMRS patterns | At least one of 15-1, 15-2, 15-3 | *fewerSymbolSlotSidelink-r16* | *BandSidelink-r16* | n/a | n/a |  | Optional with capability signalling |
|  | 15-23 | Support of open loop SL power control and RSRP report | 1) Support sidelink pathloss based open loop power control and RSRP report in case of unicast | 15-1 and at least one of 15-2 and 15-3 | *sl-openLoopPC-RSRP-ReportSidelink-r16* | *BandSidelink-r16* | n/a | n/a | This is the basic FG for NR sidelink | Optional with capability signalling  For UE supports NR sidelink, UE must indicate this FG is supported. |
|  | 15-24 | Simultaneous reception of downlink and sidelink | 1) UE supports reception of PC5 simultaneously with Uu downlink in a band combination for which the UE indicated simultaneous sidelink and downlink support in a band combination. | 15-1 | *supportedRxBandCombListPerBC-Sidelink-r16* | *BandCombination-v1630* | n/a | n/a |  | Optional with capability signalling |
|  | 15-25 | Transmitting NR sidelink mode 1 scheduled by NR Uu on a different carrier | 1) UE can monitor DCI format 3\_0 on a different carrier from sidelink for NR sidelink dynamic scheduling and configured grant type 2 | FG 15-2 | *sl-CrossCarrierScheduling-r16* | *BandParametersSidelinkEUTRA-NR-v1630* | n/a | n/a | If the UE indicates support for FG 15-2 in a band indicated with only the PC5 interface in Table 5.2E.1-1 of 38.301-1, the UE must indicate that FG 15-25 is supported for a band combination with that band. | Optional with capability signalling |

### 5.1.8 NR\_eMIMO

Table 5.1.8-1: Layer-1 feature list for NR\_eMIMO

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 | Parent IE in TS 38.331 | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 16. NR\_eMIMO | 16-1a-1 | SSB/CSI-RS for L1-SINR measurement | Per slot limitations:  1. The max number of SSB/CSI-RS (1Tx) for CMR  2. The max number of CSI-IM/NZP-IMR resources  3. The max number of CSI-RS (2Tx) resources for CMR  Memory limitations:  4. The max number of SSB/CSI-RS resources as CMR  5. The max number of CSI-IM/NZP IMR resources  Other limitations:  6. Supported density of CSI-RS (CMR)  7. The max number of aperiodic CSI-RS resources across all CCs configured to measure L1-SINR (including CMR and IMR) shall not exceed MD\_1  8. Supported SINR 7.measurements | 2-21, 2-22 or 2-23, 2-23a | *ssb-csirs-SINR-measurement-r16 {*  *maxNumberSSB-CSIRS-OneTx-CMR-r16,*  *maxNumberCSI-IM-NZP-IMR-res-r16,*  *maxNumberCSIRS-2Tx-res-r16,*  *maxNumberSSB-CSIRS-res-r16,*  *maxNumberCSI-IM-NZP-IMR-res-mem-r16,*  *supportedCSI-RS-Density-CMR-r16,*  *maxNumberAperiodicCSI-RS-Res-r16,*  *supportedSNIR-meas-r16*  *}* | *MIMO-ParametersPerBand* | No | No | Component 1: Candidate values {8, 16, 32, 64}  Component 2: Candidate values {8, 16, 32, 64}  Component 3: Candidate values {0, 4, 8, 16, 32, 64}  Component 4: Candidate values {8, 16, 32, 64 , 128}  Component 5: Candidate values {8, 16, 32, 64 , 128}  Component 6: Candidate values {'1 only', '3 only', '1 and 3'}  Component 7: Candidate values {2, 4, 8, 16, 32, 64}  Component 8: Candidate values: bitmap with entries {SSB as CMR with dedicated CSI-IM, SSB as CMR with dedicated NZP IMR, CSI-RS as CMR with dedicated NZP IMR configured, CSI-RS as CMR without dedicated IMR configured}  If a UE supports FG 16-1a-1 it must support CMR(CSI-RS) + dedicated CSI-IM  Note1: The reference slot duration is the shortest slot duration defined for the FR where the reported band belongs  Note2: For component 4 and 5 the configured CSI-RS resources for both active and inactive BWPs are counted  Note3: For components 1, 2 and 3, CSI-RS resources configured as CMR without dedicated IMR are counted both as CMR and IMR  Note4: For components 1, 2, 3, 7, a SSB/CSI-RS resource is counted within the duration of a reference slot in which the corresponding reference signals are transmitted  Note5: For components 1, 2, 3, 7, if one resource used for L1-SINR measurement is referred N times by one or more CSI reporting settings with reportQuantity -r16= ssb-Index-SINR -r16 or cri-SINR -r16, it is counted N times. | Optional with capability signalling |
| 16-1a-2 | Non-group based L1-SINR reporting | 1. Support of non-group based L1-SINR reporting with N\_max L1-SINR values reported | 16-1a-1 | *nonGroupSINR-reporting-r16* | *MIMO-ParametersPerBand* | No | No | Note: Default value is N\_max = 1 in case 16-1a-2 is not provided by the UE.  Candidate value set is {1, 2, 4} | Optional with capability signalling |
| 16-1a-3 | Group based L1-SINR reporting | 1. Support of group based L1-SINR reporting | 16-1a-1 | *groupSINR-reporting-r16* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signalling |
| 16-1a-4 | Semi-persistent L1-SINR report on PUCCH | 1. Support report on PUCCH formats over 1 – 2 OFDM symbols once per slot (or piggybacked on a PUSCH)  2. Support report on PUCCH formats over 4 – 14 OFDM symbols once per slot (or piggybacked on a PUSCH) | 16-1a-1 | *semi-PersistentL1-SINR-Report-PUCCH-r16 {*  *supportReportFormat1-2OFDM-syms-r16,*  *supportReportFormat4-14OFDM-syms-r16}* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signalling |
| 16-1a-5 | Semi-persistent L1-SINR report on PUSCH | 1. Support semi-persistent report on PUSCH | 16-1a-1 | *semi-PersistentL1-SINR-Report-PUSCH -r16* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signalling |
| 16-1b-1 | TCI state activation across multiple CCs | 1. Support of Simultaneous TCI state activation across multiple CCs: PDCCH, PDSCH | Component 1: 2-1, 2-4 | *simultaneousTCI-ActMultipleCC-r16* | *Phy-ParametersFRX-Diff* | No | Yes | Note: Whether a FG to indicate group(s) of bands that share the same DL spatial filters will be introduced is in RAN4 domain | Optional with capability signaling |
| 16-1b-2 | Spatial relation update across multiple CCs | 1. Support of Simultaneous spatial relation update across multiple CCs: AP-SRS, SP-SRS | Component 1: 2-59, 2-60 | *simultaneousSpatialRelationMultipleCC-r16,*  *cli-RSSI-FDM-DL-r16,*  *cli-SRS-RSRP-FDM-DL-r16* | *Phy-ParametersFRX-Diff* | No | Yes | Note: Whether a FG to indicate group(s) of bands that share the same UL spatial filters will be introduced is in RAN4 domain | Optional with capability signaling |
| 16-1b-3 | Spatial relation update for PUCCH group | 1. Support of PUCCH resource groups per BWP for simultaneous spatial relation update | 2-53, 2-59, 4-24 | *simul-SpatialRelationUpdatePUCCHResGroup-r16* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signalling |
| 16-1c | Default spatial relation | 1. Support of default spatial relation and pathloss reference RS for dedicated-PUCCH/SRS and PUSCH | 2-53, 2-59 | *defaultSpatialRelationPathlossRS-r16* | *Phy-ParametersFR2* | No | FR2 only |  | Optional with capability signaling |
| 16-1d | MAC CE spatial relation update for AP-SRS | 1. Support of spatial relation update for AP-SRS via MAC CE | 2-53, 2-59 | *spatialRelationUpdateAP-SRS-r16,*  *maxNumberSRS-PosSpatialRelationsAllServingCells-r16* | *Phy-ParametersFR2* | No | FR2 only |  | Optional with capability signalling |
| 16-1e | Pathloss reference RS activation via MAC CE | 1. The maximum number of configured pathloss reference RSs for PUSCH/PUCCH/SRS by RRC for MAC-CE based pathloss reference RS update | 8-3 | *maxNumberPathlossRS-Update-r16* | *Phy-ParametersCommon* | No | No | Candidate values for component (1): {4, 8, 16, 32, 64} | Optional with capability signaling |
| 16-1f | SCell beam failure recovery | 1. The maximum number of SCells configured for SCell beam failure recovery simultaneously | 2-31 | *maxNumberSCellBFR-r16* | *MIMO-ParametersPerBand* | No | No | Component-1: candidate value set is {1,2,4,8} | Optional with capability signaling |
| 16-1g | Resources for beam management, pathloss measurement, BFD, RLM and new beam identification | 1. The maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs in one frequency range for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification  2. The maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs in one frequency range for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification | 2-24, 2-31 | *maxTotalResourcesForOneFreqRange-r16 {*  *maxNumberResWithinSlotAcrossCC-OneFR-r16,*  *maxNumberResAcrossCC-OneFR-r16}* | *Phy-ParametersFRX-Diff* | No | Yes | Component-1: candidate value set is {2, 4, 8, 12, 16, 32, 64, 128}  Component-2: candidate value set is {2, 4, 8, 12, 16, 32, 40, 48, 64, 72, 80, 96, 128, 256}  Note: For RS configured for new beam identification, they are always counted regardless of beam failure event  Note: The "configure to measure" RS (component1) only counts those in active BWP but the configured RS (component2) counts all configured including both active and inactive BWP  Note: the reference slot duration is the shortest slot duration defined for the reported FR supported by the UE  Note: The "configured to measure" RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted  Note: Regarding the "configured to measure" RS counting  - If one resource is used for one or multiple of BFD /RLM , it is counted as one (basic usage1)  - If one resource is used for one or multiple of NBI (New Beam Identification)/ PL-RS/ L1-RSRP, add 1 (basic usage 2)  - L1-RSRP measurement includes cases associated with reports with reportQuantity set to 'ssb-Index-RSRP', 'cri-RSRP' or with reportQuantity set to 'none' and CSI -RS-ResourceSet with higher layer parameter trs-Info is not configured  - If one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings with reportQuantity -r16 ::= 'ssb-Index-SINR -r16' or 'cri-SINR -r16' | Optional with capability signaling |
| 16-1g-1 | Resources for beam management, pathloss measurement, BFD, RLM and new beam identification across frequency ranges | 1. The maximum total number of SSB/CSI-RS/CSI-IM resources configured to measure within a slot across all CCs for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification  2. The maximum total number of SSB/CSI-RS/CSI-IM resources configured across all CCs for any of L1-RSRP measurement, L1-SINR measurement, pathloss measurement, BFD, RLM and new beam identification | 2-24, 2-31, 16-1g | *maxTotalResourcesForAcrossFreqRanges-r16 {*  *maxNumberResWithinSlotAcrossCC-AcrossFR-r16,*  *maxNumberResAcrossCC-AcrossFR-r16}* | *Phy-ParametersCommon* | No | No | Component-1: candidate value set is {2, 4, 8, 12, 16, 32, 64, 128}  Component-2: candidate value set is {2, 4, 8, 12, 16, 32, 40, 48, 64, 72, 80, 96, 128, 256}  Note: This FG indicates the maximum number of resources across all FR(s) that are supported by the UE  Note: The signalled values apply to the shortest slot duration defined in any FR(s) that are supported by the UE  Note: The "configured to measure" RS is counted within the duration of a reference slot in which the corresponding reference signals are transmitted  Note: Regarding the "configured to measure" RS counting  - If one resource is used for one or multiple of BFD /RLM , it is counted as one (basic usage1)  - If one resource is used for one or multiple of NBI (New Beam Identification)/ PL-RS/ L1-RSRP, add 1 (basic usage 2)  - L1-RSRP measurement includes cases associated with reports with reportQuantity set to 'ssb-Index-RSRP', 'cri-RSRP' or with reportQuantity set to 'none' and CSI -RS-ResourceSet with higher layer parameter trs-Info is not configured  - If one resource is used for L1-SINR in addition to basic usage 1 & 2, add N if referred N times by one or more CSI Reporting Settings with reportQuantity -r16 ::= 'ssb-Index-SINR -r16' or 'cri-SINR -r16' | Optional with capability signaling |
| 16-1h | Support of 64 configured PUCCH spatial relations | 1. Support of configuring maximum 64 PUCCH spatial relations per BWP per CC  2. Maximum number of configured spatial relations per CC for PUCCH and SRS | 2-59 | *spatialRelations-v1640*  *{*  *maxNumberConfiguredSpatialRelations-v1640 ENUMERATED {n96, n128, n160, n192, n224, n256, n288, n320}*  *}* | *MIMO-ParametersPerBand* | No | FR2 only | Component 2: Candidate value set {96, 128, 160, 192, 224, 256, 288, 320}  Note: if component 2 is reported, UE shall report 96 in FG 2-59 and the UE may assume that the value reported in FG 2-59 is used by Rel-15 gNB and ignored by Rel-16 gNB. | Optional with capability signalling |
| 16-1j-1 | 2 port CSI -RS for new beam identifications | 1. Support of 2 port CSI -RS for new beam identification with the same resource counting as in FG 16-1g, FG 16-1g-1 |  | *newBeamIdentifications2PortCSI-RS-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 16-1j-2 | 2 port CSI -RS for pathloss estimation | 1. Support of 2 port CSI -RS for pathloss estimation with the same resource counting as in FG 16-1g, FG 16-1g-1 |  | *pathlossEstimation2PortCSI-RS-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 16-1l | Support of 64 configured candidate beam RSs for PCell/PSCell BFR | 1. Support of configuring maximum 64 candidate beam RSs per BWP per CC | 2-31 | *support64CandidateBeamRS-BFR-r16* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signalling |
| 16-2a | Multi-DCI based multi-TRP | 1. The maximum number of CORESETs configured per BWP per cell in addition to CORESET 0 for multi-DCI based multi-TRP PDSCH/PUSCH operation  2. The maximum number of CORESETs configured per CORESETPoolIndex ( if CORESETPoolIndex is not configured, it is assumed CORESETPoolIndex = 0) per BWP per cell in addition to CORESET 0 for multi-DCI based multi-TRP PDSCH/PUSCH operation  3. Support fully/partially overlapping PDSCHs in time and non-overlapping in frequency  4. Maximum number of unicast PDSCHs per CORESETPoolIndex per slot |  | *multiDCI-MultiTRP-r16* | *FeatureSetDownlinkPerCC-v1620* | No | No | Note: A UE may assume that its maximum receive timing difference between the DL transmissions from two TRPs is within a CP  Note: Processing capability 2 is not supported in any CC if at least one CC is configured with two values of CORESETPoolIndex  Component 1: Candidate values {2,3,4,5} Note: 1. If UE reports value N1 for component 1, that means UE supports up to min (N1+1, 5) CORESETs in total (including CORESET#0) if there is CORESET#0, and supports maximal N1 CORESETs if there is no CORESET#0.  Component 2: Candidate values {1,2,3}  Note: If UE reports value N2 for component 2, that means UE supports up to min (N2+1, 3) CORESETs in total (including CORESET#0) for a TRP if there is CORESET#0, and supports maximal N2 CORESETs for another TRP if there is no CORESET#0.  Component 4: Candidate values {1,2,3,4,7}  Note: per SCS, similar with Rel-15  For the multi-DCI based multi-TRP PUSCH operation, the maximum number of unicast PUSCHs that UE can support per slot is based on Rel-15 FG5-12/12a/12b, and it is counted across both CORESETPoolIndex of TRPs. | Optional with capability signaling |
| 16-2a-0 | Overlapping PDSCHs in time and fully overlapping in frequency and time | 1. Support PDSCHs with fully overlapping REs, i.e. the allocated REs for PDSCH scheduled by DCI in CORESET configured with CORESETPoolIndex = 0 and PDSCH scheduled by DCI in CORESET configured with CORESETPoolIndex = 1 are exactly the same REs  2. The maximal number of PDSCH scrambling sequences per serving cell | 16-2a | *overlapPDSCHsFullyFreqTime-r16* | *MIMO-ParametersPerBand* | No | No | Note: A UE may assume that its maximum receive timing difference between the DL transmissions from two TRPs is within a CP  Component 2: Candidate values {1, 2} | Optional with capability signalling |
| 16-2a-1 | Overlapping PDSCHs in time and partially overlapping in frequency | 1. Support PDSCHs with partially overlapping REs, i.e. the allocated REs for PDSCH scheduled by DCI in CORESET configured with CORESETPoolIndex = 0 and PDSCH scheduled by DCI in CORESET configured with CORESETPoolIndex = 1 are partially overlapped, with at least one RE | 16-2a-0 | *overlapPDSCHsInTimePartiallyFreq-r16* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signalling |
| 16-2a-2 | Out-of-order operation for DL | 1. Support out-of-order operation for PDCCH to PDSCH  2. Support out-of-order operation for PDSCH to HARQ-ACK | 16-2a | *outOfOrderOperationDL-r16 {*  *supportPDCCH-ToPDSCH-r16,*  *supportPDSCH-ToHARQ-ACK-r16*  *}* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signalling |
| 16-2a-3 | Out-of-order operation for UL | 1. Support out-of-order operation for PDCCH to PUSCH | 16-2a | *outOfOrderOperationUL-r16* | *MIMO-ParametersPerBand* | No | No | Note: "Same closed loop index for power control across PUSCHs associated with different CORESETPoolIndex values is not supported by a UE indicating the support of this feature" | Optional with capability signalling |
| 16-2a-4 | HARQ-ACK for multi-DCI based multi-TRP - separate | 1. Support of separate HARQ-ACK  2. The maximum number of long PUCCHs within a slot for separate HARQ-Ack | 16-2a | *harqACK-separateMultiDCI-MultiTRP-r16 {*  *maxNumberLongPUCCHs-r16*  *}* | *Phy-ParametersCommon* | No | No | Candidate values for Component 2:  {LongAndLong, LongAndShort, ShortAndShort} | Optional with capability signalling |
| 16-2a-4a | HARQ-ACK for multi-DCI based multi-TRP - joint | 1. Support of joint HARQ-ACK | 16-2a | *harqACK-jointMultiDCI-MultiTRP-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 16-2a-5 | Separate CRS rate matching | 1. Whether the UE can rate match around configured CRS patterns which is associated with CORESETPoolIndex (if configured) and are applied to the PDSCH scheduled with a DCI detected on a CORESET with the same value of CORESETPoolIndex | 16-2a and 14-1a | *separateCRS-RateMatching-r16* | *MIMO-ParametersPerBand* | No | FR1 only | Note: only applicable for 15kHz SCS | Optional with capability signalling |
| 16-2a-6 | Default QCL enhancement for multi-DCI based multi-TRP | 1. Support of default QCL assumption per CORESETPoolIndex | 16-2a and 16-2c | *defaultQCL-PerCORESETPoolIndex-r16* | *MIMO-ParametersPerBand* | n/a | FR2 only |  | Optional with capability signalling |
| 16-2a-7 | Maximum number of activated TCI states | 1. The maximal number of activated TCI states per CORESETPoolIndex per BWP per CC including data and control  2. The maximal total number of activated TCI states across CORESETPoolIndex per BWP per CC including data and control | 16-2a | *maxNumberActivatedTCI-States-r16 {*  *maxNumberPerCORESET-Pool-r16,*  *maxTotalNumberAcrossCORESET-Pool-r16*  *}* | *MIMO-ParametersPerBand* | No | No | Candidate values for Component 1: {1,2,4,8}  Candidate values for Component 2: {2,4,8,16} | Optional with capability signalling |
| 16-2a-8 | Indicates that retransmission scheduled by a different CORESETPoolIndex for multi-DCI multi-TRP is not supported. | 1. For multi-DCI multi-TRP operation, if this FG is indicated, UE does not support retransmission scheduled by PDCCH received in a different CORESETPoolIndex compared to the CORESETPoolIndex of the initial transmission, i.e., the UE is not expected to receive, for the same HARQ process ID, DCI from a different CORESETPoolIndex that schedules the retransmission, i.e., NDI not flipped. This applies to both PDSCH and PUSCH retransmissions. | 16-2a | *supportRetx-Diff-CoresetPool-Multi-DCI-TRP-r16* | *Phy-ParametersCommon* | n/a | n/a |  | Optional with capability signalling |
| 16-2c | Simultaneous reception with different Type-D | 1. Supports simultaneous reception with different QCL Type-D RSs. |  | *simultaneousReceptionDiffTypeD-r16* | *MIMO-ParametersPerBand* | n/a | FR2 only |  | Optional with capability signalling |
| 16-2a-9 | Interpretation of maxNumberMIMO-LayersPDSCH for multi-DCI based mTRP | 1. For multi-DCI multi-TRP operation, if this FG is indicated, "maxNumberMIMO-LayersPDSCH" is interpreted as the maximum number of layers per PDSCH. | 16-2a-0 | *maxMIMO-LayersForMulti-DCI-mTRP-r16* | *MIMO-ParametersPerBand* | No | No | Note1: For multi-DCI multi-TRP operation, if this FG is not indicated, maxNumberMIMO-LayersPDSCH is interpreted as the maximum number of layers across two PDSCHs if having at least one RE overlapped.  Note2: For data rate calculation in clause 4.1.2 of 38.306, if this FG is indicated, each multi-DCI based multi-TRP CC is counted two times toward J. | Optional with capability signalling |
| 16-2a-10 | Value of BD factor | 1. Value of R for BD/CCE | 16-2a | *blindDetectFactor-r16* | *CA-ParametersNR-v1610* | No | No | Component: {1,2} | Optional with capability signalling |
| 16-2b-0 | Two default beams for single-DCI based multi-TRP | 1. Support of default QCL assumption with two TCI states | 16-2c | *defaultQCL-TwoTCI-r16* | *MIMO-ParametersPerBand* | n/a | FR2 only |  | Optional with capability signaling |
| 16-2b-1 | Single-DCI based SDM scheme | 1. Support of single-DCI based SDM scheme |  | *singleDCI-SDM-scheme-r16* | *FeatureSetDownlink-v1610* | n/a | n/a |  | Optional with capability signaling |
| 16-2b-1b | Single-DCI based SDM scheme – Support of new DMRS port entry | 1. Support of new DMRS port entry {0, 2, 3} | 16-2b-1 | *supportNewDMRS-Port-r16* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signaling |
| 16-2b-1a | Downlink PTRS | 1. Support of 2-port DL PTRS | 16-2b-1 | *supportTwoPortDL-PTRS-r16* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signaling |
| 16-2b-2 | Single-DCI based FDMSchemeA | 1. Support of single-DCI based FDMSchemeA |  | *supportFDM-SchemeA-r16* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signaling |
| 16-2b-3 | Single-DCI based FDMSchemeB | 1. Support of single-DCI based FDMSchemeB |  | *supportFDM-SchemeB-r16* | *FeatureSetDownlinkPerCC-v1620* | No | No |  | Optional with capability signaling |
| 16-2b-3a | Single-DCI based FDMSchemeB CW soft combining | 1. For FDMSchemeB, Support CW soft combining that UE can support | 16-2b-3 | *supportCodeWordSoftCombining-r16* | *MIMO-ParametersPerBand* | No | No |  | Optional with capability signaling |
| 16-2b-4 | Single-DCI based TDMSchemeA | 1. Support of single-DCI based TDMSchemeA  2. Supported maximum TBS size for TDMSchemeA |  | *supportTDM-SchemeA-r16* | *MIMO-ParametersPerBand* | No | No | Component 2 candidate values {3, 5, 10, 20, no restriction} KByte | Optional with capability signaling |
| 16-2b-5 | Single-DCI based inter-slot TDM | 1. Support of single-DCI based inter-slot TDM  2. Support of RepNumR16 in PDSCH-TimeDomainResourceAllocation and the maximum value of RepNumR16  3. Supported maximum TBS size  4. Maximum number of TCI states |  | *supportInter-slotTDM-r16 {*  *supportRepNumPDSCH-TDRA-r16,*  *maxTBS-Size-r16,*  *maxNumberTCI-states-r16}* | *MIMO-ParametersPerBand* | No | No | Component 2 candidate values: {{2,3,4,5,6,7,8,16}}  Component 3 candidate values {{3, 5, 10, 20, no restriction} KByte }  Component 4 candidate values: {1,2} | Optional with capability signaling |
| 16-3a | Regular eType-II | Basic components:  1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support regular eType-II for R=1  2. Support of parameter combinations 1-6  3. Support of rank 1,2 | 2-35 | *etype2R1-r16*  *{*  *supportedCSI-RS-ResourceListAdd-r16*  *},* | *CodebookParametersAddition-r16* | n/a | n/a | Candidate values for component 1:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256} | Optional with capability signaling |
| 16-3a-1 | Support of PMI sub-bands with R=2 | 1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support regular eType-II for R=2 | 16-3a | *etype2R2-r16*  *{*  *supportedCSI-RS-ResourceListAdd-r16*  *}* | *CodebookParametersAddition-r16* | n/a | n/a | Candidate values for component 1:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256} | Optional with capability signaling |
| 16-3a-2 | Support of parameter combinations 7-8 | 1. Support of parameter combinations 7-8 | 16-3a | *paramComb7-8-r16* | *CodebookParametersAddition-r16* | n/a | n/a |  | Optional with capability signaling |
| 16-3a-3 | Support of rank 3,4 | 1. Support of rank 3,4 | 16-3a | *rank3-4-r16* | *CodebookParametersAddition-r16* | n/a | n/a |  | Optional with capability signaling |
| 16-3a-4 | CBSR | 1. CBSR with amplitude subset restriction | 16-3a | *softAmpRestriction-r16* | *CodebookParametersAddition-r16* | n/a | n/a |  | Optional with capability signaling |
| 16-3b | Port selection eType-II | Basic components:  1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support port selection eType-II for R=1  2. 6 parameter combinations (combos with L=6 don't apply)  3. Support of rank 1,2 | 2-35 | *etype2R1-PortSelection-r16*  *{*  *supportedCSI-RS-ResourceListAdd-r16*  *}* | *CodebookParametersAddition-r16* | n/a | n/a | Candidate values for component 1:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256} | Optional with capability signaling |
| 16-3b-1 | Support of PMI sub-bands with R=2 | 1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support port selection eType-II for R=2 | 16-3b | *etype2R2-PortSelection-r16*  *supportedCSI-RS-ResourceListAdd-r16*  *}* | *CodebookParametersAddition-r16* | n/a | n/a | Candidate values for component 1:  - Maximum 16 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256} | Optional with capability signaling |
| 16-3b-2 | Support of rank 3,4 | 1. Support of rank 3,4 | 16-3b | *rank3-4-r16* | *CodebookParametersAddition-r16* | n/a | n/a |  | Optional with capability signaling |
| 16-4 | Low PAPR DMRS for DL | 1. Low PAPR DMRS for PDSCH |  | *lowPAPR-DMRS-PDSCH-r16* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signaling |
| 16-5a | UL full power transmission mode of *fullpower* | 1. Supported UL full power transmission mode of *fullpower* | 2-13, 2-14 | *ul-FullPwrMode-r16* | *FeatureSetUplink-v1610* | n/a | n/a |  | Optional with capability signaling |
| 16-5b | UL full power transmission *fullpowerMode1* | 1. Supported UL full power transmission *fullpowerMode1* | 2-13, 2-14 | *ul-FullPwrMode1-r16* | *FeatureSetUplink-v1610* | No | No |  | Optional with capability signaling |
| 16-5c | UL full power transmission *fullpowerMode2* | 1. The maximum number of SRS resources in one SRS resource set with usage set to 'codebook' for Mode 2: {1, 2, 4} | 2-13, 2-14 | *ul-FullPwrMode2-MaxSRS-ResInSet* | *FeatureSetUplink-v1610* | No | No | A UE that supports FG 16-5c supports at least full power operation with single port | Optional with capability signaling |
| 16-5c-2 | UL full power transmission fullpowerMode2 – SRS resources | 1. The SRS configuration with different number of antenna ports per SRS resource for Mode 2 | 16-5c | *ul-FullPwrMode2-SRSConfig-diffNumSRSPorts-r16* | *FeatureSetUplink-v1610* | No | No | Component (1) candidate values: {1\_2, 1\_4, 1\_2\_4}  1st state (1\_2): each SRS resource can be configured with 1 port or 2 ports  2nd state (1\_4): each SRS resource can be configured with 1 port or 4 ports  3rd state (1\_2\_4): each SRS resource can be configured with 1 port or 2 ports or 4 ports  Note: The first, second, or third state can be used if 16-5c is reported as 2 or 4.t | Optional with capability signaling |
| 16-5c-3 | UL full power transmission fullpowerMode2 – full power TPMI groups | 1. TPMI group(s) which delivers full power | 16-5c | *ul-FullPwrMode2-TPMIGroup-r16 {*  *twoPorts-r16,*  *fourPortsNonCoherent-r16,*  *fourPortsPartialCoherent-r16*  *}* | *FeatureSetUplink-v1610* | No | No | Candidate component values: any of {2-port {2-bit bitmap}, one of 4-port non-coherent {G0~G3}, one of 4-port partial-coherent {G0~G6}}  Note: When a full coherent UE operates in mode 2, the way it reports TPMIs should be the same as a partial-coherent UE  Note: For 4 port partial-coherent or full-coherent UE, UE can report: 2-port {2-bit bitmap} and one of 4-port non-coherent {G0~G3} and one of 4-port partial-coherent {G0~G6}  For 4 port non-coherent UE, UE can report: 2-port {2-bit bitmap} and one of 4-port non-coherent {G0~G3}  For 2 port UE, UE can report: 2-port {2-bit bitmap}  Note: A UE that supports FG 16-5c-3 must report at least one | Optional with capability signaling |
| 16-6a | Low PAPR DMRS for PUSCH without transform precoding | 1. For PUSCH without transform precoding |  | *lowPAPR-DMRS-PUSCHwithoutPrecoding-r16* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signalling |
| 16-6b | Low PAPR DMRS for PUCCH | 1. For PUCCH format 3 and PUCCH format 4 with transform precoding and with pi/2 BPSK modulation | FG 1-7 (RAN4) and any combination of {4-4, 4-5 , 4-7} | *lowPAPR-DMRS-PUCCH-r16* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signalling |
|  | 16-6c | Low PAPR DMRS for PUSCH with transform precoding and with pi/2 BPSK | 1. For PUSCH with transform precoding and with pi/2 BPSK modulation | 1-6 (RAN4) and 2-12 | *lowPAPR-DMRS-PUSCHwithPrecoding-r16* | *MIMO-ParametersPerBand* | n/a | n/a |  | Optional with capability signalling |
| 16-7 | Extension of the maximum number of configured aperiodic CSI report settings | 1. Extension of the maximum number of configured aperiodic CSI report settings for all codebook types | 2-32 | *csi-ReportFrameworkExt-r16* | *Phy-ParametersFRX-Diff*  *AND*  *MIMO-ParametersPerBand* | n/a | n/a | Candidate values: {1 to 8} | Optional with capability signaling |
| 16-8 | Active CSI-RS resources and ports for mixed codebook types in any slot | 1. Report a list of codebook combinations as {codebook 1, codebook 2, codebook 3}  2. For each codebook combination, report a list of {max number of ports per resource, max number of resources, max number of total ports} | 2-36/2-40/2-41/2-43 in Rel-15, and 16-3a, 16-3a-1, 16-3b, 16-3b-1 in Rel-16 | *{*  *type1SP-Type2-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1SP-Type2PS-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1SP-eType2R1-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1SP-eType2R2-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1SP-eType2R1PS-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1SP-eType2R2PS-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1SP-Type2-Type2PS-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1MP-Type2-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1MP-Type2PS-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1MP-eType2R1-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1MP-eType2R2-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1MP-eType2R1PS-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1MP-eType2R2PS-null-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *type1MP-Type2-Type2PS-r16 {*  *supportedCSI-RS-ResourceListAdd-r16}*  *}* | *CodebookComboParametersAddition-r16* | n/a | n/a | Component-1 candidate values:  Codebook 1 = {Type I SP, Type I MP}  (Codebook 2, Codebook 3) = {(Type II, NULL), (Type II PS, NULL), (eType II R=1, NULL), (eType II R=2, NULL), (eType II PS R=1, NULL), (eType II PS R=2, NULL), (Type II, Type II PS)}  Note 3：if a UE reports one or more codebook combinations in 16-8, then usage of active CSI-RS resources and ports for multiple codebooks in any slot is allowed only within those combinations  Note 4: For coexisting of mixed codebooks in any slot, gNB need to honor 16-8 and per-codebook capability 2-36/40/41/43, 16-3a/b and 16-3a-1/16-3b-1  Note 5: Up to 4 combinations for component 1  Component-2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256} | Optional with capability signaling |
|  | 16-x RAN2 | Mulit-CC simultaneous TCI activation with multi-TRP | 1. Indicates whether the UE supports receiving the Enhanced TCI States Activation/Deactivation for UE-specific PDSCH MAC CE (as specified in TS 38.321 [10] clause 6.1.3.24) indicating a serving cell configured as part of *simultaneousTCI-UpdateList1* or *simultaneousTCI-UpdateList2* as specified in TS 38.331 [2]. | If the UE indicates support of 16-1b-1 for a FR and support of at least one of 16-2b-1, 16-2b-2, 16-2b-3, 16-2b-4 or 16-2b-5 for at least one band or component carrier of this FR, the UE shall indicate support of 16-x for this FR | *twoTCI-Act-servingCellInCC-List-r16* | *Phy-ParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
|  | 16-y RAN2 | Slot based repetition | 1. Indicates whether UE supports the value 0 for the parameter sequenceOffsetforRV. | 16-2b-5 and *maxNumberTCI-states-r16* is set to 2 for at least one band | *supportRepetitionZeroOffsetRV-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
|  | 16-z RAN2 | spCell-BFR-CBRA-r16 | 1. Indicates whether the UE supports sending BFR MAC CE for SpCell BFR as specified in TS 38.321 [10]. |  | *spCell-BFR-CBRA-r16* | *BeamFailureRecoveryConfig* | No | No |  | Optional with capability signalling |

### 5.1.9 NR\_CLI\_RIM

Table 5.1.9-1: Layer-1 feature list for NR\_CLI\_RIM

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 | Parent IE in TS 38.331 | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 17. NR\_CLI\_RIM | 17-1 | CLI-RSSI measurement | 1. Support CLI-RSSI measurement. The max number of resources across all CCs configured to measure RSSI shall not exceed 64.  2. Maximum number of measurement resources configured for CLI-RSSI measurement |  | *cli-RSSI-Meas-r16*  *maxNumberCLI-RSSI-r16* | *MeasAndMobParametersFRX-Diff* | No (TDD only) | Yes | Candidate values for component 2 are {8, 16, 32, 64}.  CLI measurement is not supported in unlicensed bands in Rel-16 | Optional with capability signalling |
| 17. NR\_CLI\_RIM | 17-2 | SRS-RSRP measurement | 1. Support SRS-RSRP measurement. The max number of SRS resources across all CCs configured to measure SRS-RSRP shall not exceed 32.  2. Maximum number of measurement resources across all CCs configured for SRS-RSRP measurement  3. Maximum number of measurement resources across all CCs configured for SRS-RSRP measurement within a slot  - A slot is based on minimum SCS among active BWPs across all CCs configured for SRS-RSRP measurement  - A SRS resource occasion that overlaps with the slot is counted as one measurement resource in the slot |  | *cli-SRS-RSRP-Meas-r16*  *maxNumberCLI-SRS-RSRP-r16*  *maxNumberPerSlotCLI-SRS-RSRP-r16* | *MeasAndMobParametersFRX-Diff* | No (TDD only) | Yes | Candidate values for component 2 are {4, 8, 16, 32}.  Candidate values for component 3 are {2, 4, 8}.  CLI measurement is not supported in unlicensed bands in Rel-16 | Optional with capability signalling |
| 17. NR\_CLI\_RIM | 17-3 | Simultaneous reception of DL signals/channels and CLI-RSSI measurement resource | Support simultaneous reception of DL signals/channels and CLI-RSSI measurement resource | 17-1 | *cli-RSSI-FDM-DL-r16* | *Phy-ParametersFRX-Diff* | No (TDD only) | Yes | UE shall prioritize CLI-RSSI measurement when simultaneous reception of DL signals/channels and CLI-RSSI measurement resource is not supported.  How to capture this sentence is up to RAN2 | Optional with capability signalling |
| 17. NR\_CLI\_RIM | 17-4 | Simultaneous reception of DL signals/channels and SRS-RSRP measurement resource | Support simultaneous reception of DL signals/channels and SRS-RSRP measurement resource | 17-2 | *cli-SRS-RSRP-FDM-DL-r16* | *Phy-ParametersFRX-Diff* | No (TDD only) | Yes | UE shall prioritize SRS-RSRP measurement when simultaneous reception of DL signals/channels and SRS-RSRP measurement resource is not supported.  How to capture this sentence is up to RAN2 | Optional with capability signalling |

### 5.1.10 MR-DC/CA enhancement

Table 5.1.10-1: Layer-1 feature list for MR-DC/CA enhancement

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 | Parent IE in TS 38.331 | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 18. MR-DC/CA enhancement | 18-1 | Basic UL power sharing for DC | Semi-static power sharing mode1 between MCG and SCG cells of same FR for NR dual connectivity. |  | *intraFR-NR-DC-PwrSharingMode1-r16* | *CA-ParametersNRDC-v1610* | n/a | n/a | Absence means intra-FR DC is not supported. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-1a | Semi-static UL power sharing mode 2 for DC | Semi-static power sharing mode 2 between MCG and SCG cells of same FR for NR dual connectivity. | 18-1 | *intraFR-NR-DC-PwrSharingMode2-r16* | *CA-ParametersNRDC-v1610* | n/a | n/a | Semi-static power sharing mode 2 between MCG and SCG cells of same FR is applicable only for synchronous NR dual connectivity | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-1b | Dynamic UL power sharing for DC | Dynamic power sharing between MCG and SCG cells of same FR for NR dual connectivity.  1) T\_offset | 18-1 | *intraFR-NR-DC-DynamicPwrSharing-r16,* | *CA-ParametersNRDC-v1610* | n/a | n/a | 1) {short, long} | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-4 | SCell dormancy indication within active time | Support for SCell dormancy indication sent within the active time on PCell with DCI format 0\_1/1\_1 | 6-5 | *scellDormancyWithinActiveTime-r16* | *CA-ParametersNR-v1610* | n/a | n/a | One dormant BWP and one non-dormant BWP is supported per carrier  More than one non-dormant BWP per carrier is supported only if UE feature 6-3/6-4 is also supported  One dormant BWP and one non-dormant BWP are UE specific BWPs even for UEs not supporting 6-2 or 6-3 | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-4a | SCell dormancy indication outside active time | Support for SCell dormancy indication sent outside the active time on PCell with DCI format 2\_6 | 19-1 | *scellDormancyOutsideActiveTime-r16* | *CA-ParametersNR-v1610* | n/a | n/a | One dormant BWP and one non-dormant BWP is supported per carrier  More than one non-dormant BWP per carrier is supported only if UE feature 6-3/6-4 is also supported  One dormant BWP and one non-dormant BWP are UE specific BWPs even for UEs not supporting 6-2 or 6-3 | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5 | DL cross-carrier scheduling with different SCS | 1. The UE supports DL cross carrier scheduling for the different numerologies with carrier indicator field (CIF) in DL carrier aggregation where numerologies for the scheduling CC and scheduled CC are different  Candidate value set for component 1: {Scheduling CC of lower SCS and scheduled CC of higher SCS, Scheduling CC of higher SCS and scheduled CC of lower SCS, both}  Note: Following components are applicable to CCS from lower SCS to higher SCS when the UE reports FG 18-5  - Processing one unicast DCI scheduling DL per scheduling CC slot per scheduled CC for FDD scheduling CC  - Processing one unicast DCI scheduling DL per scheduling CC slot per scheduled CC for TDD scheduling CC  Note: Following components are applicable to CCS from higher SCS to lower SCS when the UE reports FG 18-5  - Processing one unicast DCI scheduling DL per N consecutive scheduling CC slot per scheduled CC for FDD scheduling CC  - Processing one unicast DCI scheduling DL per N consecutive scheduling CC slot per scheduled CC for TDD scheduling CC  - N is based on pair of (scheduling CC SCS, scheduled CC SCS): N=2 for (30,15), (60,30), (120,60) and N=4 for (60,5), (120,30), N = 8 for (120,15) | 6-5 | *crossCarrierSchedulingDL-DiffSCS-r16* | *CA-ParametersNR-v1610* | n/a | n/a | crossCarrierScheduling-OtherSCS | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5a | Default QCL assumption for cross-carrier scheduling | Indicates whether the UE can be configured with enabledDefaultBeamForCCS for default QCL assumption for cross-carrier scheduling for same/different numerologies  - Candidate values are {different only, both}  - When "both" is reported, the UE supports this feature for same SCS and for different SCS combination(s) (low-to-high, high-to-low or both) reported for 18-5 | one of {6-10, 18-5} | *crossCarrierSchedulingDefaultQCL-r16* | *CA-ParametersNR-v1610* | n/a | n/a |  | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5b | UL cross-carrier scheduling with different SCS | 1. The UE supports UL cross carrier scheduling for the different numerologies with carrier indicator field (CIF) in UL carrier aggregation where numerologies for the scheduling CC and scheduled CC are different  Candidate value set for component 1: {Scheduling CC of lower SCS and scheduled CC of higher SCS, Scheduling CC of higher SCS and scheduled CC of lower SCS, both}  Note: Following components are applicable to CCS from lower SCS to higher SCS when the UE reports FG 18-5b  - Processing one unicast DCI scheduling UL per scheduling CC slot per scheduled CC for FDD scheduling CC  - Processing 2 unicast DCI scheduling UL per scheduling CC slot per scheduled CC for TDD scheduling CC  Note: Following components are applicable to CCS from higher SCS to lower SCS when the UE reports FG 18-5b  - Processing one unicast DCI scheduling UL per N consecutive scheduling CC slot per scheduled CC for FDD scheduling CC  - Processing 2 unicast DCI scheduling UL per N consecutive scheduling CC slot per scheduled CC for TDD scheduling CC  - N is based on pair of (scheduling CC SCS, scheduled CC SCS): N=2 for (30,15), (60,30), (120,60) and N=4 for (60,5), (120,30), N = 8 for (120,15) | 6-6 | *crossCarrierSchedulingUL-DiffSCS-r16* | *CA-ParametersNR-v1610* | n/a | n/a | crossCarrierScheduling-OtherSCS | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5c | Processing up to X unicast DCI scheduling for DL per scheduled CC | Processing up to X unicast DCI scheduling for DL per scheduled CC  - X is based on pair of (scheduling CC SCS, scheduled CC SCS):  - Candidate value(s) of X  - X={1,2,4} for (15,120), (15,60), (30,120) and X={2} for (15,30), (30,60), (60,120 kHz)  - X applies per slot of scheduling CC | 18-5 | *crossCarrierSchedulingProcessing-DiffSCS-r16 {*  *scs-15kHz-120kHz-r16,*  *scs-15kHz-60kHz-r16,*  *scs-30kHz-120kHz-r16,*  *scs-15kHz-30kHz-r16,*  *scs-30kHz-60kHz-r16,*  *scs-60kHz-120kHz-r16*  *}* | *FeatureSetDownlink-v1610* | n/a | n/a | This FG is only applicable to the basic PDCCH monitoring capability 3-1  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 18-5c is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell  - If reported value of X in FG18-5c is different between the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell, the value of X reported for the scheduling/triggering/indicating cell is applied. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-5d | Processing up to X unicast DCI scheduling for UL per scheduled CC | Processing up to X unicast DCI scheduling for UL per scheduled CC  - X is based on pair of (scheduling CC SCS, scheduled CC SCS):  - Candidate value(s) of X  - X={1,2,4} for (15,120), (15,60), (30,120) and X={2} for (15,30), (30,60), (60,120 kHz)  - X applies per slot of scheduling CC | 18-5b | *crossCarrierSchedulingProcessing-DiffSCS-r16 {*  *scs-15kHz-120kHz-r16,*  *scs-15kHz-60kHz-r16,*  *scs-30kHz-120kHz-r16,*  *scs-15kHz-30kHz-r16,*  *scs-30kHz-60kHz-r16,*  *scs-60kHz-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | n/a | n/a | This FG is only applicable to the basic PDCCH monitoring capability 3-1  Regarding the interpretation of UE capabilities in case of cross-carrier operation, support of 18-5d is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell  - If reported value of X in FG18-5d is different between the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell, the value of X reported for the scheduling/triggering/indicating cell is applied. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-6 | Cross-carrier A-CSI RS triggering with different SCS | Cross-carrier A-CSI RS triggering with different SCS  Candidate value set: {PDCCH cell of lower SCS and A-CSI RS cell of higher SCS, PDCCH cell of higher SCS and A-CSI-RS of lower SCS, both} | 2-33 and 6-5 | *crossCarrierA-CSI-trigDiffSCS-r16* | *CA-ParametersNR-v1610* | n/a | n/a |  | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-6a | Default QCL assumption for cross-carrier A-CSI-RS triggering | Indicates whether the UE can be configured with enabledDefaultBeamForCCS for default QCL assumption for cross-carrier A-CSI-RS triggering for same/different numerologies  - Candidate values are {different only, both}  - When "both" is reported, the UE supports this feature for same SCS and for different SCS combination(s) (low-to-high, high-to-low or both) reported for 18-5 | 6-5 | *defaultQCL-CrossCarrierA-CSI-Trig-r16* | *CA-ParametersNR-v1610* | n/a | n/a |  | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-7 | CA with non-aligned frame boundaries | CA with non-aligned frame boundaries for inter-band CA | 6-5 for DL CA with non-aligned frame boundaries for inter-band CA  6-6 for UL CA with non-aligned frame boundaries for inter-band CA | *interCA-NonAlignedFrame-r16* | *CA-ParametersNR-v1610* | n/a | n/a | Defines whether the UE supports carrier aggregation operation where the frame boundaries of the Pcell and the Scell are not aligned, while the slot boundaries are. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-8 | HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group | HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group | 6-7 | *harqACK-CB-SpatialBundlingPUCCH-Group-r16* | *Phy-ParametersCommon* | No | No | Support HARQ-ACK codebook type and HARQ-ACK spatial bundling configuration per PUCCH group.  Rel-15 had this per cell group | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-9 | Type2 HARQ-ACK codebook for >1 unicast DL DCIs in same Monitoring Occasion | For HARQ-ACK type 2 codebook: Usage of the PDSCH starting time in addition to the existing MO and Cell index to order the HARQ-ACK feedback | 3-1 | *type2-HARQ-ACK-Codebook-r16* | *Phy-ParametersCommon* | No | No | Note: The UE capability is introduced with following assumption:  - Specification reflects that UE behavior is modified only for UEs supporting this capability.  - UE behavior of a UE supporting this capability is different from UE behavior of a UE not supporting this capability only for following case:  - Type-2 HARQ-ACK codebook when HARQ-ACK feedback in a codebook corresponds to more than one unicast DL DCI for same scheduled cell in a MO of a scheduling cell. | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-2 | Single UL TX operation for TDD PCell in EN-DC | TDM restriction to LTE TDD PCell in EN-DC for single UL-Transmission associated functionality when tdm-patternConfig-r16 is configured  1) TDD UL/DL configuration#2, #4, #5 configured as DL-reference UL/DL configuration  2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (only for type 1 UE)  3) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe not limited to the reference TDM pattern (only for type 1 UE)  4) the UE does not transmit on SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG if the conditions in TS38.213 clause 7.6.1 are satisfied | EN-DC | *tdm-restrictionTDD-endc-r16* | *MRDC-Parameters-v1620* | Applicable to TDD-TDD EN-DC only | Applicable to FR1 only | Extension of the R15 capability tdm-Pattern to TDD PCell  This FG is for synchronous EN-DC | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-2a | Enhanced single UL TX operation for FDD Pcell EN-DC | TDM restriction to LTE FDD Pcell in EN-DC for single UL-Transmission associated functionality when tdm-patternConfig-r16 is configured  1) DL-reference UL/DL configuration defined for LTE-FDD-SCell in LTE-TDD-FDD CA with LTE-TDD-PCell  2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (only for type 1 UE)  3) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe not limited to the reference TDM pattern (only for type 1 UE)  4) the UE does not transmit on SCG in FR1 when the UE has overlapped transmission on a subframe on the MCG if the conditions in TS38.213 clause 7.6.1 are satisfied | 6-13 | *tdm-restrictionFDD-endc-r16* | *MRDC-Parameters-v1620* | Applicable to in FDD-LTE -NR EN-DC | Applicable to FR1 only | Enhancement to the R15 capability tdm-Pattern | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-2b | Support of HARQ-offset for SUO case1 in EN-DC with LTE TDD PCell for type 1 UE | Support of HARQ-offset for SUO case1 in EN-DC with LTE TDD PCell for type 1 UE | 18-2 | *singleUL-HARQ-offsetTDD-PCell-r16* | *MRDC-Parameters-v1620* | n/a | n/a | This FG is for synchronous EN-DC | Optional with capability signaling |
| 18. MR-DC/CA enhancement | 18-3 | Dual Tx transmission for EN-DC with FDD PCell(TDM pattern for dual Tx UE) | TDM restriction to LTE FDD PCell in EN-DC for dual UL Tx operation when tdm-patternConfig-r16 is configured  1) DL-reference UL/DL configuration defined for LTE-FDD-SCell in LTE-TDD-FDD CA with LTE-TDD-PCell  2) PRACH transmission in non- designated UL subframes given by the DL-reference configuration (only for type 1 UE)  3) LTE UL transmissions scheduled/triggered by a DCI in any UL subframe not limited to the reference TDM pattern (only for type 1 UE) | 6-13, EN-DC | *tdm-restrictionDualTX-FDD-endc-r16* | *MRDC-Parameters-v1620* | Applicable to EN-DC with LTE FDD PCell only | Applicable to FR1 only | Extension of the R15 capability tdm-Pattern to a dual Tx UE | Optional with capability signalling |
| 18. MR-DC/CA enhancement | 18-3a | Semi-statically configured LTE UL transmissions in all UL subframes not limited to tdm-pattern in case of FDD PCell | UE configured with tdm-patternConfig-r16 can be semi-statically configured with LTE UL transmissions in all UL subframes not limited to the reference tdm-pattern (only for type 1 UE) in case of FDD PCell | One of {18-2a, 18-3} | *fdd-PCellUL-TX-AllUL-Subframe-r16* | *Phy-ParametersMRDC* | Applicable to EN-DC only | Applicable to FR1 only |  | Optional with capability signaling |
| 18. MR-DC/CA enhancement | 18-3b | Semi-statically configured LTE UL transmissions in all UL subframes not limited to tdm-pattern in case of TDD PCell | UE configured with tdm-patternConfig-r16 can be semi-statically configured with LTE UL transmissions in all UL subframes not limited to the reference tdm-pattern (only for type 1 UE) in case of TDD PCell | 18-2 | *tdd-PCellUL-TX-AllUL-Subframe-r16* | *Phy-ParametersMRDC* | Applicable to EN-DC only | Applicable to FR1 only | This FG is for synchronous EN-DC | Optional with capability signaling |
| 18. MR-DC/CA enhancement | 18-7a | CA with non-aligned frame boundaries | Indicates whether the UE supports inter-band carrier aggregation operation where, within the same cell group, the frame boundaries of the SpCell and the SCell(s) are not aligned, the slot boundaries are aligned and the lowest subcarrier spacing of the subcarrier spacings given in *scs-SpecificCarrierList* for SpCell is larger than the lowest subcarrier spacing of the subcarrier spacings given in *scs-SpecificCarrierList* for at least one of the non-aligned Scells. | 18-7 | *interCA-NonAlignedFrame-B-r16* | *CA-ParametersNR-v1630* | n/a | n/a |  | Optional with capability signaling |

### 5.1.11 UE Power Saving

Table 5.1.11-1: Layer-1 feature list for UE Power Saving

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 19.UE Power Saving | 19-1 | DRX Adaptation | (1) Configured PS\_offset for the detection of DCI format 2\_6 with CRC scrambling by PS-RNTI and reported minimum time gap before the start of drx\_onDurationTimer  (2) Indication of UE whether or not to start drx\_OnDuration timer for the next DRX cycle by detection of DCI format 2\_6  (3) Configured UE wakeup or not when DCI format 2\_6 is not detected at all monitoring occasions outside Active time  (4) Configured periodic CSI report apart from L1-RSRP when impacted by DCI format 2\_6 that drx\_OnDurationTimer does not start for the next DRX cycle  (5) Configured periodic L1-RSRP report when impacted by DCI format 2\_6 that drx\_OnDurationTimer does not start for the next DRX cycle | N/A | *drx-Adaptation-r16*  *{*  *non-SharedSpectrumChAccess-r16 MinTimeGap-r16,*  *sharedSpectrumChAccess-r16*  *MinTimeGap-r16*  *}* | *MAC-ParametersFRX-Diff-r16* | No | Yes | The minimum time gap between the end of the slot of last DCI format 2\_6 monitoring occasion and the beginning of the slot where the UE would start the drx\_onDurationTimer is a UE capability based on subcarrier spacing.  - The reporting is per SCS in units of slots of the respective SCS  - The candidate value set for 15kHz SCS: {1,3} slots  - The candidate value set for 30kHz SCS: {1,6} slots  - The candidate value set for 60kHz SCS: {1,12} slots  - The candidate value set for 120kHz SCS: {2,24} slots  UE is not required to monitor PDCCH for detection of DCI format 2\_6 during the minimum time gap  Note: FR1 bit set to 'yes' means support of DCI 2\_6 monitoring on primary cell in FR1  FR2 bit set to 'yes' means support of DCI 2\_6 monitoring on primary cell in FR2  Note: RAN1 agreed it should be possible to separately indicate support of this FG based on whether the UE is operated with or without shared spectrum access. It is left to RAN2 how to implement this while leaving the type as "per UE" | Optional with capability signalling |
| 19-2 | Cross Slot Scheduling | 1) Dynamic indication of applicable minimum scheduling restriction by DCI format 0\_1 and 1\_1  2 minimumSchedulingOffset K0 configuration for PDSCH and aperiodic CSI-RS triggering offset  3) minimumSchedulingOffset K2 configuration for PUSCH  4) Support of extended value range for aperiodic CSI-RS triggering offset |  | *crossSlotScheduling-r16 {*  *non-SharedSpectrumChAccess-r16,*  *sharedSpectrumChAccess-r16*  *}* | *Phy-ParametersCommon* | No | No | Note: RAN1 agreed it should be possible to separately indicate support of this FG based on whether the UE is operated with or without shared spectrum access. It is left to RAN2 how to implement this while leaving the type as "per UE" | Optional with capability signalling |
| 19-3 | Maximum MIMO Layer Adaptation | Support of maximum number of MIMO layer configuration per DL BWP | See Note | *maxLayersMIMO-Adaptation-r16* | *Phy-ParametersFRX-Diff* | No | Yes | This capability is indicated only if UE supports the network configuration of maxMIMO-Layers according to maxLayersMIMO-Indication | Optional with capability signalling |
| 19-4a | UE assistance information | Support of reporting preferred minimum K0/K2 via UE assistance information  - 15kHz/30kHz SCS: {1, 2, 4, 6} slots  - 60kHz/120kHz SCS: {2, 4, 8, 12} slots | 19-2 | *minSchedulingOffsetPreference-r16* | *PowSav-ParametersCommon-r16* | No | No | The minimum applicable value of K0 (K2) for an active DL (UL) BWP for the carrier where PDSCH(PUSCH) is transmitted | Optional with capability signalling |

### 5.1.12 NR\_IAB

Table 5.1.12-1: Layer-1 feature list for NR\_IAB

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 20. NR\_IAB | 20-2 | Inter-IAB-node discovery and measurements: SSB reception configuration | Support up to 4 SMTCs configured for an IAB node MT per frequency location, including IAB-specific SMTC window periodicities |  | *seperateSMTC-InterIAB-Support-r16* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Mandatory with capability signalling |
| 20-3 | Extension of RACH occasions and periodicities for backhaul RACH resources | Support RACH configuration for IAB-MT separately from the RACH configuration for UE access, including new IAB-specific offset and scaling factors |  | *seperateRACH-IAB-Support-r16* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling |
| 20-5a | UL-Flexible-DL slot formats | Support semi-static configuration/indication of UL-Flexible-DL slot formats for IAB-MT resources | 5-1a | *ul-flexibleDL-SlotFormatSemiStatic-IAB-r16* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling |
| 20-5b | UL-Flexible-DL slot formats | Support dynamic indication of UL-Flexible-DL slot formats for IAB-MT resources | 3-6 | *ul-flexibleDL-SlotFormatDynamics-IAB-r16* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling |
| 20-6 | Dynamic indication of soft resource availability | Support monitoring DCI Format 2\_5 scrambled by AI-RNTI for indication of soft resource availability to an IAB node |  | *dci-25-AI-RNTI-Support-IAB-r16* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |
| 20-7 | Case 1 OTA timing alignment | Support T\_delta reception. |  | *t-DeltaReceptionSupport-IAB-r16* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |
| 20-8 | Guard symbols | 1) Support DesiredGuardSymbols reporting  2) Support ProvidedGuardSymbols reception |  | *guardSymbolReportReception-IAB-r16* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |

### 5.1.13 Mobility Enhancement

Table 5.1.13-1: Layer-1 feature list for Mobility Enhancement

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 21. Mobility Enhancement | 21-1a | Intra-frequency DAPS HO | Support of intra-frequency DAPS-HO  1) Support of simultaneous DL reception of PDCCH and PDSCH from source and target cell in DAPS-HO  2) Support of PDCCH blind decoding capability in the first MCG and second MCG.  Support of cancelling UL transmission to the source cell for intra-frequency DAPS-HO | DAPS  (Note: RAN2 feature) | *No separate capability, implied by intraFreqDAPS-r16 and intraFreqDAPS-UL-r16* | *FeatureSetDownlink-v1610*  *FeatureSetUplink-v1610* | No | n/a |  | Optional with capability signalling |
| 21-1b | Inter-frequency DAPS HO | Support of inter-frequency DAPS-HO  1) Support of simultaneous DL reception of PDCCH and PDSCH from source and target cell in DAPS-HO  2) Support of PDCCH blind decoding capability in the first MCG and second MCG. | DAPS  (Note: RAN2 feature) | *No separate capability, implied by interFreqDAPS-r16* | *CA-ParametersNR-v1610* | No | n/a |  | Optional with capability signalling |
| 21-2 | Semi-static UL power sharing mode 1 for DAPS HO | Support of semi-static power sharing mode1 between source and target cells of same FR for inter-frequency DAPS HO | DAPS, 21-1b  (Note: RAN2 feature) | *interFreqSemiStaticPowerSharingDAPS-Mode1-r16* | *intraFreqDAPS-UL-r16* | No | n/a |  | Optional with capability signalling |
| 21-2a | Semi-static UL power sharing mode 2 for DAPS HO | Support of semi-static power sharing mode 2 between source and target cells of same FR for inter-frequency DAPS HO | 21-2, 21-1b | *interFreqSemiStaticPowerSharingDAPS-Mode2-r16* | *intraFreqDAPS-UL-r16* | No | n/a | only applicable to DAPS HO in synchronous scenarios | Optional with capability signalling |
| 21-2b | Dynamic UL power sharing for DAPS HO | Support of dynamic power sharing between source and target cells of same FR for inter-frequency DAPS HO  1) T\_offset | 21-2, 21-1b | *interFreqDynamicPowerSharingDAPS-r16* | *intraFreqDAPS-UL-r16* | No | n/a | Candidate values for (1) are {short, long} | Optional with capability signalling |
| 21-2d | UL transmission cancellation | Indicates support of cancelling UL transmission to the source cell for inter-frequency DAPS-HO | 21-1b | *interFreqUL-TransCancellationDAPS-r16* | *interFreqDAPS-r16* | No | n/a |  | Optional with capability signalling |

### 5.1.14 Potential change/update on existing UE features for Rel-16 UE

Table 5.1.14-1: Layer-1 feature list for Potential change/update on existing UE features for Rel-16 UE

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 8. UL TPC | 8-1 | Dynamic power sharing for LTE-NR DC | When total transmission power exceeds Pcmax, UE scales NR transmission power. | EN-DC | *dynamicPowerSharingENDC* | *MRDC-Parameters* | No | No |  | Mandatory with capability signalling set to 1 |

### 5.1.15 New FGs that are not dedicated to a specific Rel-16 work item/TEI

Table 5.1.15-1: New FGs that are not dedicated to a specific Rel-16 work item/TEI

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 22. NR Others | 22-1 | Indicating supported option for UL Tx switching for inter-band UL CA | | Indicating supported option for UL Tx switching for inter-band UL CA  Candidate values set is {option1, option2, both option 1 and option 2} | 6-6 and RAN4 FG 7-1 (Tx switching period between two uplink carriers) |  |  | **n/a** | **n/a** (FR1 only) | It has been agreed in RAN1 that UE can report support of one of the three candidates {option1, option2, both option1 and option2}. It is up to RAN2 to design the corresponding UE capability signalling. | Signaling of this FG is mandatory conditioned on the support of switching time capability for Tx switching between two uplink carriers in inter-band UL CA band combinations in RAN4 FG 7-1 (i.e. Tx switching period between two uplink carriers) |
| 22-2 | Indicating supported option for UL Tx switching for EN-DC | | Indicating supported option for UL Tx switching for EN-DC  Candidate values set is {option1, option2} | EN-DC and RAN4 FG 7-1 (Tx switching period between two uplink carriers) |  |  | **n/a** | **n/a** (FR1 only) |  | Signaling of this FG is mandatory conditioned on the support of switching time capability for Tx switching between two uplink carriers in EN-DC in RAN4 FG 7-1 (i.e. Tx switching period between two uplink carriers) |
| 22-3a | CBG based transmission for UL with 1 unicast PUSCH per slot per CC with UE processing time Capability 2 | | CBG based transmission for UL with 1 unicast PUSCH per slot per CC with UE processing time Capability 2 |  | *No separate capability*  *cbgPUSCH-ProcessingType2-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-3b | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | *No separate capability*  *cbgPUSCH-ProcessingType2-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-3c | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | *No separate capability*  *cbgPUSCH-ProcessingType2-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-3d | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 | | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | *No separate capability*  *cbgPUSCH-ProcessingType2-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-3e | CBG based transmission for DL with 1 unicast PDSCH per slot per CC with UE processing time Capability 2 | | CBG based transmission for DL with 1 unicast PDSCH per slot per CC with UE processing time Capability 2 |  | *No separate capability*  *cbgPDSCH-ProcessingType2- DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetDownlink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-3f | CBG based transmission for DL with up to 2 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 | | CBG based transmission for DL with up to 2 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | *No separate capability*  *cbgPDSCH-ProcessingType2- DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetDownlink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-3g | CBG based transmission for DL with up to 7 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 | | CBG based transmission for DL with up to 7 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | *No separate capability*  *cbgPDSCH-ProcessingType2- DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetDownlink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-3h | CBG based transmission for DL with up to 4 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 | | CBG based transmission for DL with up to 4 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 2 |  | *No separate capability*  *cbgPDSCH-ProcessingType2- DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetDownlink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-4a | CBG based transmission for UL with 1 unicast PUSCH per slot per CC with UE processing time Capability 1 | | CBG based transmission for UL with 1 unicast PUSCH per slot per CC with UE processing time Capability 1 |  | *No separate capability*  *cbgPUSCH-ProcessingType1-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-4b | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 | | CBG based transmission for UL with up to 2 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | *No separate capability*  *cbgPUSCH-ProcessingType1-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-4c | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 | | CBG based transmission for UL with up to 7 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | *No separate capability*  *cbgPUSCH-ProcessingType1-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-4d | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 | | CBG based transmission for UL with up to 4 unicast PUSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | *No separate capability*  *cbgPUSCH-ProcessingType1-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetUplink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-4e | CBG based transmission for DL with 1 unicast PDSCH per slot per CC with UE processing time Capability 1 | | CBG based transmission for DL with 1 unicast PDSCH per slot per CC with UE processing time Capability 1 |  | *No separate capability*  *cbgPDSCH-ProcessingType1-* *DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetDownlink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-4f | CBG based transmission for DL with up to 2 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 | | CBG based transmission for DL with up to 2 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | *No separate capability*  *cbgPDSCH-ProcessingType1-* *DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetDownlink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-4g | CBG based transmission for DL with up to 7 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 | | CBG based transmission for DL with up to 7 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | *No separate capability*  *cbgPDSCH-ProcessingType1-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  *}* | *FeatureSetDownlink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-4h | CBG based transmission for DL with up to 4 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 | | CBG based transmission for DL with up to 4 unicast PDSCHs per slot per CC for different TBs with UE processing time Capability 1 |  | *No separate capability*  *cbgPDSCH-ProcessingType1-DifferentTB-PerSlot-r16*  *{*  *scs-15kHz-r16,*  *scs-30kHz-r16,*  *scs-60kHz-r16,*  *scs-120kHz-r16*  ***}*** | *FeatureSetDownlink-v1610* | **n/a** | **n/a** | This capability is necessary for each SCS | Optional with capability signalling |
| 22-5a | Simultaneous transmission of SRS for antenna switching and SRS for CB/NCB /BM for intra-band UL CA | | 1. Support transmission of SRS for xTyR (x<y) based antenna switching and SRS for CB/NCB /BM on different CCs in overlapped symbol(s) for intra-band UL CA  2. Support transmission of SRS for xTyR (x=y) based antenna switching and SRS for CB/NCB /BM on different CCs in overlapped symbol(s) for intra-band UL CA |  | *Same for 22-5a/22-5c*  *simulTX-SRS-AntSwitchingIntraBandUL-CA-r16*  *SimulSRS-ForAntennaSwitching-r16* | *BandNR* | **n/a** | **n/a** |  | Optional with capability signaling  Note: For component 1 and 2, a UE not reporting this component does not support the feature |
| 22-5b | Simultaneous transmission of SRS for antenna switching and SRS for CB/NCB /BM for inter-band UL CA | | 1. Support transmission of SRS for xTyR (x<y) based antenna switching and SRS for CB/NCB /BM on different CCs in overlapped symbol(s) for inter-band UL CA  2. Support transmission of SRS for xTyR (x=y) based antenna switching and SRS for CB/NCB /BM on different CCs in overlapped symbol(s) for inter-band UL CA |  | *Same for 22-5b/22-5d*  *simulTX-SRS-AntSwitchingInterBandUL-CA-r16*  *SimulSRS-ForAntennaSwitching-r16* | *CA-ParametersNR-v1610* | **n/a** | **n/a** |  | Optional with capability signaling  Note: For component 1 and 2, a UE not reporting this component does not support the feature |
| 22-5c | Simultaneous transmission of SRS for antenna switching and SRS for antenna switching for intra-band UL CA | | 1. Support transmission of SRS for antenna switching and SRS for antenna switching on different CCs in overlapped symbol(s) for intra-band UL CA |  | *Same for 22-5a/22-5c*  *simulTX-SRS-AntSwitchingIntraBandUL-CA-r16*  *SimulSRS-ForAntennaSwitching-r16* | *BandNR* | **n/a** | **n/a** |  | Optional with capability signaling |
| 22-5d | Simultaneous transmission of SRS for antenna switching and SRS for antenna switching for inter-band UL CA | | 1. Support transmission of SRS for antenna switching and SRS for antenna switching on different CCs in overlapped symbol(s) for inter-band UL CA |  | *Same for 22-5b/22-5d*  *simulTX-SRS-AntSwitchingInterBandUL-CA-r16*  *SimulSRS-ForAntennaSwitching-r16* | *CA-ParametersNR-v1610* | **n/a** | **n/a** |  | Optional with capability signaling |
| 22-6 | Support of up to three different numerologies in the same NR PUCCH group for NR part of EN-DC, NGEN-DC, NE-DC and NR-CA where UE is not configured with two NR PUCCH groups | | Support of up to three different numerologies in the same NR PUCCH group for NR-CA where UE is not configured with two NR PUCCH groups  1) Which NR Carrier type(s) that can transmit NR PUCCH |  | *maxUpTo3Diff-NumerologiesConfigSinglePUCCH-grp-r16* | *CA-ParametersNR-v1640* | **n/a** | **n/a** | Candidate values  1) One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} that can be configured with the PUCCH transmission  Note: When the carrier type of NUL is indicated for PUCCH transmission location, the SUL in the same cell as in the NUL can also be configured for PUCCH transmission | Optional with capability signalling |
| 22-6a | Support of up to four different numerologies in the same NR PUCCH group for NR part of EN-DC, NGEN-DC, NE-DC and NR-CA where UE is not configured with two NR PUCCH groups | | Support of up to four different numerologies in the same NR PUCCH group for NR-CA where UE is not configured with two NR PUCCH groups  1) Which NR Carrier type(s) that can transmit NR PUCCH |  | *maxUpTo4Diff-NumerologiesConfigSinglePUCCH-grp-r16* | *CA-ParametersNR-v1640* | **n/a** | **n/a** | Candidate values  1) One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} that can be configured with the PUCCH transmission  Note: When the carrier type of NUL is indicated for PUCCH transmission location, the SUL in the same cell as in the NUL can also be configured for PUCCH transmission | Optional with capability signalling |
| 22-7 | Support two PUCCH groups for NR-CA with 3 or more bands with at least two carrier types from carrier types {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} | | For the BC, the UE reports one or multiple of supported configuration(s) of {primary PUCCH group config, secondary PUCCH group config} where for each supported configuration,  - the "primary PUCCH group config" includes following information:  - One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} mapped to the primary PUCCH group  - One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} that can be configured with the PUCCH transmission in the primary PUCCH group  - the "secondary PUCCH group config" includes following information:  - One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} mapped to the secondary PUCCH group  - One or multiple from {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} that can be configured with the PUCCH transmission in the secondary PUCCH group  - Note: for each {primary PUCCH group config, secondary PUCCH group config}, each carrier type of {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2} is mapped to either or both of the primary PUCCH group config and the secondary PUCCH group config. |  | *twoPUCCH-Grp-ConfigurationsList-r16* | *CA-ParametersNR-v1640* | **n/a** | **n/a** | Note: For a band combination with SUL, the SUL band is counted as one of the bands for the condition of FG22-7.  Note: For a band combination with SDL, the SDL band is counted as one of the bands for the condition of FG22-7  - SDL is indicated as 'FR1 licensed FDD' carrier type when FG22-7 is applied to SDL carrier  - Note: Per UE capabilities that are TDD only are not applicable to SDL  Note: When the carrier type of NUL is indicated for PUCCH transmission location, the SUL in the same cell as in the NUL can also be configured for PUCCH transmission  Note: When the carrier type of NUL is indicated for one PUCCH group config, the SUL in the same cell as in the NUL can also be configured for the PUCCH group  Note: If UE indicating this FG does not support FG 22-7a, the UE can only be configured with the same SCS across NR PUCCH groups. | Optional with capability signalling |
| 22-7a | Different numerology across NR PUCCH groups | | For UE supporting two PUCCH groups for CA with 3 or more bands with at least two carrier types from carrier types {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2}, different numerology between two NR PUCCH groups for data/control channel at a given time | 22-7 | *diffNumerologyAcrossPUCCH-Group-CarrierTypes-r16* | *CA-ParametersNR-v1640* | n/a | n/a |  | Optional with capability signaling |
| 22-7b | Different numerologies across NR carriers within the same NR PUCCH group, with PUCCH on a carrier of smaller SCS | | For UE supporting two PUCCH groups for CA with 3 or more bands with at least two carrier types from carrier types {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2}, different numerologies across NR carriers up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with smaller SCS for data/control channel at a given time | 22-7 | *diffNumerologyWithinPUCCH-GroupSmallerSCS-CarrierTypes-r16* | *CA-ParametersNR-v1640* | n/a | n/a | NR PUCCH is sent on a carrier with SCS not larger than SCS of any DL carriers corresponding to the NR PUCCH group. | Optional with capability signaling |
| 22-7c | Different numerologies across NR carriers within the same NR PUCCH group, with PUCCH on a carrier of larger SCS | | For UE supporting two PUCCH groups for CA with 3 or more bands with at least two carrier types from carrier types {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2}, different numerologies across NR carriers up to two different numerologies within the same NR PUCCH group wherein NR PUCCH is sent on the carrier with larger SCS for data/control channel at a given time | 22-7 | *diffNumerologyWithinPUCCH-GroupLargerSCS-CarrierTypes-r16* | *CA-ParametersNR-v1640* | n/a | n/a | NR PUCCH is sent on a carrier with SCS not smaller than SCS of any DL carriers corresponding to the NR PUCCH group. | Optional with capability signaling |
| 22-8 | For SRS for CB PUSCH and antenna switching on FR1 with symbol level offset for aperiodic SRS transmission | | For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | *offsetSRS-CB-PUSCH-Ant-Switch-fr1-r16* | *FeatureSetUplink-v1630* | n/a | n/a |  | Optional with capability signalling |
| 22-8a | PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot and constrained timeline for SRS for CB PUSCH and antenna switching on FR1 | | 1. For a given UE, all search space configurations are within the same span of 3 consecutive OFDM symbols in the slot  2. For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | *offsetSRS-CB-PUSCH-PDCCH-MonitorSingleOcc-fr1-r16* | *FeatureSetUplink-v1630* | n/a | n/a |  | Optional with capability signalling |
| 22-8b | For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 and constrained timeline for SRS for CB PUSCH and antenna switching on FR1 | | 1. For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2  2. For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | *offsetSRS-CB-PUSCH-PDCCH-MonitorAnyOccWithoutGap-fr1-r16* | *FeatureSetUplink-v1630* | n/a | n/a |  | Optional with capability signalling |
| 22-8c | For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 with a DCI gap and constrained timeline for SRS for CB PUSCH and antenna switching on FR1 | | 1. For type 1 CSS with dedicated RRC configuration, type 3 CSS and UE-SS, monitoring occasion can be any OFDM symbol(s) of a slot for Case 2, with minimum time separation (including the cross-slot boundary case) between two DL unicast DCIs, between two UL unicast DCIs, or between a DL and an UL unicast DCI in different monitoring occasions where at least one of them is not the monitoring occasions of FG-3-1, for a same UE as  - 2OFDM symbols for 15kHz  - 4OFDM symbols for 30kHz  - 7OFDM symbols for 60kHz with NCP  - 11OFDM symbols for 120kHz  2. Up to one unicast DL DCI and up to one unicast UL DCI in a monitoring occasion except for the monitoring occasions of FG 3-1.  3. In addition for TDD the minimum separation between the first two UL unicast DCIs within the first 3 OFDM symbols of a slot can be zero OFDM symbols.  4. For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | *offsetSRS-CB-PUSCH-PDCCH-MonitorAnyOccWithGap-fr1-r16* | *FeatureSetUplink-v1630* | n/a | n/a |  | Optional with capability signalling |
| 22-8d | All PDCCH monitoring occasion can be any OFDM symbol(s) of a slot for Case 2 with a span gap and constrained timeline for SRS for CB PUSCH and antenna switching on FR1 | | PDCCH monitoring occasions of FG-3-1, plus additional PDCCH monitoring occasion(s) can be any OFDM symbol(s) of a slot for Case 2, and for any two PDCCH monitoring occasions belonging to different spans, where at least one of them is not the monitoring occasions of FG-3-1, in same or different search spaces, there is a minimum time separation of X OFDM symbols (including the cross-slot boundary case) between the start of two spans, where each span is of length up to Y consecutive OFDM symbols of a slot. Spans do not overlap. Every span is contained in a single slot. The same span pattern repeats in every slot. The separation between consecutive spans within and across slots may be unequal but the same (X, Y) limit must be satisfied by all spans. Every monitoring occasion is fully contained in one span. In order to determine a suitable span pattern, first a bitmap b(l), 0<=l<=13 is generated, where b(l)=1 if symbol l of any slot is part of a monitoring occasion, b(l)=0 otherwise. The first span in the span pattern begins at the smallest l for which b(l)=1. The next span in the span pattern begins at the smallest l not included in the previous span(s) for which b(l)=1. The span duration is max{maximum value of all CORESET durations, minimum value of Y in the UE reported candidate value} except possibly the last span in a slot which can be of shorter duration. A particular PDCCH monitoring configuration meets the UE capability limitation if the span arrangement satisfies the gap separation for at least one (X, Y) in the UE reported candidate value set in every slot, including cross slot boundary.  For the set of monitoring occasions which are within the same span:  - Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for FDD  - Processing one unicast DCI scheduling DL and two unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD  - Processing two unicast DCI scheduling DL and one unicast DCI scheduling UL per scheduled CC across this set of monitoring occasions for TDD  The number of different start symbol indices of spans for all PDCCH monitoring occasions per slot, including PDCCH monitoring occasions of FG-3-1, is no more than floor(14/X) (X is minimum among values reported by UE).  The number of different start symbol indices of PDCCH monitoring occasions per slot including PDCCH monitoring occasions of FG-3-1, is no more than 7.  The number of different start symbol indices of PDCCH monitoring occasions per half-slot including PDCCH monitoring occasions of FG-3-1 is no more than 4 in SCell.  For SRS for CB PUSCH and antenna switching on FR1, UE requires minimum of 19 symbols offset between aperiodic SRS triggering and transmission | 2-53 | *offsetSRS-CB-PUSCH-PDCCH-MonitorAnyOccWithSpanGap-fr1-r16* | *FeatureSetUplink-v1630* | n/a | n/a | This capability is necessary for each SCS.  Candidate value set for (X, Y):  {(7, 3),  (4, 3) and (7, 3),  (2, 2) and (4, 3) and (7, 3)} | Optional with capability signalling |
| 22-9 | Cancellation of PUCCH, PUSCH or PRACH with a DCI scheduling a PDSCH or CSI-RS or a DCI format 2\_0 for SFI | | A UE supports the partial cancellation of the PUCCH or PUSCH or PRACH configured transmission:  1. The UE cancels the configured PUCCH or PUSCH or PRACH in a set of symbols of a slot due to detection of a DCI format 2\_0 with a slot format value other than 255 that indicates a slot format with a subset of symbols from the set of symbols as downlink or flexible.  2. The UE cancels the configured PUCCH or PUSCH or PRACH in a set of symbols of a slot due to a DCI format 2\_0 being configured but not detected, when either a subset of symbols from the set of symbols are indicated as flexible by *tdd-UL-DL-ConfigurationCommon*, and *tdd-UL-DL-ConfigurationDedicated* if provided, or *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated* are not provided to the UE.  3. The UE cancels the configured PUCCH or PUSCH or PRACH in a set of symbols of a slot due to the detection of a DCI format 1\_0, DCI format 1\_1, DCI format 1\_2 or DCI format 0\_1 and DCI format 0\_2 indicating to the UE to receive CSI-RS or PDSCH in a subset of symbols from the set of symbols. |  | *partialCancellationPUCCH-PUSCH-PRACH-TX-r16* | *FeatureSetUplink-v1630* | n/a | n/a |  | Optional with capability signalling |
|  | 22-10 | Support of pdcch-MonitoringAnyOccasionsWithSpanGap in case of cross-carrier scheduling with different SCSs in the scheduling cell and the scheduled cell | | Support of pdcch-MonitoringAnyOccasionsWithSpanGap in case of cross-carrier scheduling with different SCSs in the scheduling cell and the scheduled cell  - Candidate values: {Interpretation2, Interpretation3} | 3-5b, 18-5 | *pdcch-MonitoringAnyOccasionsWithSpanGapCrossCarrierSch-r16* | *Phy-ParametersCommon* | No | No | Candidate values: {Interpretation2, Interpretation3}  If UE indicates Interpretation2, it supports 22-10 as long as pdcch-MonitoringAnyOccasionsWithSpanGap is supported for the band of the scheduling/triggering/indicating cell.  If UE indicates Interpretation3, it supports 22-10 as long as pdcch-MonitoringAnyOccasionsWithSpanGap is supported in both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell.  For pdcch-MonitoringAnyOccasionsWithSpanGap, the supported set (set1, set2 or set 3) for cross-carrier scheduling with the different SCSs in the scheduling cell and the scheduled cell is still based on the indicated value for the band of the scheduling cell. | Optional with capability signalling |
|  | 22-11 | Support of 'cri-RI-CQI' report without non-PMI-PortIndication | | UE supports CSI-ReportConfig with the higher layer parameter reportQuantity set to 'cri-RI-CQI' and the higher layer parameter non-PMI-PortIndication is not configured | 2-35 | *cri-RI-CQI-WithoutNon-PMI-PortInd-r16* | *Phy-Parameters* | N/A | Yes |  | Optional with capability signalling |
|  | 22-12 | PDCCH monitoring with a single span of three contiguous OFDM symbols that is within the first four OFDM symbols in a slot | | Indicates whether the UE supports receiving PDCCH in a search space configured to be monitored within a single span of any three contiguous OFDM symbols that are within the first four OFDM symbols in a slot with the capability of supporting at least 44 blind decodes in a slot for 15 kHz subcarrier spacing. |  | *pdcch-MonitoringSingleSpanFirst4Sym-r16* | *Phy-ParametersFR1* | No | FR1 only |  | Optional with capability signalling |
| Further RRM enhancement for NR and MR-DC | 22-13 | CSI reporting cross PUCCH group | | 1) Support reporting CSI of an SCell belonging to secondary PUCCH group by PUSCH or PUCCH of active serving cells belonging to primary PUCCH group, for both during and after SCell activation procedure.  2) Support reporting CSI of an SCell belonging to primary PUCCH group by PUSCH or PUCCH of active serving cells belonging to secondary PUCCH group, for both during and after SCell activation procedure.  3) Support for P-CSI and A-CSI for cross-PUCCH group CSI reporting  - Indication for UE CSI computation time for A-CSI report = {same as no-cross-PUCCH-group, relaxed}  4) Additional indication for support/not of SP-CSI on PUCCH for cross-PUCCH group CSI reporting  5) Additional indication for support/not of SP-CSI on PUSCH for cross-PUCCH group CSI reporting  6) UE indicates one or multiple supported carrier type pairs(s), each carrier type pair is {carrier type in a PUCCH-group in which CSI measurement is performed, carrier type in the other PUCCH-group in which CSI report is performed}, where a carrier type is one of {FR1 licensed TDD, FR1 unlicensed TDD, FR1 licensed FDD, FR2}  NOTE: The UE capability is introduced from Rel-16. | FG 2-35 and either FG 6-7 or FG 22-7 | *csi-ReportingCrossPUCCH-Grp-r16 SEQUENCE*  *{*  *computationTimeForA-CSI-r16,*  *additionalSymbols-r16 SEQUENCE {*  *scs-15kHz-additionalSymbols-r16,*  *scs-30kHz-additionalSymbols-r16,*  *scs-60kHz-additionalSymbols-r16,*  *scs-120kHz-additionalSymbols-r16*  *}*  *sp-CSI-ReportingOnPUCCH-r16*  *sp-CSI-ReportingOnPUSCH-r16 carrierTypePairList-r16*  *}* | *CA-ParametersNR-v1690* | n/a | n/a | Note: RAN1 didn't discuss the potential conflicts with the definition of PUCCH group that was discussed in RAN2  Component 3: if "relaxed" is reported, then indicate additional number of symbols required in addition to existing Z and Z' for aperiodic CSI report for cross-PUCCH group CSI reporting, which is per SCS (the same SCS set definition as in S5.4 of TS 38.214) reported and has candidate values {val#1, val#2, val#3}.  Note: the candidate value {val#1, val#2, val#3} is with range from 14 to 56 symbols only, their exact values are FFS. | Optional with capability signalling |
|  | 22-14 | Multiplexing HARQ-ACK without PUCCH on PUSCH | | Multiplexing HARQ-ACK in a PUSCH in a PUCCH slot when the UE misses any HARQ-ACK to transmit in any PUCCH but receives UL grant(s) with UL-TDAI field to transmit multiple PUSCHs in the PUCCH slot |  | *mux-HARQ-ACK-withoutPUCCH-onPUSCH-r16* | *Phy-Parameters* | No | No |  | Optional with capability signalling |

## 5.2 Layer-2 and Layer-3 features

### 5.2.0 General

Tables 5.2.1-1 to 5.2.24-1 provide the list of Layer-2 and Layer-3 features, as shown in [7] and the corresponding UE capability field name, as specified in TS 38.331 [2].

### 5.2.1 NR\_IAB-Core

Table 5.2.1-1: Layer-2 and Layer-3 feature list for NR\_IAB-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 11. NR\_IAB-Core | 11-1 | Basic BAP procedures | 1) Routing  2) Bearer mapping  3) IP assignment over RRC |  | N/A | N/A | N/A | N/A |  | Mandatory without capability signalling for IAB MT |
| 11-2 | HbH flow control | 1) Indicates whether the IAB-MT supports flow control procedures and flow control feedback per backhaul RLC channel, as specified in TS 38.340 [11].  2) Indicates whether the IAB-MT supports flow control procedures and flow control feedback per Routing ID, as specified in TS 38.340 [11]. |  | 1) *flowControlBH-RLC-ChannelBased-r16*  2) *flowControlRouting-ID-Based-r16* | *BAP-Parameters-r16* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-3 | RLF handling | Indicates whether the IAB-MT supports BH RLF indication handling as specified in TS 38.331 [2] and in TS 38.340 [11]. |  | *bh-RLF-Indication-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-4 | QoS | Indicates whether the IAB-MT supports flow-based QoS and multiple flows to 1 DRB mapping, as specified in TS 37.324 [13]. |  | *sdap-QOS-IAB-r16* | *SDAP-Parameters* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-5 | HD format | Indicates whether the IAB-MT supports UL SDAP header and SDAP End-marker, as specified in TS 37.324 [13]. |  | *sdapHeaderIAB-r16* | *SDAP-Parameters* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-6 | DRB handling | 1) Indicates whether the IAB-MT supports DRB configuration including split DRB with one UL path, (de)ciphering on DRB and PDCP status reporting.  2) Indicates whether the IAB-MT supports SRB2 configuration without a DRB, as specified in TS 38.331 [2]. |  | *1) drb-IAB-r16*  *2) non-DRB-IAB-r16* | *PDCP-Parameters* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-7 | Scheduling | Indicates whether the IAB-MT supports Pre-emptive BSR as specified in TS 38.321 [10]. |  | *preEmptiveBSR-r16* | *MAC-ParametersCommon* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-8 | LCID extension | Indicates whether the IAB-MT supports extended Logical Channel ID space using two-octet eLCID, as specified in TS 38.321 [10]. |  | *lcid-ExtensionIAB-r16* | *MAC-ParametersCommon* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-9a | F1AP over LTE leg signaling for EN-DC IAB-MT | Indicates whether the IAB-MT supports F1-C signalling over *DLInformationTransfer* and *ULInformationTransfer* messages via MN when IAB-MT operates in EN-DC mode, as specified in TS 36.331 [12]. |  | *f1c-OverEUTRA-r16* | *GeneralParametersMRDC-v1610* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-9b | F1AP over LTE leg signaling for EN-DC IAB-MT | Indicates whether the IAB-MT supports SCG DRB with NR PDCP when IAB-MT operates in EN-DC mode. |  | *scg-DRB-NR-IAB-r16* | *PDCP-ParametersMRDC-v1610* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-9c | F1AP over LTE leg signaling for EN-DC IAB-MT | Indicates whether the IAB-MT supports NR measurement and reports while in EUTRA connected and event B1-based measurement and reports while in EUTRA connected. |  | *interNR-MeasEUTRA-IAB-r16* | *MeasAndMobParametersMRDC-v1610* | No | No |  | Optional with capability signalling for IAB-MT |
| 11-10 | Intra-frequency HO | Indicates whether the IAB-MT supports intra-frequency HO. It indicates the support for intra-frequency HO from the corresponding duplex mode if this capability is included in *fdd-Add-UE-NR-Capabilities* or *tdd-Add-UE-NR-Capabilities*. It indicates the support for intra-frequency HO in the corresponding frequency range if this capability is included in *fr1-Add-UE-NR-Capabilities* or *fr2-Add-UE-NR-Capabilities*. |  | *handoverIntraF-IAB-r16* | *BandNR* | N/A | N/A | IAB-MT shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Optional with capability signaling for IAB-MT |
| 11-11 | Multiple frequency band indication | Indicates whether the IAB-MT supports multiple frequency band indication. |  | *mfbi-IAB-r16* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signaling for IAB-MT |
| 11-12 | Direct SN addition | Indicates whether the IAB-MT supports direct SN addition in the first RRC connection reconfiguration after RRC connection establishment. |  | *directSN-AdditionFirstRRC-IAB-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signaling for IAB-MT |

### 5.2.2 NR\_unlic-Core

Table 5.2.2-1: Layer-2 and Layer-3 feature list for NR\_unlic-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 12. NR\_unlic-Core | 12-1 | UL LBT failure detection and recovery | Indicates whether the UE supports consistent uplink LBT failure detection and recovery, as specified in TS 38.321 [10], for cells operating with shared spectrum channel access. |  | *ul-LBT-FailureDetectionRecovery-r16* | *MAC-ParametersCommon* | No | No | This feature applies to all serving cells with which the UE is configured with shared spectrum channel access. | Optional with capability signaling |

### 5.2.3 5G\_V2X\_NRSL-Core

Table 5.2.3-1: Layer-2 and Layer-3 feature list for 5G\_V2X\_NRSL-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 13. 5G\_V2X\_NRSL-Core | 13-1 | Sidelink General Parameters | Indicates the access stratum release for NR sidelink communication the UE supports as specified in TS 38.331 |  | *accessStratumReleaseSidelink-r16* | *UECapabilityInformationSidelink-IEs-r16* | No | No |  | Mandatory with capability signalling |
| 13-2 | Sidelink PDCP parameters | Indicates whether UE supports out of order delivery of data to upper layers by PDCP for sidelink |  | *outOfOrderDeliverySidelink-r16* | *PDCP-ParametersSidelink-r16* | No | No |  | Optional with capability signaling |
| 13-3 | Sidelink RLC parameters – Support AM DRB with 18-bit length RLC SN | Indicates whether the UE supports AM DRB with 18-bit length of RLC sequence number for sidelink |  | *am-WithLongSN-Sidelink-r16* | *RLC-ParametersSidelink-r16* | No | No |  | Optional with capability signaling |
| 13-4 | Sidelink RLC parameters – Support UM DRB with 12-bit length RLC SN | Indicates whether the UE supports UM DRB with 12-bit length of RLC sequence number for sidelink |  | *um-WithLongSN-Sidelink-r16* | *RLC-ParametersSidelink-r16* | No | No |  | Optional with capability signaling |
| 13-5 | Sidelink MAC parameters - selection of logical channels for each SL grant based on RRC configured restriction | Indicates whether UE supports the selection of logical channels for each SL grant based on RRC configured restriction |  | *lcp-RestrictionSidelink-r16* | *MAC-ParametersSidelinkCommon-r16* | No | No |  | Optional with capability signaling |
| 13-6 | Sidelink MAC parameters – support of *logicalChannelSR-DelayTimer* | Indicates whether the UE supports the *logicalChannelSR-DelayTimer* as specified in TS 38.321 [10] for sidelink logical channel(s). |  | *logicalChannelSR-DelayTimerSidelink-r16* | *MAC-ParametersSidelinkXDD-Diff-r16* | Yes | No |  | Optional with capability signaling |
| 13-7 | Sidelink MAC parameters – 8 SR configurations per PUCCH cell group | Indicates whether the UE supports 8 SR configurations per PUCCH cell group as specified in TS 38.321 [10] for sidelink. |  | *multipleSR-ConfigurationsSidelink-r16* | *MAC-ParametersSidelinkXDD-Diff-r16* | Yes | No |  | Optional with capability signaling |
| 13-8 | Sidelink MAC parameters - 8 sidelink configured grant configurations | Indicates whether UE supports 8 sidelink configured grant configurations (including both Type 1 and Type 2) in a resource pool. |  | *multipleConfiguredGrantsSidelink-r16* | *MAC-ParametersSidelinkCommon-r16* | No | No | If absent, for each resource pool, the UE only supports one sidelink configured grant configuration. | Optional with capability signaling |

### 5.2.4 RACS-RAN-Core

Table 5.2.4-1: Layer-2 and Layer-3 feature list for RACS-RAN-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 14. RACS-RAN-Core | 14-1 | Segmentation for UE capability information | Support segmentation of *UECapabilityInformation* as specified in TS 38.331 [2]. |  |  |  | n/a | n/a |  | Optional without capability signalling |

### 5.2.5 NR\_IIOT-Core

Table 5.2.5-1: Layer-2 and Layer-3 feature list for NR\_IIOT-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 5. NR\_IIOT-Core | 15-1 | Reference time provisioning | Indicates whether the UE supports provision of referenceTimeInfo in *DLInformationTransfer* message and in SIB9 and reference time information preference indication via assistance information, as specified in TS 38.331 [2]. |  | *referenceTimeProvision-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signalling |
| 15-2 | LCP restriction enhancements | 1) Indicates whether the UE supports restricting data transmission from a given LCH to a configured (sub-) set of configured grant configurations (see *allowedCG-List-r16* in *LogicalChannelConfig* in TS 38.331 [2]) as specified in TS 38.321 [10].  2) Indicates whether the UE supports restricting data transmission from a given LCH to a configured (sub-) set of dynamic grant priority levels (see *allowedPHY-PriorityIndex-r16* in *LogicalChannelConfig* in TS 38.331 [2]) as specified in TS 38.321 [10]. |  | 1) *lch-ToConfiguredGrantMapping-r16*  2) *lch-ToGrantPriorityRestriction-r16* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 15-3 | Extended periodicities for CG | Indicates that the UE supports extended periodicities for CG Type 1 (if the UE indicates *configuredUL-GrantType1* capability) or CG Type 2 (if the UE indicates *configuredUL-GrantType2* capability) as specified by *periodicityExt-r16* field of IE *ConfiguredGrantConfig* in TS 38.331 [2]. |  | *extendedCG-Periodicities-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 15-4 | Extended periodicities for SPS | Indicates that the UE supports extended periodicities for downlink SPS as specified by *periodicityExt-r16* field of IE *SPS-Config* in TS 38.331 [2]. |  | *extendedSPS-Periodicities-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 15-5 | Ethernet header compression | 1) Indicates that the UE supports Ethernet header compression and decompression using EHC protocol, as specified in TS 38.323 [15].  2) Indicates that the UE supports EHC context continuation operation where the UE keeps the established EHC context(s) upon PDCP re-establishment, as specified in TS 38.323 [15].  3) Indicates whether the UE supports simultaneous configuration of EHC and ROHC protocols for the same DRB.  4) Defines the maximum number of Ethernet header compression contexts supported by the UE across all DRBs and across UE's EHC compressor and EHC decompressor. The indicated number defines the number of contexts in addition to CID = "all zeros" as specified in TS 38.323 [15]. |  | 1) *ehc-r16*  2) *continueEHC-Context-r16*  3) *jointEHC-ROHC-Config-r16*  4) *maxNumberEHC-Contexts-r16* | *PDCP-Parameters* | No | No | 1) The UE indicating this capability and indicating support for at least one ROHC profile, shall support simultaneous configuration of EHC and ROHC on different DRBs. | Optional with capability signalling |
| 15-6 | Intra-UE prioritization | 1) Indicates whether the UE supports prioritization between overlapping grants and between scheduling request and overlapping grants based on LCH priority as specified in TS 38.321 [10].  2) Indicates whether the UE supports autonomous transmission of the MAC PDU generated for a deprioritized configured uplink grant as specified in TS 38.321 [10]. | 2) *lch-priorityBasedPrioritization-r16* | 1) *lch-PriorityBasedPrioritization-r16*  2) *autonomousTransmission-r16* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 15-7 | PDCP duplication | Defines whether the UE supports PDCP duplication with more than two RLC entities as specified in TS 38.323 [15]. | *pdcp-DuplicationMCG-OrSCG-DRB*, *pdcp-DuplicationSplitDRB*, *pdcp-DuplicationSplitSRB* and *pdcp-DuplicationSRB*. | *pdcp-DuplicationMoreThanTwoRLC-r16* | *PDCP-Parameters* | No | No | The UE supporting this feature supports secondary RLC entity(ies) activation and deactivation based on duplication RLC Activation/Deactivation MAC CE as specified in TS 38.321 [10]. | Optional with capability signalling |

### 5.2.6 NR\_pos-Core

Table 5.2.6-1: Layer-2 and Layer-3 feature list for NR\_pos-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 37.355 [9] | Parent IE in TS 37.355 [9] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 16. NR\_pos-Core | 16-1 | Additional paths reporting | Indicates whether the UE supports additional paths reporting for Multi-RTT or DL-TDOA |  | *additionalPathsReport-r16* | *NR-Multi-RTT-ProvideCapabilities-r16 or*  *NR-DL-TDOA-ProvideCapabilities-r16*  *LPP* | N/A | N/A |  | Optional with capability signalling |
| 16-2 | Periodical Reporting | Indicates whether the UE supports periodical Reporting for NR ECID, DL-AoD, Multi-RTT or DL-TDOA |  | *periodicalReporting-r16* | *NR-Multi-RTT-ProvideCapabilities-r16 or*  *NR-DL-TDOA-ProvideCapabilities-r16 or*  *NR-ECID-ProvideCapabilities-r16 or*  *NR-DL-AoD-ProvideCapabilities-r16*  *LPP* | N/A | N/A |  | Optional with capability signalling |
| 16-3 | Triggered Reporting | Indicates whether the UE supports triggered Reporting for NR ECID |  | *triggeredReporting-r16* | *NR-ECID-ProvideCapabilities-r16*  *LPP* | N/A | N/A |  | Optional with capability signalling |
| 16-4 | Positioning Modes for DL-TDOA | Indicates what positoining mode the UE supports for DL-TDOA. The positioning mode incldues standalone, ue-based, and ue-assisted |  | *nr-DL-TDOA-Mode-r16* | *NR-DL-TDOA-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling |
| 16-5 | Positioning Modes for DL-AoD | Indicates what positoining mode the UE supports for DL-TDOA. The positioning mode incldues standalone, ue-based, and ue-assisted |  | *nr-DL-AoD-Mode-r16* | *NR-DL-AOD-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling |
| 16-6 | SSR URS | Indicates whether the UE support SSR URS |  | *gnss-SSR-URA-Support-r16* | *A-GNSS-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling |
| 16-7 | SSR Phase Bias | Indicates whether the UE support SSR Phase Bias |  | *gnss-SSR-PhaseBiasSupport-r16* | *A-GNSS-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling |
|  | 16-8 | SSR STEC Correction | Indicates whether the UE support SSR STEC Correction |  | *gnss-SSR-STEC-CorrectionSupport-r16* | *A-GNSS-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling |
|  | 16-9 | SSR Gridded Correction | Indicates whether the UE support SSR Gridded Correction |  | *gnss-SSR-GriddedCorrectionSupport-r16* | *A-GNSS-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling |

### 5.2.7 NR\_Mob\_enh-Core

Table 5.2.7-1: Layer-2 and Layer-3 feature list for NR\_Mob\_enh-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 17. NR\_Mob\_enh-Core | 17-1 | CHO | Indicates whether the UE supports conditional handover between FDD and TDD cells. | The parameter can only be set if *condHandover-r16* is set for at least one FDD band and one TDD band. | *condHandoverFDD-TDD-r16* | *condHandoverParametersCommon-r16* | No | No |  | Optional with capability signalling |
| 17-2 | CHO | Indicates whether the UE supports conditional handover HO between FR1 and FR2. | The parameter can only be set if *condHandover-r16* is set for at least one FR1 band and one FR2 band. | *condHandoverFR1-FR2-r16* | *condHandoverParametersCommon-r16* | No | No |  | Optional with capability signalling |
| 17-3 | CHO | Indicates whether the UE supports conditional handover including execution condition, candidate cell configuration and maximum 8 candidate cells. |  | *condHandover-r16* | *BandNR* | N/A | N/A | UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Optional with capability signalling |
| 17-4 | CHO | Indicates whether the UE supports conditional handover during re-establishment procedure when the selected cell is configured as candidate cell for condition handover. |  | *condHandoverFailure-r16* | *BandNR* | N/A | N/A | UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Optional with capability signalling |
| 17-5 | CHO | Indicates whether the UE supports 2 trigger events for same execution condition. | 17-3 | *condHandoverTwoTriggerEvents-r16* | *BandNR* | N/A | N/A | UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Conditional mandatory with capability signalling |
| 17-6 | CPC | Indicates whether the UE supports conditional PSCell change between FDD and TDD cells. | The parameter can only be set if *condPSCellChange-r16* is set for at least one FDD band and one TDD band. | *condPSCellChangeFDD-TDD-r16* | *condPSCellChangeParametersCommon-r16* | No | No |  | Optional with capability signalling |
| 17-7 | CPC | Indicates whether the UE supports conditional PSCell change between FR1 and FR2. | The parameter can only be set if *condPSCellChange-r16* is set for at least one FR1 band and one FR2 band. | *condPSCellChangeFR1-FR2-r16* | *condPSCellChangeParametersCommon-r16* | No | No |  | Optional with capability signalling |
| 17-8 | CPC | Indicates whether the UE supports conditional PSCell change including execution condition, candidate cell configuration and maximum 8 candidate cells. |  | *condPSCellChange-r16* | *BandNR* | N/A | N/A | UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Optional with capability signalling |
| 17-9 | CPC | Indicates whether the UE supports 2 trigger events for same execution condition. | 17-8 | *condPSCellChangeTwoTriggerEvents-r16* | *BandNR* | N/A | N/A | UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Conditional mandatory with capability signalling |
| 17-10 | T312 for PCell | Indicates whether the UE supports T312 based fast failure recovery for PCell. |  | *pcellT312-r16* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 17-11 | T312 for PSCell | Indicates whether the UE supports T312 based fast failure recovery for PSCell. |  | *pscellT312-r16* | *MeasAndMobParametersMRDC-Common-v1610* | No | No |  | Optional with capability signalling |

### 5.2.8 LTE\_NR\_DC\_CA\_enh-Core

Table 5.2.8-1: Layer-2 and Layer-3 feature list for LTE\_NR\_DC\_CA\_enh-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 18. LTE\_NR\_DC\_CA\_enh-Core | 18-1 | Recovery from MCG RLF vis split SRB1 or SRB3 | Indicates whether the UE supports recovery from MCG RLF via split SRB1 (if supported) and via SRB3 (if supported) as specified in TS 38.331[2]. |  | *mcgRLF-RecoveryViaSCG-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signalling |
| 18-2 | Resume with stored MCG SCell configuration | Indicates whether the UE supports not deleting the stored MCG SCell configuration when initiating the resume procedure. |  | *resumeWithStoredMCG-SCells-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signalling |
| 18-3 | Support of (re-)configuration of an SCG during resume | Indicates whether the UE supports (re-)configuration of an SCG during the resume procedure. |  | *resumeWithSCG-Config-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signalling |
| 18-4 | Resume with stored SCG configuration | Indicates whether the UE supports not deleting the stored SCG configuration when initiating resume. | 18-3 | *resumeWithStoredSCG-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signalling |
| 18-5 | Direct NR MCG SCell activation | 1) Indicates whether the UE supports direct NR MCG SCell activation, as specified in TS 38.321 [10], upon SCell addition, upon reconfiguration with sync of the MCG, as specified in TS 38.331 [2].  2) Indicates whether the UE supports direct NR MCG SCell activation, as specified in TS 38.321 [10], upon reception of an *RRCResume* message, as specified in TS 38.331 [2]. |  | 1) *directMCG-SCellActivation-r16*  2) *directMCG-SCellActivationResume-r16* | *MAC-ParametersFRX-Diff-r16* | No | Yes |  | Optional with capability signalling |
| 18-6 | Direct NR SCG SCell activation | 1) Indicates whether the UE supports direct NR SCG SCell activation, as specified in TS 38.321 [10], upon SCell addition and upon reconfiguration with sync of the SCG, both performed via an *RRCReconfiguration* message received via SRB3 or contained in an *RRC(Connection)Reconfiguration* message received via SRB1, as specified in TS 38.331 [2] and TS 36.331 [12].  2) Indicates whether the UE supports direct NR SCG SCell activation, as specified in TS 38.321 [10]:  - upon reception of an *RRCReconfiguration* included in an *RRCConnectionResume* message, as specified in TS 38.331 [2] and TS 36.331 [12], if the UE indicates support of *en-dc* and of *resumeWithSCG-Config-r16* as specified in TS 36.331 [12],  - upon reception of an *RRCReconfiguration* included in an *RRCResume* message, as specified in TS 38.331 [2], if the UE indicates support of *nr-dc* and of *resumeWithSCG-Config-r16* as specified in TS 38.331 [2]. | 1) Support of EN-DC or NGEN-DC as specified in TS 36.331 [12], or Support of *nr-dc* as specified in TS 38.331 [2].  2) Support of EN-DC or NGEN-DC, and *resumeWithSCG-Config-r16* as specified in TS 36.331 [12], or Support of *nr-dc* and *18-3* | 1) *directSCG-SCellActivation-r16*  2) *directSCG-SCellActivationResume-r16* | *MAC-ParametersFRX-Diff-r16* | No | Yes |  | Optional with capability signalling |
| 18-7 | RRM during IDLE/INACTIVE – Support of NR SSB measurement and reporting upon network request | 1) Indicates whether the UE supports configuration of NR SSB measurements in RRC\_IDLE/RRC\_INACTIVE and reporting of the corresponding results upon network request as specified in TS 38.331 [2]. |  | *idleInactiveNR-MeasReport-r16* | *MeasAndMobParametersFRX-Diff* | No | Yes | 1) If this parameter is indicated for FR1 and FR2 differently, each indication corresponds to the frequency range of measured target cell. | Optional with capability signalling |
| 18-8 | RRM during IDLE/INACTIVE – Support of NR measurements and reporting upon network request | Indicates whether the UE supports configuration of a validity area for NR measurements in RRC\_IDLE/RRC\_INACTIVE as specified in TS 38.331 [2]. |  | *idleInactive-ValidityArea-r16* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 18-9 | RRM during IDLE/INACTIVE – Support of E-UTRA measurements and reporting upon network request | Indicates whether the UE supports configuration of E-UTRA measurements in RRC\_IDLE/RRC\_INACTIVE and reporting of the corresponding results upon network request as specified in TS 38.331 [2]. |  | *idleInactiveEUTRA-MeasReport-r16* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 18-10 | Async NR-DC UE capability | Indicates whether the UE supports asynchronous NR-DC with MRTD and MTTD as specified in clause 7.5 and 7.6 of TS 38.133. If the band combination is comprised of a single band entry for more than two carriers, the UE shall support any permutations of carriers to CGs. If the band combination is comprised of at least two band entries, the carriers corresponding to a band entry shall belong to only one cell group. |  | *asyncNRDC-r16* | *CA-ParametersNRDC-v1610* | No | No | A UE indicating this capability shall support asynchronous NR-DC configuration where all serving cells of the MCG are in FR1 and all serving cells of the SCG are in FR2. | FFS |

### 5.2.9 NR\_UE\_pow\_sav-Core

Table 5.2.9-1: Layer-2 and Layer-3 feature list for NR\_UE\_pow\_sav-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 19. NR\_UE\_pow\_sav-Core | 19-1 | UE assistance information for power saving – DRX preference | Indicates whether the UE supports providing its preference of a cell group on DRX parameters for power saving in RRC\_CONNECTED, as specified in TS 38.331 [2]. |  | *drx-Preference-r16* | *PowSav-ParametersCommon-r16* | No | No |  | Optional with capability signalling |
| 19-2 | UE assistance information for power saving – Maximum aggregated bandwidth preference | Indicates whether the UE supports providing its preference of a cell group on the maximum aggregated bandwidth for power saving in RRC\_CONNECTED, as specified in TS 38.331 [2]. |  | *maxBW-Preference-r16* | *PowSav-ParametersFRX-Diff-r16* | No | Yes |  | Optional with capability signalling |
| 19-3 | UE assistance information for power saving – Maximum number of secondary component carrier preference | Indicates whether the UE supports providing its preference of a cell group on the maximum number of secondary component carriers for power saving in RRC\_CONNECTED, as specified in TS 38.331 [2]. |  | *maxCC-Preference-r16* | *PowSav-ParametersCommon-r16* | No | No |  | Optional with capability signalling |
| 19-4 | UE assistance information for power saving – Maximum number of MIMO layers preference | Indicates whether the UE supports providing its preference of a cell group on the maximum number of MIMO layers for power saving in RRC\_CONNECTED, as specified in TS 38.331 [2]. |  | *maxMIMO-LayerPreference-r16* | *PowSav-ParametersFRX-Diff-r16* | No | Yes |  | Optional with capability signalling |
| 19-5 | UE assistance information for power saving – preference to transition out of RRC\_CONNECTED | Indicates whether the UE supports providing its preference assistance information to transition out of RRC\_CONNECTED for power saving, as specified in TS 38.331 [2]. |  | *releasePreference-r16* | *PowSav-ParametersCommon-r16* | No | No |  | Optional with capability signalling |
| 19-6 | Relaxed measurement | It is optional for UE to support relaxed RRM measurements of neighbour cells in RRC\_IDLE/RRC\_INACTIVE as specified in TS 38.304. |  | *N/A* | *N/A* | N/A | N/A |  | Optional without UE capability signalling |

### 5.2.20 NR\_SON\_MDT-Core

Table 5.2.20-1: Layer-2 and Layer-3 feature list for NR\_SON\_MDT-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 20. NR\_SON\_MDT-Core | 20-1 | RACH reporting | Indicates whether the UE supports delivery of *rachReport* upon request from the network. |  | *rach-Report-r16* | *SON-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-2 | Measurement reporting – barometer measurement upon network request | Indicates whether UE supports uncompensated barometeric pressure measurement reporting upon request from the network. |  | *barometerMeasReport-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-3 | Immediate Measurement reporting – Bluetooth measurement | Indicates whether the UE supports Bluetooth measurements in RRC\_CONNECTED state. |  | *immMeasBT-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-4 | Immediate Measurement – WLAN measurement | Indicates whether the UE supports WLAN measurements in RRC\_CONNECTED state. |  | *immMeasWLAN-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-5 | Logged Measurement – Bluetooth measurement | Indicates whether the UE supports Bluetooth measurements in RRC\_IDLE and RRC\_INACTIVE state. |  | *loggedMeasBT-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-6 | Logged Measurement – UE support | Indicates whether the UE supports logged measurements in RRC\_IDLE and RRC\_INACTIVE. A UE that supports logged measurements shall support both periodical logging and event-triggered logging. The memory size of MDT logged measurements is 64KB. |  | *loggedMeasurements-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-7 | Logged Measurement – WLAN measurement | Indicates whether the UE supports WLAN measurements in RRC\_IDLE and RRC\_INACTIVE state. |  | *loggedMeasWLAN-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-8 | Measurement reporting – Orientation measurement upon network request | Indicates whether the UE supports orientation information reporting upon request from the network. |  | *orientationMeasReport-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-9 | Measurement reporting – Speed information upon network request | Indicates whether the UE supports speed information reporting upon request from the network. |  | *speedMeasReport-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-10 | Support of GNSS or A-GNSS to provide location information with SON and MDT related measurement | Indicates whether the UE is equipped with a GNSS or A-GNSS receiver that may be used to provide detailed location information along with SON or MDT related measurements in RRC\_CONNECTED, RRC\_IDLE and RRC\_INACTIVE. |  | *gnss-Location-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-11 | Support of UL PDCP Packet Average Delay measurement | Indicates whether the UE supports UL PDCP Packet Average Delay measurement (as specified in TS 38.314) and reporting in RRC\_CONNECTED state. |  | *ulPDCP-Delay-r16* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 20-12 | Mobility history information storage | It is optional for UE to support the storage of mobility history information and the reporting in *UEInformationResponse* message as specified in TS 38.331 [2]. |  | *N/A* | *N/A* | N/A | N/A |  | Optional without capability signalling |
| 20-13 | Cross RAT RLF Report | It is optional for UE to support the delivery of EUTRA RLF report to an NR node upon request from the network. |  | *N/A* | *N/A* | N/A | N/A |  | Optional without capability signalling |
| 20-14 | Radio Link Failure Report for inter-RAT MRO EUTRA | It is optional for UE to support:  - Include EUTRA CGI and associated TAC, if available, and otherwise to include the physical cell identity and carrier frequency of the target PCell of the failed handover as *failedPCellId* in *RLF-Report* upon request from the network as specified in TS 38.331 [2].  - Include EUTRA CGI and associated TAC as *previousPCellId* in *RLF-Report* as specified in TS 38.331 [2].  - Include *eutraReconnectCellId* in *reconnectCellId* in the *RLF-Report* as specified in TS 38.331 [2] upon UE has radio link failure or handover failure and successfully re-connected to an E-UTRA cell. |  | *N/A* | *N/A* | N/A | N/A |  | Optional without capability signalling |
| 20-15 | Connection Establishment Failure Reporting | It is mandatory for UE to support Connection Establishment Failure Reporting. |  | N/A | N/A | N/A | N/A |  | Mandatory without capability signalling |
| 20-16 | Radio Link Failure Reporting | It is mandatory for UE to support Radio Link Failure Reporting. |  | N/A | N/A | N/A | N/A |  | Mandatory without capability signalling |
| 20-17 | Location reporting | If location information is available, it is mandatory for UE to include location information for SON and MDT related reporting. |  | N/A | N/A | N/A | N/A |  | Mandatory without capability signalling |

### 5.2.21 NR\_L1enh\_URLLC-Core

Table 5.2.21-1: Layer-2 and Layer-3 feature list for NR\_L1enh\_URLLC-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 21. NR\_L1enh\_URLLC-Core | 21-1 | New values for PDCP discard timer | Indicates whether the UE supports the additional values of PDCP discard timer. The supported additional values are 0.5ms, 1ms, 2ms, 4ms, 6ms and 8ms, as specified in TS 38.331 [2]. |  | *extendedDiscardTimer-r16* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 21-2 | New values for RLC *T-PollRetransmit* timer | Indicates whether the UE supports the additional values of *T-PollRetransmit* timer. The supported additional values are 1ms, 2ms, 3ms and 4ms, as specified in TS 38.331 [2]. |  | *extendedT-PollRetransmit-r16* | *RLC-Parameters* | No | No |  | Optional with capability signalling |
| 21-3 | New values for RLC *T-StatusProhibit* timer | Indicates whether the UE supports the additional values of *T-StatusProhibit* timer. The supported additional values are 1ms, 2ms, 3ms and 4ms, as specified in TS 38.331 [2]. |  | *extendedT-StatusProhibit-r16* | *RLC-Parameters* | No | No |  | Optional with capability signalling |

### 5.2.22 SRVCC\_NR\_to\_UMTS-Core

Table 5.2.22-1: Layer-2 and Layer-3 feature list for SRVCC\_NR\_to\_UMTS-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 22. SRVCC\_NR\_to\_UMTS-Core | 22-1 | SRVCC to UMTS | 1) Indicates whether the UE supports NR to UTRA-FDD CELL\_DCH CS handover. It is mandatory to support both UTRA-FDD measurement and event B triggered reporting, and periodic UTRA-FDD measurement and reporting if the UE supports HO to UTRA-FDD. If this field is included, then UE shall support IMS voice over NR. |  | *handoverUTRA-FDD-r16* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 22-2 | SupportedBandList UTRA-FDD | Radio frequency bands defined in 4.5.7, TS 25.306 |  | *supportedBandListUTRA-FDD-r16* | *UTRA-FDD-Parameters-r16* | No | N/A |  | Optional with capability signalling |

### 5.2.23 NG\_RAN\_PRN-Core

Table 5.2.23-1: Layer-2 and Layer-3 feature list for NG\_RAN\_PRN-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 23. NG\_RAN\_PRN-Core | 23-1 | CGI acquisition of NPN relevant CGI-information | Defines whether the UE supports acquisition of NPN-relevant CGI-information from a neighbouring intra-frequency or inter-frequency NR NPN cell by reading the SI of the neighbouring cell and reporting the acquired information to the network as specified in TS 38.331 [2]. |  | *nr-CGI-Reporting-NPN-r16* | *MeasAndMobParametersCommon* | No | No |  | Conditional mandatory with capability signalling  If UE supports NPN, UE shall support this feature. |

### 5.2.24 TEI16 and Others

Table 5.2.24-1: Layer-2 and Layer-3 feature list for TEI16 and Others

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 24. TEI16/Others | 24-1 | Secondary DRX group | Indicates whether UE supports secondary DRX group as specified in TS 38.321 [10]. |  | *secondaryDRX-Group-r16* | *MAC-ParametersXDD-Diff* | Yes | No |  | Optional with capability signalling |
| 24-2 | Increase number of CSI-RS resource | Indicates support of up to 192 CSI-RS resource for L3 mobility configuration per measurement object configured with *associatedSSB*. |  | *increasedNumberofCSIRSPerMO-r16* | *MeasAndMobParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 24-3 | Support of SMTC configuration of target SCG for PSCell addition and change | Indicates the support of configuration of SMTC of target SCG cell with field *targetCellSMTC-SCG*. |  | *targetSMTC-SCG-r16* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 24-4 | Support of on demand request procedure in RRC CONNECTED | Indicates whether the UE supports the on-demand request procedure of SIB(s) or posSIB(s) while in RRC\_CONNECTED, as specified in TS 38.331 [2]. |  | *onDemandSIB-Connected-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signalling |
| 24-5 | P bit in single entry PHR MAC CE | Indicates whether UE supports the P bit in single PHR MAC CE as specified in TS 38.321 [10]. |  | *singlePHR-P-r16* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 24-6 | UE support of dynamic reporting of measurement gap requirement | Indicates whether the UE supports reporting the measurement gap requirement information for NR target in the UE response to a network configuration RRC message. |  | *nr-NeedForGap-Reporting-r16* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 24-7 | IDC | Indicates whether the UE supports IDC (In-Device Coexistence) assistance information as specified in TS 38.331 [2]. |  | *inDeviceCoexInd-r16* | *UE-NR-Capability-v1610* | No | No |  | Optional with capability signalling |
|  | 24-8 | Segmentation of DL RRC messages | Indicates whether the UE supports reception of segmented DL RRC messages. |  | dl-DedicatedMessageSegmentation-r16 | UE-NR-Capability-v1610 | No | No |  | Optional with capability signalling |
|  | 24-9 | Voice fallback to LTE EPC | Indicates whether the UE supports *voiceFallbackIndication* in *RRCRelease* and *MobilityFromNRCommand*. If this field is included, the UE shall support IMS voice over NR and IMS voice over E-UTRA via EPC. | *voiceOverNR* ***(0-5)*** | *voiceFallbackIndicationEPS-r16* | *IMS-ParametersCommon* | No | No |  | Optional with capability signalling |
|  | 24-10 | HO from NR to EN-DC | Indicates whether the UE supports inter-RAT handover from NR to EN-DC while NR-DC or NE-DC is not configured as defined in TS 36.306 [14]. It is mandated for UE support EN-DC. |  | *nr-HO-ToEN-DC-r16* | *EUTRA-ParametersCommon* | No | n/a |  | Conditional Mandatory with capability signalling for UE supporting EN-DC. |
|  | 24-11 | Periodic reporting of best neighouring cells | Defines whether the UE supports periodic reporting of best neighbour cells per serving frequency, as defined in TS 38.331 [2]. |  | *reportAddNeighMeasForPeriodic-r16* | *MeasAndMobParametersCommon* | No | No |  | Mandatory with capability signalling |
|  | 24-12 | Releasing SUL configuration | Release of the uplink configuration configured by *supplementaryUplink*. |  |  |  | n/a | N/A |  | Mandatory without capability signalling |
|  | 24-13 | Bit rate multiplier for recommended bit rate MAC CE | Indicates whether the UE supports the bit rate multiplier for recommended bit rate MAC CE as specified in TS 38.321 [10], clause 6.1.3.20. | *R2 3-7* | *recommendedBitRateMultiplier-r16* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
|  | 24-14 | Introduction of a second SMTC per frequency carrier in idle/inactive (smtc2-LP-r16 in SIB2/SIB4) | Introduction of a second SMTC (*smtc2-LP-r16*) per frequency carrier in idle/inactive in SIB2/SIB4 |  |  |  | n/a | n/a |  | Mandatory without capability signalling |
|  | 24-15 | Random access prioritization for MPS and MCS | It is optional for UE that is configured for MPS or MCS to support random access prioritization for Access Identity 1 or 2 as specified in TS 38.321 [10]. |  |  |  | n/a | n/a |  | Optional without capability signalling |
|  | 24-16 | skipUplinkTxCg-r16 | Indicates whether the UE supports skipping UL transmission for a configured uplink grant indicated on PDCCH only if no data is available for transmission and no UCI is multiplexed on the corresponding PUSCH of the uplink grant as specified in TS 38.321 [10]. |  | *enhancedSkipUplinkTxConfigured-r16* | *MAC-CellGroupConfig*  *MAC-ParametersXDD-Diff* | Yes | No |  | FFS if Mandatory with capability signalling |
|  | 24-17 | skipUplinkTxDynamic-r16 | Indicates whether the UE supports skipping UL transmission for a dynamic uplink grant indicated on PDCCH only if no data is available for transmission and no UCI is multiplexed on the corresponding PUSCH of the uplink grant as specified in TS 38.321 [10]. |  | *enhancedSkipUplinkTxDynamic-r16* | *MAC-CellGroupConfig*  *MAC-ParametersXDD-Diff* | Yes | No |  | FFS if Mandatory with capability signalling |
|  | 24-18 | eCall over IMS | It is optional for UE to support eCall over IMS as specified in TS 38.331 [2] |  |  |  | n/a | n/a |  | Optional without capability signalling |
|  | 24-19 | Access Category 1 selection assistance information enhancement | It is optional for UE that is configured for delay tolerant service to support Access Category 1 selection assistance information enhancement, according to *uac-AC1-SelectAssistInfo-r16* as specified in TS 38.331 [2]. |  |  |  | n/a | n/a |  | Optional without capability signalling |
|  | 24-20 | redirectAtResumeByNAS-r16 | Indicates whether the UE supports reception of redirectedCarrierInfo in an RRCRelease message in response to an RRCResumeRequest or RRCResumeRequest1 which is triggered by the NAS layer, as specified in TS 38.331 [2]. |  | *redirectAtResumeByNAS-r16* | *UE-NR-Capability-v1640* | No | No |  | Optional with capability signalling |
|  | 24-21 | MAC subheaders with one-octet eLCID field | It is mandatory to support MAC subheaders with one-octet eLCID field for UEs /IAB-MTs supporting MAC CEs using extended LCID values as specified in TS 38.321 [10]. |  |  |  | n/a | n/a |  | Conditional mandatory without capability signalling |
|  | 24-22 | Uplink RRC Segmentation | Indicates the UE supports uplink RRC segmentation of *UECapabilityInformation* as specified in TS 38.331 [2]. In this version of the specification, the absence of this parameter does not indicate the UE does not support uplink RRC segmentation of *UECapabilityInformation*. |  | *ul-RRC-Segmentation-r16* | *General Parameters* | n/a | n/a |  | Optional with capability signalling |

## 5.3 RF and RRM Features

### 5.3.0 General

Tables 5.3.1-1 to 5.3.13-1 provide the list of RF and RRM features, as shown in [8], and the corresponding UE capability field name, as specified in TS 38.331 [2].

### 5.3.1 NR-based access to unlicensed spectrum

Table 5.3.1-1: RF and RRM Feature List for NR-based access to unlicensed spectrum

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 4. NR-based access to unlicensed spectrum | 4-1 | DL reception in intra-carrier guardband | Capability of reception in the non-zero intra-cell guardband between contiguous RB sets in DL wideband carrier operation wider than 20MHz when LBT is successful only in a subset of RB sets | 4-2 | *dl-ReceptionIntraCellGuardband-r16* | *SharedSpectrumChAccessParamsPerBand-v1630* | No | No |  | Optional with capability signalling |
| 4-2 | DL reception when gNB does not transmit on all RB sets of a carrier as a result of LBT | Capability of reception in a wideband carrier when LBT is successful in a subset of the configured RB sets, which are either contiguous or non-contiguous, of ~~[~~the carrier~~]~~. |  | *dl-ReceptionLBT-subsetRB-r16* | *SharedSpectrumChAccessParamsPerBand-v1630* | No | No | There is no restriction for gNB to schedule in mode 2 or mode 3 | Optional with capability signalling |

### 5.3.2 NR mobility enhancement

Table 5.3.2-1: RF and RRM Feature List for NR mobility enhancement

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 5. Mobility Enhancement | 5-1 | Synchronous DAPS handover for intra-frequency case | Support of synchronous DAPS handover for intra-frequency case |  | *implied by intraFreqDAPS-r16 and intraFreqDAPS-UL-r16* | *FeatureSetDownlink-v1610*  *FeatureSetUplink-v1610* | No | No |  | Optional with capability signalling |
| 5-2 | Asynchronous DAPS handover for intra-frequency case | Support of asynchronous DAPS handover for intra-frequency case |  | *intraFreqAsyncDAPS-r16* | *FeatureSetDownlink-v1610->*  *intraFreqDAPS-r16* | No | No |  | Optional with capability signalling |
| 5-3 | Synchronous DAPS handover for inter-frequency case | Support of synchronous DAPS handover for inter-frequency case |  | *implied by*  *interFreqDAPS-r16* | *CA-ParametersNR-v1610* | No | No |  | Optional with capability signalling |
| 5-4 | Asynchronous DAPS handover for inter-frequency case | Support of asynchronous DAPS handover for inter-frequency case |  | *interFreqAsyncDAPS-r16* | *CA-ParametersNR-v1610->*  *interFreqDAPS-r16* | No | No |  | Optional with capability signalling |
| 5-5 | Simultaneous UL transmission for DAPS handover for intra-frequency | Support of simultaneous UL transmission for DAPS handover for intra-frequency case | 1) Support any FG of 5-1, 5-2, 5-3 and 5-4  2) Supports any of the power sharing FG (in RAN1 feature list) 21-2/2a/2b | *Note: RAN2 have agreed to remove it;* |  | No | No | If the 5-5 is absent, the default is UE does NOT support simultaneous transmission | Optional with capability signalling |
|  | 5-6 | Simultaneous UL transmission for DAPS handover for inter-frequency | Support of simultaneous UL transmission for DAPS handover for inter-frequency case | 1) Support any FG of 5-1, 5-2, 5-3 and 5-4  2) Supports any of the power sharing FG (in RAN1 feature list) 21-2/2a/2b | *interFreqMultiUL-TransmissionDAPS-r16* | *CA-ParametersNR-v1610->*  *interFreqDAPS-r16* | No | No | If the 5-6 is absent, the default is UE does NOT support simultaneous transmission | Optional with capability signalling |
|  | 5-7 | Support of multi TAG for intra-frequency | Support of different TAGs in source and target cells for intra-frequency case | Support any FG of 5-1, 5-2, 5-3 and 5-4 | *intraFreqTwoTAGs-DAPS-r16* | *FeatureSetDownlink-v1610->*  *intraFreqDAPS-UL-r16* | No | No | If the 5-7 is absent, the default is UE supports different TAGs in source and target cells | Optional with capability signalling |
|  | 5-8 | Support of multi TAG for inter-frequency | Support of different TAGs in source and target cells for inter-frequency case | Support any FG of 5-1, 5-2, 5-3 and 5-4 | *supportedNumberTAG* | *CA-ParametersNR* | No | No | If the 5-8 is absent, the default is UE supports different TAGs in source and target cells | Optional with capability signalling |
|  | 5-9 | Support of different SCS-s in source and target cells for intra-frequency | Support of different SCS-s in source and target cells for intra-frequency case | Support any FG of 5-1, 5-2, 5-3 and 5-4 | *intraFreqDiffSCS-DAPS-r16* | *FeatureSetDownlink-v1610 ->*  *intraFreqDAPS-r16* | No | No | If the 5-9 is absent, the default is UE does NOT support different SCS-s in source and target cells | Optional with capability signalling |
|  | 5-10 | Support of different SCS-s in source and target cells for inter-frequency | Support of different SCS-s in source and target cells for inter-frequency case | Support any FG of 5-1, 5-2, 5-3 and 5-4 | *interFreqDiffSCS-DAPS-r16* | *CA-ParametersNR-v1610->*  *interFreqDAPS-r16* | No | No | If the 5-10 is absent, the default is UE does NOT support different SCS-s in source and target cells | Optional with capability signalling |

### 5.3.3 Multi-RAT Dual-Connectivity and Carrier Aggregation enhancements

Table 5.3.3-1: Multi-RAT Dual-Connectivity and Carrier Aggregation enhancements

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 6. LTE\_NR\_DC\_CA\_enh | 6-1 | Support of beam level Early Measurement Reporting | Supporting of beam level measurement and reporting when in NR Idle/Inactive mode for Early Measurement Reporting at connection setup. | *idleInactiveNR-MeasReport-r16* | *idleInactiveNR-MeasBeamReport-r16* | *MeasAndMobParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 6-2a | Support of beam level Early Measurement Reporting | Supporting of NR beam level measurement and reporting when in LTE Idle/Inactive mode for Early Measurement Reporting at connection setup for FR1 | endc-IdleInactiveMeasFR1-r16 | *n/a (LTE feature)* | *n/a (LTE feature)* | No | n/a |  | Optional with capability signalling |
| 6-2b | Support of beam level Early Measurement Reporting | Supporting of NR beam level measurement and reporting when in LTE Idle/Inactive mode for Early Measurement Reporting at connection setup for FR2 | endc-IdleInactiveMeasFR2-r16 | *n/a (LTE feature)* | *n/a (LTE feature)* | No | n/a |  | Optional with capability signalling |
| 6-3 | Dormant BWP switching on multiple CCs RRM requirements | Incremental delay for BWP switch processing on additional SCells in DCI based simultaneous dormant BWP switching on multiple SCells | RAN1 feature 18-4 or 18-4a | *bwp-SwitchingMultiDormancyCCs-r16*  *CHOICE {*  *type1-r16 ENUMERATED {us100, us200},*  *type2-r16 ENUMERATED {us200, us400, us800, us1000}*  *}* | *Phy-ParametersCommon* | No | No | For component 2), the candidate values are:  - {100us, 200us} for UE indicates type1 in bwp-SwitchingDelay  - {200us, 400us, 800us, 1000us} for UE indicates type 2 in bwp-SwitchingDelay  The total BWP switching delay will be captured in TS38.133  UE needs to indicate either of the candidate values in case it supports dormant BWP | Optional with capability signalling |

### 5.3.4 RF requirements for NR frequency range 1 (FR1)

Table 5.3.4-1: RF and RRM Feature List for RF requirements for NR frequency range 1 (FR1)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 7. RF requirements for NR frequency range 1 (FR1) | 7-1 | Dynamic Tx switching between two uplink carriers | 1) Indicate support of dynamic UL Tx switching between two uplink carriers for inter-band UL CA, SUL or inter-band EN-DC  2) Indicate the supported switching period for Tx switching between two uplink carriers in inter-band EN-DC, inter-band UL CA or SUL band combinations |  | *BandCombinationList-UplinkTxSwitch-r16 ::= SEQUENCE (SIZE (1..maxBandComb)) OF BandCombination-UplinkTxSwitch-r16*  *BandCombination-UplinkTxSwitch-r16 ::= SEQUENCE {*  *bandCombination-r16 BandCombination,*  *bandCombination-v1540BandCombination-v1540 OPTIONAL,*  *bandCombination-v1560 BandCombination-v1560 OPTIONAL,*  *bandCombination-v1570 BandCombination-v1570 OPTIONAL,*  *bandCombination-v1580 BandCombination-v1580 OPTIONAL,*  *bandCombination-v1590 BandCombination-v1590 OPTIONAL,*  *bandCombination-v1610 BandCombination-v1610 OPTIONAL,*  *supportedBandPairListNR-r16 SEQUENCE (SIZE (1..maxULTxSwitchingBandPairs)) OF ULTxSwitchingBandPair-r16,*  *uplinkTxSwitching-OptionSupport-r16 ENUMERATED {switchedUL, dualUL, both} OPTIONAL,*  *uplinkTxSwitching-PowerBoosting-r16 ENUMERATED {supported} OPTIONAL,*  *...*  *}* | *RF-Parameters-> supportedBandCombinationList-UplinkTxSwitch-r16* | No need | FR1 only | Candidate value set for UL CA and SUL combinations: {35us, 140 us, 210us}  Candidate value set for EN-DC:  {35us, 140 us}  NOTE: Signalling structure is up to RAN2  If UE reports support of this feature group, it means UE supports both components. | Optional with capability signalling |
| 7-2 | Application of DL interruptions due to UL Tx switching between two uplink carriers | 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  - TDD+TDD EN-DC with the same UL-DL pattern | 7-1 | *ULTxSwitchingBandPair-r16 ::= {*  *bandIndexUL1-r16,*  *bandIndexUL2-r16,*  *uplinkTxSwitchingPeriod-r16,*  *uplinkTxSwitching-DL-Interruption-r16*  *}* | *RF-Parameters-> supportedBandCombinationList-UplinkTxSwitch-r16* | No need | FR1 only | The capability is introduced according to the agreement in R4-2005665.  NOTE: Signalling structure is up to RAN2  The following duplex mode combinations do not require DL interruption (carrier 1+ carrier 2):  - SUL+TDD,  - TDD+TDD CA with the same UL-DL pattern,  - TDD+TDD EN-DC with the same UL-DL pattern  RAN4 will specify for UL CA and EN-DC for which band combinations DL interruptions are allowed. | Optional with capability signalling |
| 7-3a | NR CA class List for intra-band non-contiguous CA | Indicate the UL frequency separation class that UE can support which includes both the aggregated bandwidth and the gap bandwidth between two non-contiguous CCs for intra-band non-contiguous CA  Note: UL frequency separation class means maximum frequency span between lower edge of lowest component carrier and upper edge of highest component carrier that UE can support in uplink | Intra-band UL non-contiguous CA band combination | *intraBandFreqSeparationUL-AggBW-GapBW-r16* | *CA-ParametersNR-v1630* | No need | FR1 only | Based on the agreed WF R4-2005660 both 1PA and 2PA architecture for intra-band non-contiguous UL CA will be considered for UE capability, and MIMO supporting with 4TX for 2PA UL NC CA should not be excluded.  The maximum UL CC number for intra-band UL CA is 2 in Rel-16.  NC CA UL separation class candidate values:  - Class I: NC CA separation class≤ 100MHz  - Class II: 100< NC CA separation class≤ 200MHz  Class III: NC CA separation class > 200MHz and <600MHz= | Optional with capability signalling |
| 7-3b | NR CA class List for Intra-band contiguous CA | 1. Indicate the contiguous CA bandwidth class that UE can support in uplink  2. On the condition that component 1 is indicated, indicate the PA architecture, i.e., 1PA or 2PA  3. On the condition that component 1 and component 2 are indicated, indicate the MIMO layer number for each UL CC separately  NOTE1: there is dependency for the three components as given above  NOTE2: component 1/2/3 are existing signaling from Rel-15, the dependency and conditioned relation need to be ensured in Rel-16 signalling. It is up to RAN2 to decide how to ensure dependency and conditioned relation or new Rel-16 signaling is needed. | Intra-band UL contiguous CA band combination | *RAN2 agreed that the existing signalling is sufficient* |  | No need | FR1 | for each contiguous CA bandwidth class, if 2PA architecture is indicated, MIMO is not supported for both UL CCs by default | Optional with capability signalling |
| 7-4 | Transient period | Report the shorter transient capability supported by the UE: 2, 4 or 7us |  | *enhancedUL-TransientPeriod-r16* | *BandNR* | n/a | FR1 | No value reported means UE supports the legacy 10us transient period | Optional with capability signalling |
|  | 7-5 | DC location for intra-band CA | Indicate whether UE support Additional DC location reporting for intra-band UL CA |  | *uplinkTxDC-TwoCarrierReport-r16* | *CA-ParametersNR-v1640* | No need | FR1 and FR2 |  | Optional with capability signalling |
|  | 7-6 (RAN2) | Indicating support of the uplink codebook subset when uplink Tx switching is triggered between last transmitted SRS and scheduled PUSCH transmission | UE indicating support of full coherent codebook subset shall also support non-coherent codebook subset.  If the field is absent, the supported uplink codebook subset indicated by *pusch-TransCoherence* applies when the uplink switching is triggered between last transmitted SRS and scheduled transmission. |  | *uplinkTxSwitching-PUSCH-TransCoherence-r16* | *BandCombination-UplinkTxSwitch-r16* | n/a | FR1 only |  | Optional with capability signalling |

### 5.3.5 NR RF requirement enhancements for frequency range 2 (FR2)

Table 5.3.5-1: RF requirement enhancements for NR frequency range 2 (FR2)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 8. NR RF Requirement Enhancements for FR2 | 8-1 | MPE | 1 P-MPR reporting |  | *tdd-MPE-P-MPR-Reporting-r16* | *MAC-ParametersCommon* | TDD only | FR2 only |  | Optional with capability signalling |
| 8-2 | SSB based Beam correspondence | Support for beam correspondence based on SSB  A UE indicating support for beam correspondence based on SSB has the ability to select its uplink beam based on measurements of SSB.  Supported by UEs with capability *beamCorrespondenceWithoutUL-BeamSweeping = {0,1}*  If a UE supports beam correspondence based on SSB, then the network can expect the UE to also fulfill Rel-15 beam correspondence requirements. |  | *beamCorrespondenceSSB-based-r16* | *MIMO-ParametersPerBand* | TDD only | FR2 only |  | Optional with capability signalling |
| 8-3 | CSI-RS based Beam correspondence | Support for beam correspondence based on CSI-RS  A UE indicating support for beam correspondence based on CSI-RS has the ability to select its uplink beam based on measurements of CSI-RS in scenarios when the SSB PSD is X dB below CSI-RS PSD.  Supported by UEs with capability beamCorrespondenceWithoutUL-BeamSweeping = {0,1}  If a UE supports beam correspondence based on CSI-RS, then the network can expect the UE to also fulfill Rel-15 beam correspondence requirements. |  | *beamCorrespondenceCSI-RS-based-r16* | *MIMO-ParametersPerBand* | TDD only | FR2 only |  | Optional with capability signalling |
| 8-4 | Non-contiguous intra-band DL CA | Support for frequency separation class for DL-only spectrum (Fsd):  DL-only spectrum is available for configuration of only DL CCs and not UL CCs.  The spectrum covered by the DL-only frequency separation extends on one-side of the bidirectional spectrum in a contiguous manner with no frequency gap between the two.  The bidirectional spectrum is defined as the UL/DL common spectrum in which the UE supports the configuration of uplink or downlink CCs and is signalled by UL and DL frequency separation from Rel-15.  The combined downlink spectrum (DL Fs + Fsd) cannot exceed 2400 MHz.  The component value range is defined in TS38.101-2 |  | *For bidirectional spectrum:*  *intraBandFreqSeparationUL-v1620*  *intraBandFreqSeparationDL-v1620*  *FreqSeparationClassDL-v1620,*  *For DL-only spectrum:*  *intraBandFreqSeparationDL-Only-r16*  *FreqSeparationClassDL-Only-r16,* | *FeatureSetDownlink-v1610* | TDD only | FR2 only |  | Optional with capability signalling |
| 8-5 | Inter-band DL CA | 1 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) |  | *beamManagementType-r16* | *CA-ParametersNR-v1630* | TDD only | FR2 only | Candidate value set for beam management type: {IBM, CBM}  The capability is restricted to IBM for the band combinations specified in Rel-16 until CBM requirement is specified in a future release. | Mandatory to report the supported beam management type |
|  | 8-6 | MPR Enhancement | UE Tx power boost feature when IBE is suspended |  | *mpr-PowerBoost-FR2-r16* | *BandNR* | TDD only | FR2 only |  | Optional with capability signalling |

### 5.3.6 NR RRM requirement enhancement

Table 5.3.6-1: NR RRM requirement enhancement

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 9. Rel-16 NR RRM Enhancement | 9-1 | BWP switching on multiple CCs RRM requirements | Incremental delay for BWP switch processing on additional CCs in timer/DCI based simultaneous BWP switching on multiple CCs | The UE indicating support of this feature shall also support bwp-SwitchingDelay, bwp-SameNumerology and/or bwp-DiffNumerology | *bwp-SwitchingMultiCCs-r16 {*  *type1-r16,*  *type2-r16*  *}* | *Phy-ParametersCommon* | No | No | For component 2), the candidate values are:  - {100us, 200us} for UE indicates type1 in bwp-SwitchingDelay  - {200us, 400us, 800us, 1000us} for UE indicates type 2 in bwp-SwitchingDelay  The total BWP switching delay will be captured in TS38.133  UE needs to indicate either of the candidate values in case it supports CA | Optional with capability signalling |
| 9-2 | Mandatory gap pattern for NR-only measurements in NR SA and NR DC | 1) Support of additional mandatory gap patterns for NR-only measurements in NR SA and NR DC, |  | *supportedGapPattern-NRonly-r16* | *MeasAndMobParametersCommon* | No | No | Note: Agreements are provided in [R4-2005846]. According to RAN4 agreement, a bitmap should be introduced | Mandatory with capability signalling |
| 9-3 | Mandatory gap pattern for NR measurement only in LTE SA, EN-DC, NE-DC | 1) Support of full set of mandatory additional gap patterns defined for NR SA and NR-DC for NR measurement only in LTE SA, EN-DC, NE-D | 9-2 | *supportedGapPattern-NRonly-NEDC-r16* | *MeasAndMobParametersCommon* | No | No | Note: Agreements are provided in [R4-2005846]. According to RAN4 agreement, a single bit should be introduced | Optional with capability signalling |
| 9-4 | SSB based inter-frequency measurement without measurement gap | 1) Support of inter-frequency measurement without MG when the inter-frequency SSB is completely contained in the active DL BWP of the UE |  | *interFrequencyMeas-Nogap-r16* | *MeasAndMobParametersFRX-Diff* | No | Yes |  | Optional with capability signalling |
| 9-5 | Different SCS between PDCCH/PDSCH and SSB in inter-frequency measurement without MG | 1) Support of SSB based measurement on inter-frequency without MG and data reception of PDCCH/PDSCH in serving with different SCS | 9-4 | *simultaneousRxDataSSB-DiffNumerology-Inter-r16* | *MeasAndMobParametersFRX-Diff* | No | Yes | Details can be found in RAN4 LS R4-2005350 to RAN2, wherein two options are listed, i.e.1) update existing IE (simultaneousRxDataSSB-DiffNumerology); 2) introduce a new UE capability | Optional with capability signalling |
|  | 9-6 | CGI reading of an NR neighbour cell | 1) Support of autonomous gap-based CGI reading of an NR neighbour cell for EN-DC, NR SA, LTE SA, NR-DC, NE-DC |  | *nr-AutonomousGaps-r16 nr-AutonomousGaps-ENDC-r16*  *nr-AutonomousGaps-NEDC-r16*  *nr-AutonomousGaps-NRDC-r16* | *MeasAndMobParametersFRX-Diff* | No | Yes | Signalling details are up to RAN2. | Optional with capability signalling |
|  | 9-7 | CGI reading of an E-UTRA neighbour cell | 1) Support of autonomous gap-based CGI reading of an E-UTRA neighbour cell for EN-DC, NR SA, LTE SA, NR-DC, NE-DC |  | *eutra-AutonomousGaps-r16,*  *eutra-AutonomousGaps-NEDC-r16*  *eutra-AutonomousGaps-NRDC-r16* | *MeasAndMobParametersCommon* | No | No | Signalling details are up to RAN2. | Optional with capability signalling |

### 5.3.7 NR support for high speed train scenario

Table 5.3.7-1: NR support for high speed train scenario

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 10. NR HST | 10-1 | RRM enhanced requirements specified within NR and NR-E-UTRAN inter-RAT measurement for NR HST | The enhanced RRM requirements specified within NR and NR-E-UTRAN inter-RAT measurement to support high speed up to 500 km/h, as specified in TS 38.133 |  | *measurementEnhancement-r16* | *UE-NR-Capability-v1610 ->*  *highSpeedParameters-r16* | NO | FR1 only |  | Optional with capability signalling |
| 10-2 | Demodulation enhancement for HST-SFN joint transmission scheme | The enhanced demodulation processing for HST-SFN joint transmission scheme with velocity up to 500km/h, as specified in TS 38.101-4 |  | *demodulationEnhancement-r16* | *UE-NR-Capability-v1610 ->*  *highSpeedParameters-r16* | NO | FR1 only |  | Optional with capability signalling |
| 10-3 | RRM enhancement for E-UTRAN -NR inter-RAT measurement for NR HST | The enhanced RRM requirements specified for E-UTRAN-NR inter-RAT measurement to support high speed up to 500 km/h, as specified in TS 36.133 |  | *n/a (LTE feature)* | *n/a (LTE feature)* | NO | FR1 only |  | Optional with capability signalling |
|  | 10-4 | RRM enhanced requirements specified within NR HST | The enhanced RRM requirements specified within NR to support high speed up to 500 km/h, as specified in TS 38.133 |  | *intraNR-MeasurementEnhancement-r16* | *UE-NR-Capability-v1650 ->*  *HighSpeedParameters-v1650* | NO | FR1 only | UE can indicate support of 10-4 only if 10-1 is not supported | Optional with capability signalling |
|  | 10-5 | RRM enhanced requirements specified for NR-E-UTRAN inter-RAT measurement for NR HST | The enhanced NR-E-UTRAN inter-RAT RRM requirements to support high speed up to 500 km/h, as specified in TS 38.133 |  | *interRAT-MeasurementEnhancement-r16* | *UE-NR-Capability-v1650 ->*  *HighSpeedParameters-v1650* | NO | FR1 only | UE can indicate support of 10-5 only if 10-1 is not supported | Optional with capability signalling |

### 5.3.8 NR Positioning Support

Table 5.3.8-1: NR Positioning Support

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 11. NR Positioning Support | 11-1 | Additional measurement gap patterns for PRS measurements | 1) MG pattern with MGL=10 ms, MGRP=80 ms for PRS measurements  2) MG pattern with MGL=20 ms, MGRP=160 ms for PRS measurements | RAN1 feature list: 13-1 Common DL PRS Processing Capability | *RRC*  *supportedGapPattern-r16* | *RRC*  *MeasAndMobParametersCommon* | No | No | New MG patterns are applicable for PRS and NR/LTE RRM measurements i.e. new gaps are not shared between PRS and 2G/3G RRM measurements.  The new measurement gap patterns can be requested by the UE for FDD and TDD NR positioning measurements.  The new measurement gap patterns can be requested by the UE and configured by the network only when the UE is configured via LPP with NR positioning measurements requiring such gaps and can only be used during the corresponding positioning measurement period. | Optional with capability signalling |

### 5.3.9 Physical layer enhancements for NR URLLC

Table 5.3.9-1: Physical layer enhancements for NR URLLC

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| B. Physical layer enhancements for NR URLLC | B-1 |  |  |  |  |  |  |  |  | Mandatory without capability signalling |
| B-2 |  |  |  |  |  |  |  |  | Mandatory without capability signalling |
| … |  |  |  |  |  |  |  |  | Mandatory without capability signalling |

### 5.3.10 Enhancements on MIMO for NR

Table 5.3.10-1: Enhancements on MIMO for NR

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| C. Enhancements on MIMO for NR | C-1 |  |  |  |  |  |  |  |  | Mandatory without capability signalling |
| C-2 |  |  |  |  |  |  |  |  | Mandatory without capability signalling |
| … |  |  |  |  |  |  |  |  | Mandatory without capability signalling |

### 5.3.11 NR RRM requirements for CSI-RS based L3 measurement

Table 5.3.11-1: NR RRM requirements for CSI-RS based L3 measurement

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 12. NR RRM requirements for CSI-RS based L3 measurement |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |

### 5.3.12 Others

Table 5.3.12-1: Others

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| UE RF | 2-18 | Maximum uplink duty cycle for TDD+TDD EN-DC power class 2 *(maxUplinkDutyCycle-interBandENDC-TDD-PC2-r16)* | Indicates the maximum percentage of symbols during a certain evaluation period that can be scheduled for NR uplink transmission under different EUTRA TDD uplink-downlink configurations so as to ensure compliance with applicable electromagnetic energy absorption requirements provided by regulatory bodies. This field is only applicable for inter-band TDD+TDD EN-DC power class 2 UE as specified in TS 38.101-3. If the field is absent, 30% shall be applied to all EUTRA TDD uplink-downlink configurations. If eutra-TDD-Configx is absent, 30% shall be applied to the corresponding EUTRA TDD uplink-downlink configuration.  Value n20 corresponds to 20%, value n40 corresponds to 40% and so on. |  | *maxUplinkDutyCycle-interBandENDC-TDD-PC2-r16*  *{*  *eutra-TDD-Config0-r16,*  *eutra-TDD-Config1-r16,*  *eutra-TDD-Config2-r16,*  *eutra-TDD-Config3-r16,*  *eutra-TDD-Config4-r16,*  *eutra-TDD-Config5-r16,*  *eutra-TDD-Config6-r16*  *}* | *MRDC-Parameters-v1620* | TDD only | FR1 only |  | Optional with capability signalling |
| 2-19 | FDD-FDD or TDD-TDD inter-band MR-DC with overlapping or partially overlapping DL spectrum | Type 1 UE: supports FDD-FDD or TDD-TDD inter-band operation with overlapping or partially DL bands with MRTD<3us and intra-band MR-DC requirements apply.  Type 2 UE: supports FDD-FDD or TDD-TDD inter-band operation with overlapping or partially overlapping DL bands with an MR-DC MRTD according to clause 7.6.2 in 38.133 and applicable inter-band RF requirements.  If absent the UE is a type 1 UE. |  | *interBandMRDC-WithOverlapDL-Bands-r16* | *MRDC-Parameters-v1630* | n/a | FR1 only |  | Optional with capability signalling |
| 2-20 | Maximum uplink duty cycle for FDD+TDD EN-DC power class 2 | The maximum percentage of symbols during a certain evaluation period that can be scheduled for NR uplink transmission and EUTRA FDD uplink transmission so as to ensure compliance with applicable electromagnetic energy absorption requirements provided by regulatory bodies for FDD+TDD EN-DC power class 2 UE. |  | *maxUplinkDutyCycle-interBandENDC-FDD-TDD-PC2-r16 {*  *maxUplinkDutyCycle-FDD-TDD-EN-DC1-r16,*  *maxUplinkDutyCycle-FDD-TDD-EN-DC2-r16*  *}* | *MRDC-Parameters-v1630* | n/a | FR1 only | Introduce 2 UE capabilities of *maxUplinkDutyCycle-FDD&TDD-EN-DC1* and *maxUplinkDutyCycle-FDD&TDD-EN-DC2* which indicate the maxUplinkDutyCycle capability of NR band corresponding to different LTE reference configurations as described in TS 38.101-3 clause 6.2B.1.3.  The value range is as below:  - maxUplinkDutyCycle-FDD&TDD-EN-DC1, maxUplinkDutyCycle-FDD&TDD-EN-DC2 ∈ {30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%}  This field is only applicable for inter-band FDD+TDD EN-DC power class 2 UE as specified in TS 38.101-3. | Optional with capability signalling |
|  | 2-21 | Transparent Tx Diversity | Indicates whether the UE supports Tx diversity requirements as specified in TS 38.101-1. The capability applies to all power classes equally in all the applicable releases via a release independent manner. |  | *txDiversity-r16* | *BandNR* | n/a | FR1 only |  | Optional with capability signalling |
|  | 2-22 (RAN2) |  | Indicates power class 1.5 the UE supports when operating according to this band combination. If the field is absent, the UE supports the default power class. If this power class is higher than the power class that the UE supports on the individual bands of this band combination *(ue-PowerClass in BandNR*), the latter determines maximum TX power available in each band. |  | *(1) powerClass-v1610*  *(2) ue-powerClass-v1610* | *(1) BandCombination-v1610*  *(2) BandNR* | N/A | FR1 only |  | Optional with capability signalling |
|  | 2-23 (RAN 2) |  | Indicates NR part power class the UE supports when operating according to this band combination.  This field only applies for MR-DC BCs containing only single CC or intra-band CA in NR side in this release. |  | *powerClassNRPart-r16* | *BandCombination-v1610* | N/A | FR1 only |  | Optional with capability signalling |

### 5.3.13 5G\_V2X\_NRSL

Table 5.3.13-1: 5G\_V2X\_NRSL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 13. 5G\_V2X\_NRSL | 13-1 | 256QAM sidelink reception for FR1 | UE can support 256QAM sidelink reception for NR V2X in FR1. | 15-1 | *sl-Rx-256QAM-r16* | *BandSidelink-r16* | n/a | FR1 only |  | optional with capability signalling |
|  | 13-2 (RAN2) | Power class per band capability | Indicates the supported power class for this band used for sidelink |  | *ue-PowerClassSidelink-r16* | *BandSidelink-r16* | n/a | n/a | If the field is absent, the UE supports the default power class in 38.101-1, Table 6.2E.1.2-2. | Optional with capability signalling |
|  | 13-3 (RAN2) | Intra-band concurrent operation power class capability per band combination | Indicates the power class, of a particular Uu band combination and the intra-band PC5 band combination(s) on which the UE supports transmission of PC5 simultaneous with Uu uplink (as indicated by *supportedTxBandCombListPerBC-Sidelink-r16*). The leading/leftmost value corresponds to the band combination of the particular Uu band combination and the first intra-band PC5 band combination included in *BandCombinationListSidelinkEUTRA-NR* which is indicated with value 1 by *supportedTxBandCombListPerBC-Sidelink-r16*, the next value corresponds to the band combination of the particular Uu band combination and the second intra-band PC5 band combination included in *BandCombinationListSidelinkEUTRA-NR* which is indicated with value 1 by *supportedTxBandCombListPerBC-Sidelink-r16* and so on. If this power class is higher than the power class that the UE supports on the individual Uu or PC5 interface of this band combination, the latter determines maximum TX power available in each interface. |  | *IntrabandConcurrentOperationPowerClass-r16 SEQUENCE (SIZE (1..maxBandComb)) OF IntraBandPowerClass-r16*  *IntraBandPowerClass-r16 ENUMERATED {PC2, PC3}* | *BandCombination-v1680* | n/a | n/a |  | Optional with capability signalling |

# 6 Release 17 UE feature list

## 6.1 Layer-1 UE features

### 6.1.0 General

Tables 6.1.1-1 to 6.1.17-1 provide the list of Layer-1 features, as shown in [17] and the corresponding UE capability field name, as specified in TS 38.331 [2].

### 6.1.1 NR\_FeMIMO

Table 6.1.1-1: Layer-1 feature list for NR\_FeMIMO

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 23. NR\_FeMIMO | 23-1-1 | Unified TCI with joint DL/UL TCI update for intra-cell beam management | 1. Joint DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals)  2. The maximum number of configured joint TCI states per BWP per CC in a band  3. One MAC-CE activated joint TCI state per CC in a band  4. TCI state indication for update and activationa) MAC CE based TCI state indication for one active TCI state  5. The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band |  | *unifiedJointTCI-r17 {*  *maxConfiguredJointTCI-r17, maxActivatedTCIAcrossCC-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 2 candidate value {8, 12, 16, 24, 32, 48, 64, 128}  Component 5 candidate value {1, 2, 4, 8, 16}  If a UE supports FG 23-1-1a, the signalled component values (except component 5) also apply to inter-cell beam management  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH transmissions | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1a | Unified TCI with joint DL/UL TCI update for inter-cell beam management | 1. Support of unified TCI with joint DL/UL TCI update for inter-cell beam management  2. Support K additional MAC-CE activated joint TCI states per CC in a band  3. Support K additional MAC-CE activated joint TCI states across all CC(s) in a band | 23-1-2, 23-1-1 | *unifiedJointTCI-InterCell-r17*  *{*  *additionalMAC-CE-PerCC-r17,*  *additionalMAC-CE-AcrossCC-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component candidate values for K: {0,1,2,4}  Note: A UE that supports 23-1-1a supports K additional MAC-CE activated joint TCI states across all CC(s) in a band in addition to the maximum number of MAC-CE activated joint TCI states across all CC(s) in a band signalled in FG 23-1-1. The signalled value in component 3 of 23-1-1a plus the signalled value in component 5 of 23-1-1 determine the maximum number of MAC-CE activated joint TCI states across all CC(s) in a band that are applied to intra and inter-cell beam management jointly. | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1b | Unified TCI with joint DL/UL TCI update for intra- and inter-cell beam management with more than one MAC-CE activated joint TCI state per CC | 1. TCI state indication for update and activation b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment)  2. The minimum beam application time in Y symbols per SCS  3. The maximum number of MAC-CE activated joint TCI states per CC in a band | 23-1-1 | *unifiedJointTCI-multiMAC-CE-r17*  *{ minBeamApplicationTime-r17,*  *maxNumMAC-CE-PerCC*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98, 112, 224, 336}, where {84, 98, 112, 224, 336} only can be indicated in FR2  Component 3 candidate values: {2, 3, 4, 5, 6, 7, 8}  Note: The maximum number of MAC-CE activated joint TCI states across all CC(s) in a band for more than one MAC-CE activated joint TCI state is signaled in 23-1-1, component 5  Note: activated joint TCI state(s) include all PDCCH/PDSCH receptions and PUSCH/PUCCH | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1c | SCell BFR with unified TCI framework | 1. Support of SCell BFR with unified TCI framework |  | *unifiedJointTCI-SCellBFR-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | The maximum number of CCs configured with SCell BFR with unified TCI framework in a band with SpCell BFR is given by FG 16-1f, in this case FG 16-1f includes SpCell | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1d | Per BWP TCI state pool configuration for CA mode | 1. Support of TCI state pool configuration per BWP for CA mode | 23-1-1 | *unifiedJointTCI-perBWP-CA-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signaling |
| 23. NR\_FeMIMO | 23-1-1e | TCI state pool configuration with TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured joint TCI state pools across all BWPs and all CCs in a band | 23-1-1 | *unifiedJointTCI-ListSharingCA-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4, 8}  A UE that supports 23-1-1 together with CA must support this FG | Optional with capability signaling |
| 23. NR\_FeMIMO | 23-1-1f | Common multi-CC TCI state ID update and activation | Common multi-CC TCI state ID update and activation | 23-1-1 | *unifiedJointTCI-commonMultiCC-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signaling |
| 23. NR\_FeMIMO | 23-1-1g | Beam misalignment between the DL source RS in the TCI state | Beam misalignment between the DL source RS in the TCI state to provide spatial relation indication and the PL-RS | 23-1-1 | *unifiedJointTCI-BeamAlignDLRS-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | FR2 only | Optional with capability signaling |
| 23. NR\_FeMIMO | 23-1-1h | Association between TCI state and UL PC settings for PUCCH, PUSCH, and SRS | For PUCCH, PUSCH, and SRS, association between TCI state and UL PC settings except for PL RS | 23-1-1 | *unifiedJointTCI-PC-association-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signaling |
| 23. NR\_FeMIMO | 23-1-1i | Indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH | Support of indication/configuration of R17 TCI states for aperiodic CSI-RS, PDCCH, PDSCH (except for TRS and for CORESET #0 and the respective PDSCH reception) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | *unifiedJointTCI-Legacy-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Note: This has no impact on detail signaling design for SRS TCI indication | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1m | Indication/configuration of R17 TCI states for SRS | Support of indication/configuration of R17 TCI states for SRS (except for periodic/semi-persistent SRS for BM) reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | *unifiedJointTCI-Legacy-SRS-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Note: This has no impact on detail signaling design for SRS TCI indication | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1j | Indication/configuration of R17 TCI states for CORESET #0 | Support of indication/configuration of R17 TCI states for CORESET #0 and the respective PDSCH reception reusing the Rel-15/16 signaling/configuration design(s) | 23-1-1 | *unifiedJointTCI-Legacy-CORESET0-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-1k | Maximum number of configured CC lists | Maximum number of configured CC lists per cell group for common multi-CC TCI state ID update and activation | 23-1-1f or 23-10-1f | *unifiedJointTCI-commonUpdate-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component candidate values: {1,2,3,4} | Optional with capability signaling |
| 23. NR\_FeMIMO | 23-1-2 | Inter-cell beam measurement and reporting (for inter-cell BM and mTRP) | 1. Support of L1-RSRP measurement and reporting on SSB(s) with PCI(s) different from serving cell PCI  2. Support of up to K SSBRI-RSRP pairs in one report where a pair is associated with a PCI different from serving cell PCI can be reported  3. The maximum number of RRC-configured PCI(s) different from serving cell PCI for L1-RSRP measurement  4. The max number of SSB resources configured to measure L1-RSRP within a slot with PCI(s) same as or different from serving cell PCI across all CC |  | *unifiedJointTCI-mTRP-InterCell-BM-r17*  *{*  *maxNumAdditionalPCI-L1-RSRP-r17,*  *maxNumSSB-ResourceL1-RSRP-AcrossCC-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 3 candidate values: {1, 2, 3, 4, 5, 6, 7}  Component 4 candidate values: {1, 2, 4, 8}  Note: K is equal to maxNumberNonGroupBeamReporting  Note: component 4 is also counted in FG16-1g/16-1g-1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-3 | MPE mitigation | 1. Support of enhanced PHR reporting which includes pairs of (P-MPR, SSBRI/CRI)  2. Maximum number of reported P-MPR and SSBRI/CRI pairs  3. Maximum number of candidate RS(s) configured in a RRC pool for MPE mitigation |  | *mpe-Mitigation-r17 {*  *maxNumP-MPR-RI-pairs-r17,*  *maxNumConfRS-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 2 candidate values: {1,2,3, 4}  Component 3 candidate values: {1, 2, 4, 8, 12, 16, 28, 32, 48, 64}  Note: FR2 only  Note: Component 3 is also counted in FG16-1g/16-1g-1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-4 | UE capability value reporting | 1. Supported UE capability value and corresponding max number of SRS ports for each UE capability value |  | *srs-PortReport-r17*  *{*  *capVal1-r17,*  *capVal2-r17,*  *capVal3-r17,*  *capVal4-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 1 candidate values: Up to 4 value each with one value of {1,2,4}  Note: the reported list contains only unique value | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-1-4a | Semi-persistent/aperiodic capability value report | Support of Semi-persistent/aperiodic capability value report | 23-1-4,  2-22 or 2-23 or 2-23a or 16-1a-1 or 16-1a-4 or 16-1a-5 | *srs-PortReportSP-AP-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Note: UE that supports this FG, supports capability value reporting together with the AP/SP L1-RSRP/L1-SINR reporting(s) that UE supports in Rel-15/16, reported by FG2-22. FG2-23, FG2-23a, FG16-1a-1, FG16-1a-4 and FG16-1a-5 | Optional with capability signaling |
| 23. NR\_FeMIMO | 23-2-1 | PDCCH repetition | 1. Support of intra-slot PDCCH repetition based on two linked SS sets associated with corresponding CORESETs including PDCCH repetition for Type 3 CSS  2. Required number of BDs for the two PDCCH candidates  3. Support max number of overlaps when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate per scheduled component carrier per slot |  | *mTRP-PDCCH-Repetition-r17*  *{*  *numBD-twoPDCCH-r17,*  *maxNumOverlaps-r17,*  *}* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a | Component 2 candidate values: 2 or 3  Component 3 candidate values: {1,2,3, 5, 10, 20, 40}  Note: UE supports PDCCH repetition for the following (basic) PDCCH monitoring capability: For type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS, the monitoring occasion is within the first 3 OFDM symbols of a slot  Note: for component 3, each unique pair of overlaps is counted as one.  Note: This FG does not include supporting Two QCL-TypeD in time-domain overlapping CORESETs in FR2. | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-2-1a | Monitoring of individual candidates | Support of monitoring of individual candidates when one of the linked PDCCH candidates uses the same set of CCEs as an individual (unlinked) PDCCH candidate, and they both are associated with the same DCI size, scrambling, and CORESET | 23-2-1 | *mTRP-PDCCH-individual-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-2-1b | PDCCH repetition with PDCCH  monitoring on any span of up to 3 consecutive OFDM symbols of a slot | Support of PDCCH repetition for PDCCH monitoring on any span of up to 3 consecutive OFDM symbols of a slot | 3-2  23-2-1 | *mTRP-PDCCH-anySpan-3Symbols-r17* | *MIMO-ParametersPerBand* | n/a | FR1 only | n/a | Applicable to 15KHz SCS only | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-2-1c | PDCCH repetition with PDCCH monitoring with a single span of three contiguous OFDM symbols that is within the first four OFDM symbols in a slot | Support of PDCCH repetition for PDCCH monitoring with a single span of three contiguous OFDM symbols that is within the first four OFDM symbols in a slot | 22-12  23-2-1 | *mTRP-PDCCH-singleSpan-r17* | *MIMO-ParametersPerBand* | No | FR1 only | No | Applicable to 15KHz SCS only | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-2-1d | PDCCH repetition for Case 2 PDCCH monitoring with a span gap | 1. Support of PDCCH repetition for PDCCH monitoring of any occasions with span gap as defined in FG 3-5b.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs | 3-5b, 23-2-1 | *mTRP-PDCCH-Case2-1SpanGap-r17*  *{*  *scs-15kHz-r17,*  *scs-30kHz-r17,*  *scs-60kHz-r17,*  *scs-120kHz-r17*  *}* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a | This capability is necessary for each SCS.  Component 2 candidate values: {intra-span, inter-span, both}  Component 3 candidate values: {4, 8, 16, 32, 44, 64, no limit}  Component 4 candidate values: {4, 8, 16, 32, 44, 64, 128, 256, 512, no limit}  Note:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit (X) is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where “received” and “not been received” is wrt the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * Candidate value “no limit” does not imply BD limit can be exceeded | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-2-1e | PDCCH repetition for Rel-16 PDCCH monitoring | 1. Support of PDCCH repetition with Rel-16 PDCCH monitoring capability as defined in FG 11-2 family.  2. Supported mode of PDCCH repetition  3. X per CC  4. X across all CCs | 11-2, 23-2-1 | *mTRP-PDCCH-legacyMonitoring-r17*  *{*  *scs-15kHz-r17,*  *scs-30kHz-r17*  *}* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a | This capability is signalled for SCS 15 kHz and 30 kHz.  Component2: {intra-span, inter-span, both}  Component3: {4, 8, 16, 32, 44, 64, no limit}  Component 4: {4, 8, 16, 32, 44, 64, 128, 256, 512, no limit}  Note:   * Components 3 and 4 are reported only if UE supports inter-span PDCCH repetition. * The limit X is associated with the total number of linked candidates of which the first candidate is received and the second one has not been received at any given span, where "received" and "not been received" is w.r.t. the end of the corresponding span of PDCCH candidate. * The limit X is indicated as a total count assuming count 1 for AL=1; 2 for AL=2; 4 for AL=4 or 8 or 16. * Candidate value “no limit” does not imply BD limit can be exceeded | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-2-2 | Two QCL TypeD for CORESET monitoring in PDCCH repetition | Support of determining two QCL-TypeD for time-domain overlapping CORESETs in the same CC or for intra-band CA when UE is configured with PDCCH repetition | 23-2-1 | *mTRP-PDCCH-TwoQCL-TypeD-r17* | *MIMO-ParametersPerBand* | n/a | FR2 only | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-2-4 | Simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | Support of simultaneous configuration of PDCCH repetition and multi-DCI based multi-TRP | 23-2-1, 16-2a | *mTRP-PDCCH-multiDCI-multiTRP-r17* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a | Note: Two linked PDCCH candidates are not expected to be associated with different *CORESETPoolIndex* values | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1 | Multi-TRP PUSCH repetition (type A) -codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to 'codebook'  3. Supported number of SRS resources in one SRS resource set | 2-14 | *mTRP-PUSCH-TypeA-CB-r17* | *FeatureSetUplink-v1710* | n/a | n/a | n/a | Component 3 candidate values: {1,2 ,4}  Note: If value 4 is reported for component 3, UE also reports value 4 in FG 16-5c. | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1-2 | Multi-TRP PUSCH repetition (type A) - non-codebook based | 1. Support of multi-TRP PUSCH repetition for non-codebook based PUSCH (based on PUSCH repetition type A)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to 'nonCodebook'  3. Supported number of SRS resources in one SRS resource set | 2-15 | *mTRP-PUSCH-RepetitionTypeA-r17* | *FeatureSetUplink-v1710* | n/a | n/a | n/a | Component 3: {1,2,3,4} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1-2a | Two associated CSI-RS resources | Support of up to two NZP CSI-RS resources associated with the two SRS resource sets for non-codebook-based mTRP PUSCH | 2-15a, 23-3-1-2 | *mTRP-PUSCH-twoCSI-RS-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1-2b | CSI-RS processing framework for SRS with two associated CSI-RS resources | 1. Maximum number of periodic SRS resources associated with first and second CSI-RS per BWP  2. Maximum number of aperiodic SRS resources associated with first and second CSI-RS per BWP  3. Maximum number of semi-persistent SRS resources associated with first and second CSI-RS per BWP  4. UE can process Y SRS resources associated with first and second CSI-RS resources simultaneously in a CC. Includes P/SP/A SRS  5. UE can process up to X CSI-RS resources associated with SRS for non-codebook based transmission simultaneously | 23-3-1-2a | *mTRP-PUSCH-CSI-RS-r17*  *{*  *maxNumPeriodicSRS-r17,*  *maxNumAperiodicSRS-r17,*  *maxNumSP-SRS-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 1: {1 to 8}  Component 2: {1 to 8}  Component 3: {0 to 8}  Component 4: {1 to 16}  Component 5: {1,2} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1a | Cyclic mapping for Multi-TRP PUSCH repetition | Support of cyclic mapping when the number of repetitions is larger than 2 | 23-3-1 or 23-3-1-2 | *mTRP-PUSCH-cyclicMapping-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Candidate component values: {for repetition Type A, for repetition Type B, both} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1b | Second TPC field for Multi-TRP PUSCH repetition | Support of second TPC field for per TRP closed-loop power control for PUSCH with DCI formats 0\_1 / 0\_2 | 23-3-1 or 23-3-1-2 | *mTRP-PUSCH-secondTPC-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1c | Two PHR reporting | Support of PHR reporting related to M-TRP PUSCH repetition (calculate two PHRs (at least corresponding to the CC that applies m-TRP PUSCH repetitions), each associated with a first PUSCH occasion corresponding to each SRS resource set, and report two PHRs.) | 23-3-1 or 23-3-1-2 | *mTRP-PUSCH-twoPHR-Reporting-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1e | A-CSI report | Support of A-CSI report on two PUSCH repetitions | 23-3-1 or 23-3-1-2 | *mTRP-PUSCH-A-CSI-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1f | SP-CSI report | Support of SP-CSI report on two PUSCH repetitions | 23-3-1 or 23-3-1-2 | *mTRP-PUSCH-SP-CSI-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1g | CG PUSCH transmission | Support of CG PUSCH transmission towards M-TRPs using a single CG configuration (Use same beam mapping principals as dynamic grant PUSCH repetition scheme.) | 23-3-1 or 23-3-1-2 | *mTRP-PUSCH-CG-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1-1 | Multi-TRP PUSCH repetition (type B) - codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of two SRS resource sets with usage set to ‘codebook’  3. Supported number of SRS resources in one SRS resource set | 2-14, 11-5 | *mTRP-PUSCH-TypeB-CB-r17* | *FeatureSetUplinkPerCC-v1700* | No | No | No | Component 3 candidate values: {1,2,4} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-1-3 | Multi-TRP PUSCH repetition (type B) – non-codebook based | 1. Support of multi-TRP PUSCH repetition (based on PUSCH repetition type B) for non-codebook based  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. support of two SRS resource sets with usage set to ‘nonCodebook’  3. supported number of SRS resources in one SRS resource set | 2-15, 11-5 |  |  | No | No | No | Component 3 candidate values: {1,2,3,4} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-2 | Multi-TRP PUCCH repetition scheme 1 (inter-slot) | 1. Support of PUCCH repetition scheme 1 (inter-slot repetition)- sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource  3. Supported PUCCH formats for this scheme |  | *mTRP-PUCCH-InterSlot-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 3 candidate values: {PF0/2, PF1/3/4, PF0-4}  Note: power control parameter sets (w/o spatial relation info) only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-2b | Cyclic mapping for multi-TRP PUCCH repetition | Support of cyclic mapping for beam mapping/power control parameter set mapping for PUCCH repetitions scheme 1 and/or 3 when the number of repetitions is larger than 2 | 23-3-2 | *mTRP-PUCCH-CyclicMapping-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-2c | Second TPC field for multi-TRP PUCCH repetition | Support of second TPC field for per TRP closed-loop power control for PUCCH with DCI formats 1\_1/1\_2 | 23-3-2 | *mTRP-PUCCH-SecondTPC-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-2d | Updating two Spatial relation or two sets of power control parameters for PUCCH group | Support of updating two Spatial Relation Info’s / two sets of power control parameters for a group of PUCCH resources in a CC by MAC-CE | 23-3-2 | *mTRP-PUCCH-MAC-CE-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-2e | Maximum number of power control parameter sets configured for multi-TRP PUCCH repetition in FR1 | Maximum number of power control parameter sets configured for multi-TRP PUCCH repetition in FR1 | 23-3-2 | *mTRP-PUCCH-maxNum-PC-FR1-r17* | *MIMO-ParametersPerBand* | n/a | FR1 only | n/a | Candidate values: {3 to 8} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-3-3 | Multi-TRP PUCCH repetition-intra-slot | 1. Support of PUCCH repetition scheme 3 (intra-slot repetition)  - sequential mapping for repetitions larger than 2  - cyclic mapping for 2 repetitions  2. Support of up to two PUCCH power control parameter sets/spatial relation info per PUCCH resource  3. Supported PUCCH formats for this scheme |  | *mTRP-PUCCH-IntraSlot-r17* | *FeatureSetUplink-v1710* | n/a | n/a | n/a | Component 3 candidate values: {PF0/2, PF1/3/4, PF0-4}  Note: power control parameter sets (w/o spatial relation info) only apply to FR1  Note: spatial relation info only applies to FR2 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-4 | IntCell-mTRP | 1. Support of RRC configuration of additional PCI different from serving cell associated with the TCI state and/or QCL-info  2. The maximum number of configured additional PCIs per CC is X1 (Case 1) when each configuration of SSB time domain positions and periodicity of the additional PCIs is the same as SSB time domain positions and periodicity of the serving cell PCI  3. The maximum number of configured additional PCIs per CC is X2 (Case 2) when the configurations of SSB time domain positions and periodicity of the additional PCIs is not according to Case 1 | 16-2a | *mTRP-inter-Cell-r17*  *{*  *maxNumAdditionalPCI-Case1-r17,*  *maxNumAdditionalPCI-Case2-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 2 candidate values: {1,2,3,4,5,6,7}  Component 3 candidate values: {0,1,2,3,4,5,6,7}  Note: case1 and case2 cannot be enabled simultaneously as any configuration that is not based on Case 1 is defined as Case 2 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-5-1 | Group based L1-RSRP reporting enhancements | 1. Max number N of beam groups (M=2 beams per beam group) in a single L1-RSRP reporting instance based on measurement on two CMR resource sets  2. Maximum number of SSB and CSI-RS resources for measurement in both CMR sets within a slot across all CCs  3. Maximum number of configured SSB and CSI-RS resources for measurement in both CMR sets across all CCs |  | *mTRP-GroupBasedL1-RSRP-r17*  *{*  *maxNumBeamGroups-r17,*  *maxNumRS-WithinSlot-r17,*  *maxNumRS-AcrossSlot-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 1 candidate values: {1,2,3,4}  Component 2 candidate values: {2,3,4,8,16,32,64}  Component 3 candidate values: {8, 16, 32, 64, 128}  Note: component 2 and 3 are also counted in FG 16-1g and 16-1g-1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-5-2 | MTRP BFR based on two BFD-RS sets | 1. Maximum number of supported measured BFD-RS resources per set per BWP  2. The maximum number of CCs per band configured with BFR (including spCell/SCell/MTRP BFR in Rel-15/16/17)  3. Supported maximum number of measured BFD-RS resources across two BFD-RS sets per BWP |  | *mTRP-BFR-twoBFD-RS-Set-r17*  *{*  *maxBFD-RS-resourcesPerSetPerBWP-r17,*  *maxBFR-r17,*  *maxBFD-RS-resourcesAcrossSetsPerBWP-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 1 candidate values: {1, 2}  Component 2 candidate values: {1, 2, 3, 4, 5, 6, 7, 8, 9}  Component 3 candidate values: {2,3,4}  Note: component 3 is also counted in FG 16-1g and 16-1g-1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-5-2a | PUCCH-SR resources for MTRP BFRQ | 1. Max number of PUCCH-SR resources for MTRP BFRQ per cell group |  | *mTRP-BFR-PUCCH-SR-perCG-r17* | *MIMO-ParametersPerBand* | No | Yes | No | Component candidate values: {1, 2}  Note: A UE that supports FG 23-5-2 must indicate this FG is supported with at least component candidate value 1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-5-2b | Association between a BFD-RS resource set on SpCell and a PUCCH SR resource | Support of association between a BFD-RS resource set on SpCell and a PUCCH SR resource | 23-5-2a | *mTRP-BFR-association-PUCCH-SR-r17* | *MIMO-ParametersPerBand* | No | Yes | No |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-5-2c | MAC-CE based update of explicit BFD-RS | 1. Support of MAC-CE based update of explicit BFD-RS for mTRP BFR  2. Maximum number of configured candidate BFD-RS per BWP for MAC-CE based update | 23-5-2 | *mTRP-BFD-RS-MAC-CE-r17* | *MIMO-ParametersPerBand* | No | Yes | No | Component 2 candidate values: {4, 8, 12, 16, 32, 48, 64} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-1 | SFN scheme A (scheme 1) for PDSCH and PDCCH | 1. Support of SFN scheme A for PDCCH scheduling SFN Scheme A PDSCH |  | *sfn-SchemeA-r17* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-1-1 | SFN scheme A (scheme 1) for PDCCH only | Support of SFN scheme A for PDCCH scheduling single TRP PDSCH |  | *sfn-SchemeA-PDCCH-only-r17* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-1a | Dynamic switching - scheme A | Support of dynamic switching between single-TRP and PDSCH SFN scheme A by TCI state field in DCI formats 1\_1, 1\_2 | 23-6-1 or 23-6-1b | *sfn-SchemeA-DynamicSwitching-r17* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-1b | SFN scheme A (scheme 1) for PDSCH only | 1. Support of SFN scheme A for PDSCH scheduled by single TRPPDCCH |  | *sfn-SchemeA-PDSCH-only-r17* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-2 | SFN scheme B (TRP based pre-compensation) for PDSCH and PDCCH | 1. Support of SFN scheme B for PDCCH scheduling SFN Scheme B PDSCH |  | *sfn-SchemeB-r17* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-2a | Dynamic switching - scheme B | Support of dynamic switching between single-TRP and PDSCH SFN scheme B by TCI state field in DCI formats 1\_1, 1\_2 | 23-6-2 or 23-6-2b | *sfn-SchemeB-DynamicSwitching-r17* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-2b | SFN scheme B (TRP based pre-compensation) for PDSCH only | 1. Support of SFN scheme B for PDSCH scheduled by single TRP PDCCH |  | *sfn-SchemeB-PDSCH-only-r17* | *FeatureSetDownlink-v1700* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-3 | Simultaneous activation of two TCI states for PDCCH across multiple CCs (HST/URLLC) | Support of simultaneous activation of two TCI states for CORESETs with the same CORESET ID in all BWPs across a set of configured component carriers by single MAC-CE | 23-6-1 or 23-6-2 or 23-6-1-1 | *sfn-SimulTwoTCI-AcrossMultiCC-r17* | *MIMO-ParametersPerBand* | No | Yes | No |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-4 | Default DL beam setup for SFN | 1. Support of PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold  2. Support PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI format 1\_0/1\_1/1\_2 when PDSCH is scheduled with offset equal or larger than the threshold, if applicable  3. Support aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold | 23-6-1 or 23-6-2 | *sfn-DefaultDL-BeamSetup-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Note: FR2 only for component 1 and 3 only | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-4a | Default UL beam setup for SFN PDCCH | 1. Support of single-TRP PUCCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  2. Support of single-TRP PUSCH transmission using default beam when enhanced SFN PDCCH transmission scheme is configured  3. Support of single-TRP SRS resource transmission using default beam when enhanced SFN PDCCH transmission scheme is configured | 23-6-1 or 23-6-2 or 23-6-1-1 | *sfn-DefaultUL-BeamSetup-r17* | *MIMO-ParametersPerBand* | n/a | FR2 only | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-5 | Support implicit configuration of RS(s) with two TCI states for beam failure detection | Support RS(s) with two TCI states configured implicitly for beam failure detection enhancement for HST |  | *sfn-ImplicitRS-twoTCI-r17* | *MIMO-ParametersPerBand* | n/a | n/a |  |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-6-6 | QCL-TypeD collision handling with CORESET with 2 TCI states | Support of identifying two QCL-TypeD properties for multiple overlapping CORESETs when a CORESET is activated with two TCI states which overlaps with another CORESET. |  | *sfn-QCL-TypeD-Collision-twoTCI-r17* | *MIMO-ParametersPerBand* | n/a | n/a |  |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-7-1 | Basic Features of CSI Enhancement for Multi-TRP | 1. Support of NZP CSI-RS resource pairs used as CMR (channel measurement resource) pairs for NCJT measurement hypothesis: Support of N=1  2, Maximum number of NZP CSI-RS resources in one CSI-RS resource set: Ks,max  3. CSI report mode selection of mode 1 with X=0 and/or mode 2  4. A list of supported combinations, up to 16, across all CCs simultaneously, where each combination is  b) Maximum number of Tx ports in one NZP CSI-RS resource associated with an NCJT measurement hypothesis  c) Maximum total number of CMRs for NCJT measurement  d) Maximum total number of Tx ports of NZP CSI-RS resources associated with NCJT measurement hypotheses  5. Supported codebook modes for NCJT CSI |  | *mTRP-CSI-EnhancementPerBC-r17*  *{*  *maxNumNZP-CSI-RS-r17,*  *cSI-Report-mode-r17,*  *supportedComboAcrossCCs-r17,*  *codebookMode-NCJT-r17*  *}* | *CA-ParametersNR-v1700* | n/a | n/a | n/a | Component 2 candidate value set: {2, 3, 4, 5, 6, 7, 8}  Component 3 candidate value set: {mode 1 with X=0, mode 2, both}  Component 4 candidate values:   1. {2, 4, 8, 12, 16, 24, 32} 2. {2,3,4 … 64} 3. {2,3,4, …, 256}   Component 5 candidate values: {mode 1, both mode 1 and mode 2} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-7-1c | Basic Features of CSI Enhancement for Multi-TRP – number of CPUs | Number of CPUs occupied by a pair of CMRs for NCJT CSI hypotheses | 23-7-1 | *mTRP-CSI-numCPU-r1* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component candidate values: {2,3 ,4}  Note: Maximum number of CPUs is reported in FG 2-35 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-7-1b | Active CSI-RS resources and ports in the presence of multi-TRP CSI | 1. List of codebook combinations  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-7-1 | *codebookComboParameterMultiTRP-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {‘NCJT’, NCJT+Type 1 SP (for sTRP)}  {Codebook 2, Codebook 3} = {(NULL, NULL}), {“Rel 16 combinations in FG 16-8”}, {“New Rel17 combinations in FG 23-9-5”}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {2, 4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1: A CMR pair configured for NCJT will be counted as two activated resources, a CMR configured for sTRP will be counted as one activated resource for a triplet.  Note2: This capability is relevant only when UE is configured with NCJT CSI in at least one CSI report setting in at least one CC in the band and/or band combination. | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-7-1a | Additional CSI report mode 1 | Maximum value of numberOfSingleTRP-CSI-Mode1 | 23-7-1 | *mTRP-CSI-additionalCSI-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 1 candidate value set: {X=1, X=2}  Note: UE reports this capability only when UE reports “mode 1 with X=0” or “both” for component 3 of FG 23-7-1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-7-4 | Support of Nmax=2 for Multi-TRP CSI | Support of maximum number of CMR pairs Nmax=2 configured in NZP-CSI-RS-ResourceSet for a given CSI report setting | 23-7-1 | *mTRP-CSI-N-Max2-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-7-5 | CMR sharing | Support a NZP CSI-RS resource referred by both a CMR pair configured for Rel-17 Multi-TRP CSI enhancement and a single CMR configured for Single-TRP measurement in a CSI reporting setting | 23-7-1 | *mTRP-CSI-CMR-r17* | *MIMO-ParametersPerBand* | n/a | FR2 only | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-1 | SRS triggering offset enhancement | The maximum number of configured available slots offsets for determining aperiodic SRS location based on available slot | 2-52 | *srs-TriggeringOffset-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Candidate 1 component values: {1, 2, 4} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-2 | Triggering SRS only in DCI 0\_1/0\_2 | Support of triggering SRS in DCI 0\_1/0\_2 without data and without CSI | 2-52 | *srs-TriggeringDCI-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-3 | SRS Antenna switching for >4Rx | 1. Support of SRS antenna switching xTyR with y>4  2. Report the entry number of the first-listed band with UL in the band combination that affects this DL  3. Report the entry number of the first-listed band with UL in the band combination that switches together with this UL | 2-55 | *srs-AntennaSwitchingBeyond4RX-r17*  *{*  *supportedSRS-TxPortSwitchBeyond4Rx-r17,*  *entryNumberAffectBeyond4Rx-r17,*  *entryNumberSwitchBeyond4Rx-r17*  *}* | *BandParameters-v1710* | n/a | n/a | n/a | Component 1 candidate values: a combination from the set {t1r1, t2r2, t1r2, t4r4, t2r4, t1r4, t2r6, t1r6, t4r8, t2r8, t1r8}  Note: For any indicated value, x shall be equal to or smaller than the one associated with the largest y  Component 2 candidate values: {1 to 32}  Component 3 candidate values: {1 to 32}  Component 2 and Component 3 are optional. If reported, the reported values for component 2 and component 3 are not valid for the same values of xTyR in component 1 reported with Rel-15/16 UE capability reporting | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-4 | Maximum 2 SP and 1 periodic SRS sets for antenna switching | Support of maximum 2 SP SRS resource sets and maximum 1 periodic SRS resource set for antenna switching | 2-53 | *srs-AntennaSwitching2SP-1Periodic-r17* | *FeatureSetUplink-v1710* | n/a | n/a | n/a | Note1:   * Applies for all supported xTyR where y<=8 * For xTyR where y>4, if UE does NOT support this feature, support maximum one SRS resource set for periodic SRS and maximum one SRS resource set for semi-persistent SRS * For xTyR where y<=4, if UE does not support this feature, follow Rel-15 on the number of resource sets for periodic and semi-persistent SRS * The two SP-SRS resource sets are not activated at the same time | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-5 | Increased repetition for SRS | Support of increased repetition patterns (8, 10, 12, 14 symbols) for SRS resource | 10-11, 2-52 | *srs-increasedRepetition-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-6 | Partial frequency sounding of SRS with frequency hopping | Support of partial frequency sounding for SRS with frequency hopping | 2-52 | *srs-partialFrequencySounding-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-7 | Start RB location hopping for partial frequency SRS | Support of start RB location hopping in partial frequency SRS transmission across different SRS frequency hopping periods for periodic/semi-persistent/aperiodoc SRS | 23-8-6 | *srs-startRB-locationHoppingPartial-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-8 | Comb-8 SRS | Support of comb-8 for SRS other than for positioning |  | *srs-combEight-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-9 | Extension of aperiodic SRS configuration for 1T4R, 1T2R and 2T4R | Support of 4 aperiodic SRS resource sets for 1T4R and 2 aperiodic resource sets for 1T2R/2T4R. | 2-53, 2-55 | *srs-ExtensionAperiodicSRS-r17* | *FeatureSetUplink-v1710* | N/A | N/A | N/A | Note: When UE only supports part of {1T4R, 1T2R, 2T4R}, this FG is only applicable to the antenna switching configuration(s) that UE supports | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-10 | 1 aperiodic SRS resource set for 1T4R | Support of 1 aperiodic SRS resource sets for 1T4R. | 10-11, 2-55 | *srs-OneAP-SRS-r17* | *FeatureSetUplink-v1710* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-8-11 | Partial frequency sounding of SRS for non-frequency hopping case | Support of partial frequency sounding for SRS for non-frequency hopping case. | 23-8-6 | *srs-partialFreqSounding-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-9-1 | Basic Features of Further Enhanced Port-Selection Type II Codebook (FeType-II) | 1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support Port-selection FeType-II with M=1 and R=1  2. Support rank 1,2  3. Support parameter combinations with M=1 | 2-35 | *codebookParametersfetype2PerBC-r17* | *CA-ParametersNR-v1700* | n/a | n/a | n/a | Component 1 candidate values:   * Maximum 16 triplets * Max # of Tx ports in one resource: {4,8,12,16,24,32} * Max # resources: {1 to 64} * Max # total ports: {4 to 256} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-9-5 | Active CSI-RS resources and ports for mixed codebook types in any slot | 1. List of codebook combinations  2. List of {max number of ports per resource, max number of resources, max number of total ports} for each codebook combination | 23-9-1, 16-3a, 2-36, 2-40, 2-41, 23-9-2, 23-9-4 | *codebookComboParameterMixedTypePerBC-r17* | *CA-ParametersNR-v1700* | n/a | n/a | n/a | Component 1 candidate values:  Codebook 1 = {Type I SP, Type I MP}  {Codebook 2, Codebook 3} = {{FeType II PS M=1, NULL},{FeType II PS M=2 R=1, NULL}, {FeType II PS M=2 R=2, NULL}, {Type II, FeType II PS M=1}, {Type II, FeType II PS M=2 R=1} ,{eType II R=1, FeType II PS M=1},{eType II R=1, FeType II PS M=2 R=1}}  Component 2 candidate values:  - Maximum 16 triplets for each codebook combination  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256}  Note 1：if a UE reports one or more codebook combinations in 23-9-5, then usage of active CSI-RS resources and ports for multiple codebooks in any slot is allowed only within those combinations  Note 2: For coexisting of mixed codebooks in any slot, gNB need to honor 16-8, 23-9-5 and per-codebook capability 2-36/40/41, 16-3a, and 23-9-1/23-9-2/23-9-4  Note 3: Up to 4 combinations for component 1 | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-9-2 | Support of M=2 and R=1 for FeType-II | 1. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support Port-selection FeType-II with M=2 and R=1  2. Support parameter combinations with M=2 | 23-9-1 | *fetype2R1-r17* | *CodebookParametersfetype2-r17* | n/a | n/a | n/a | Component 1 candidate values  - Maximum 8 triplets  - Max # of Tx ports in one resource: {4,8,12,16,24,32}  - Max # resources: {1 to 64}  - Max # total ports: {4 to 256} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-9-3 | Support of rank 3, 4 for FeType-II | Support of rank 3, 4 for FeType-II | 23-9-1 | *fetype2Rank3Rank4-r17* | *CodebookParametersfetype2-r17* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-9-4 | Support of R = 2 for FeType-II | 1. Support of R = 2 for FeType-II  2. {Max # of Tx ports in one resource, Max # of resources and total # of Tx ports} to support Port-selection FeType-II with M=2 and R=2 | 23-9-2 | *fetype2R2-r17* | *CodebookParametersfetype2-r17* | n/a | n/a | n/a | Component 2 candidate values:  • Maximum 8 triplets  • Max # of Tx ports in one resource: {4,8,12,16,24,32}  • Max # resources: {1 to 64}  • Max # total ports: {4 to 256} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-10-1 | Unified TCI with separate DL/UL TCI update for intra-cell beam management | 1. Separate DL/UL TCI update with their components: (configuration mechanism, QCL rules, applicable source and target signals)  2. The maximum number of configured DL TCI states per BWP per CC  3. The maximum number of configured UL TCI states per BWP per CC  4. One MAC-CE activated DL TCI state per CC in a band  5. One MAC-CE activated UL TCI state per CC in a band  6. TCI state indication for update and activation a) MAC CE based TCI state indication for one active DL/UL TCI state  7. The maximum number of MAC-CE activated DL TCI states across all CC(s) in a band  8. The maximum number of MAC-CE activated UL TCI states across all CC(s) in a band | 23-1-1 | *unifiedSeparateTCI-r17*  *{*  *maxConfiguredDL-TCI-r17,*  *maxConfiguredUL-TCI-r17,*  *maxActivatedDL-TCIAcrossCC-r17,*  *maxActivatedUL-TCIAcrossCC-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 2 candidate value {4, 8, 12, 16, 24, 32, 48, 64, 128}  Component 3 candidate value {4, 8, 12, 16, 24, 32, 48, 64}  Component 7 candidate value {1, 2, 4, 8, 16}  Component 8 candidate value {1, 2, 4, 8, 16}  If a UE supports FG 23-10-1m, the signalled component values (except components 7 and 8) apply to intra- and inter-cell beam management jointly | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-10-1b | Unified TCI with separate DL/UL TCI update for intra-cell beam management with more than one MAC-CE activated separate TCI state per CC | 1. TCI state indication for update and activation  b) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 with DL assignment) c) MAC-CE+DCI-based TCI state indication (use of DCI formats 1\_1/1\_2 without DL assignment)  2. The minimum beam application time in Y symbols per SCS  3. The maximum number of MAC-CE activated DL TCI states per CC in a band  4. The maximum number of MAC-CE activated UL TCI states per CC in a band | 23-10-1 | *unifiedSeparateTCI-multiMAC-CE-r17*  *{*  *minBeamApplicationTime-r17,*  *maxActivatedDL-TCIPerCC-r17,*  *maxActivatedUL-TCIPerCC-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | If a UE supports FG 23-10-1m, the signalled component values also apply to inter-cell beam management | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-10-1d | Per BWP DL/UL-TCI state pool configuration for CA mode | 1. Support of DL/UL TCI state pool configuration per BWP for CA mode | 23-10-1 | *unifiedSeparateTCI-perBWP-CA-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-10-1e | TCI state pool configuration with DL/UL-TCI pool sharing for CA mode | 1. Support of reference BWP/CC configured with reference TCI state pool shared by a set of BWP/CC  2. The maximum number of configured DL TCI state pools across all BWPs and all CCs in a band  3. The maximum number of configured UL TCI state pools across all BWPs and all CCs in a band |  | *unifiedSeparateTCI-ListSharingCA-r17*  *{*  *maxNumListDL-TCI-r17,*  *maxNumListUL-TCI-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component 2 candidate values: {1, 2, 4, 8}  Component 3 candidate values: {1, 2, 4, 8} | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-10-1f | Common multi-CC DL/UL-TCI state ID update and activation with separate DL/UL TCI update | Common multi-CC DL/UL-TCI state ID update and activation | 23-10-1 | *unifiedSeparateTCI-commonMultiCC-r17* | *MIMO-ParametersPerBand* | n/a | n/a | n/a |  | Optional with capability signalling |
| 23. NR\_FeMIMO | 23-10-1m | Unified TCI with separate DL/UL TCI update for inter-cell beam management with more than one MAC-CE activated separate TCI state per CC | 1. Support of unified TCI with separate DL/UL TCI update for inter-cell beam management with more than one MAC-CE activated separate TCI state per CC  2. Support K additional MAC-CE activated DL TCI states per CC in a band  3. Support K additional MAC-CE activated UL TCI states per CC in a band  4. Support K additional MAC-CE activated DL TCI states across all CC(s) in a band  5. Support K additional MAC-CE activated UL TCI states across all CC(s) in a band | 23-10-1 | *unifiedSeparateTCI-InterCell-r17*  *{*  *k-DL-PerCC-r17,*  *k-UL-PerCC-r17,*  *k-DL-AcrossCC-r17,*  *k-UL-AcrossCC-r17*  *}* | *MIMO-ParametersPerBand* | n/a | n/a | n/a | Component candidate values for K: {0,1,2,4}  Note: A UE that supports 23-10-1m supports K additional MAC-CE activated DL and K additional MAC-CE activated UL TCI states across all CC(s) in a band in addition to the maximum number of MAC-CE activated DL and UL TCI states across all CC(s) in a band signalled in FG 23-10-1. The signalled value in component 4 (5) of 23-10-1m plus the signalled value in component 7 (8) of 23-10-1 determine the maximum number of MAC-CE activated DL (UL) TCI states across all CC(s) in a band that are applied to intra and inter-cell beam management jointly. | Optional with capability signalling |

### 6.1.2 NR\_ext\_to\_71GHz

Table 6.1.2-1: Layer-1 feature list for NR\_ext\_to\_71GHz

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 24. NR\_ext\_to\_71GHz | 24-1 | Basic FR2-2 DL support | 1. Support reception of 120kHz subcarrier spacing for DL data and control channels, SSB, and reference signals in FR2-2 for non-initial access |  | *dl-FR2-2-SCS-120kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | A UE that supports FR2-2 must indicate this FG is supported | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1a | Basic FR2-2 UL support | 1. PRACH with 120KHz SCS and length 139  2. Support transmission of 120kHz subcarrier spacing for UL data and control channels and reference signals in FR2-2 | 24-1 | *ul-FR2-2-SCS-120kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1b | Wideband PRACH for 120 kHz in FR2-2 | Enhanced PRACH design for operation by adopting a single long ZC sequence, with ZC sequence equal to 1151 for 120kHz and ZC sequence equal to 571 for 120kHz | 24-1a | *widebandPRACH-SCS-120kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional withcapability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1c | Multi-RB support  PUCCH format 0/1/4 for 120 kHz in FR2-2 | 1. Support multi-RB PUCCH format 4 for 120 kHz  2. Support multi-RB PUCCH format 0/1 for 120 kHz | 24-1a | *multiRB-PUCCH-SCS-120kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1d | Multiple PDSCH scheduling by single DCI for 120kHz in FR2-2 | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS  2. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI | 24-1 | *multiPDSCH-SingleDCI-FR2-2-SCS-120kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1f | Multiple PDSCH scheduling by single DCI for 120kHz in FR2-1 | 1. Multi-PDSCH scheduling by single DCI for the operation with 120 kHz SCS  2. HARQ enhancements for both type 1 and type 2 HARQ codebook for supporting multi-PDSCH scheduling with singe DCI |  | *multiPDSCH-SingleDCI-FR2-1-SCS-120kHz-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1e | Multiple PUSCH scheduling by single DCI for 120kHz in FR2-2 | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS | 24-1a | *multiPUSCH-SingleDCI-FR2-2-SCS-120kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-1g | Multiple PUSCH scheduling by single DCI for 120kHz in FR2-1 | 1. Multi-PUSCH scheduling by single DCI for the operation with 120 kHz SCS with non-contiguous allocation |  | *multiPUSCH-SingleDCI-FR2-1-SCS-120kHz-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-2 | 120KHz SSB support for initial access in FR2-2 | 1. Support 120KHz SSB for initial access in FR2-2 | 24-1, 24-1a | *initialAccessSSB-120kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-3 | 480KHz SSB support for initial access in FR2-2 | 1. Support 480KHz SSB for initial access in FR2-2 | 24-2, 24-4, 24-4a | *initialAccessSSB-480kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4 | 480KHz SCS support for DL | 1. 480KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access  2. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys) = (4,1)  3. Multi- PDSCH scheduling by single DCI for the operation with 480 kHz SCS and corresponding HARQ enhancements  4. Within the Ys = 1 slot (with Xs=4), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a maximum of two monitoring spans per slot with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y) = (4, 3) and (7, 3) are supported  5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD  6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD  7. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the configured monitoring occasion(s) can be any OFDM symbol(s) of any slot(s) of the slot group, and the actual monitoring occasion for any one of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS is within a single span of three consecutive OFDM symbols within a single slot of the slot group. | 24-1 | *dl-FR2-2-SCS-480kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4a | 480KHz SCS support for UL | 1. PRACH with 480KHz and length 139  2. 480KHz SCS for UL data and control channels and reference signal transmission in FR2-2  3. Multi-PUSCH scheduling by single DCI for the operation with 480 kHz SCS | 24-1a, 24-4 | *ul-FR2-2-SCS-480kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4b | Wideband PRACH for 480 kHz in FR2-2 | PRACH with 480KHz and length 571 | 24-4a | *widebandPRACH-SCS-480kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4c | Multi-RB PUCCH format 0/1/4 for 480 kHz in FR2-2 | Support multi-RB PUCCH format 0/1/4 for 480 kHz | 24-4a | *multiRB-PUCCH-SCS-480kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-4f | Enhanced PDCCH monitoring for 480KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 480KHz with (Xs,Ys)=(4,2)  2.) Within each of the Ys = 2 slots (with Xs=4), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot | 24-4 | *enhancedPDCCH-monitoringSCS-480kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5 | 960KHz SCS support for DL | 1. 960KHz SCS for DL data and control channels, SSB, and reference signal reception in FR2-2 for non-initial access  2. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)=(8,1)  3. MultiPDSCH scheduling by single DCI for the operation with 960 kHz SCS and corresponding HARQ enhancements  4. Within the Ys = 1 slot (with Xs=8), monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y)= (7, 3) is supported  5. Processing one unicast DCI scheduling DL and one unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for FDD  6. Processing one unicast DCI scheduling DL and 2 unicast DCI scheduling UL per slot group of Xs slots per scheduled CC for TDD  7. For type 1 CSS without dedicated RRC configuration and for type 0, 0A, and 2 CSS, the configured monitoring occasion(s) can be any OFDM symbol(s) of any slot(s) of the slot group, and the actual monitoring occasion for any one of Type 1- CSS without dedicated RRC configuration, or Types 0, 0A, or 2 CSS is within a single span of three consecutive OFDM symbols within a single slot of the slot group. | 24-1 | *dl-FR2-2-SCS-960kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5a | 960KHz SCS support for UL | 1. PRACH with 960KHz and length 139  2. 960KHz SCS for UL data and control channels and reference signal transmission in FR2-2  3. Multi-PUSCH scheduling by single DCI for the operation with 960 kHz SCS | 24-1a, 24-5 | *ul-FR2-2-SCS-960kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A |  | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5c | Multi-RB PUCCH format 0/1/4 for 960 kHz in FR2-2 | Support multi-RB PUCCH format 0/1/4 for 960 kHz | 24-5a | *multiRB-PUCCH-SCS-960kHz-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | This FG is only applicable when PSD limitation applies within FR2-2 based on the regional regulations | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-5f | Enhanced PDCCH monitoring for 960KHz in FR2-2 | 1. Multiple-slot PDCCH monitoring for 960KHz with (Xs,Ys)  2.) Within each of the Ys = 2 (with Xs=4) or Ys = 4 (with Xs=8) slots, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS in the first 3 OFDM symbols of each slot or within the Ys = 1 (with Xs=4) slot, monitoring of type 1 CSS with dedicated RRC configuration, type 3 CSS, and UE-SS with a span duration of Y symbols and a minimum gap of X symbols between the start of two spans, where (X,Y) = (7, 3) | 24-5 | *enhancedPDCCH-monitoringSCS-960kHz-r17*  *{*  *pdcch-monitoring4-1-r17,*  *pdcch-monitoring4-2-r17,*  *pdcch-monitoring8-4-r17*  *}* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | Component 1 candidate values: one or more of {(4,1), (4,2), (8,4)} | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-6 | Type 1 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 1 channel access procedure  2. Support LBT performed per channel, as defined in 37.213 Clause 4.4 | 24-1a | *type1-ChannelAccess-FR2-2-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-7 | Type 2 channel access procedure in uplink for FR2-2 with shared spectrum channel access | 1. Support Type 2 channel access procedure  2. Support LBT performed per channel, as defined in 37.213 Clause 4.4 | 24-1a, 24-6 | *type2-ChannelAccess-FR2-2-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | A UE that supports FR2-2 must indicate this FG is supported when required by regulation | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-8 | 32 DL HARQ processes for FR 2-2 | Support 32 HARQ processes in DL for 120/480/960 kHz | 24-1 | *support32-DL-HARQ-ProcessPerSCS-r17*  *{*  *scs-120kHz-r17,*  *scs-480kHz-r17,*  *scs-960kHz-r17*  *}* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for DL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for DL in FR2-2 | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-8b | 32 DL HARQ processes for FR 2-2 - maximum number of component carriers | Maximum number of component carriers that can be configured with 32 DL HARQ processes | 24-8 | *maxCC-32-DL-HARQ-ProcessFR2-2-r17* | *CA-ParametersNR-v1700* | N/A | N/A | Candidate component values: {1,2,3,4,6,8,16,32} | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-9 | 32 UL HARQ processes for FR 2-2 | Support 32 HARQ processes in UL for 120/480/960 kHz | 24-1 | *support32-UL-HARQ-ProcessPerSCS-r17*  *{*  *scs-120kHz-r17,*  *scs-480kHz-r17,*  *scs-960kHz-r17*  *}* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | A UE supporting 32 maximum number of HARQ processes for 480/960 kHz SCS for UL shall support 32 as the maximum number of HARQ processes for 120 kHz SCS for UL in FR2-2 | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-9b | 32 UL HARQ processes for FR 2-2 - maximum number of component carriers | Maximum number of component carriers that can be configured with 32 UL HARQ processes | 24-9 | *maxCC-32-UL-HARQ-ProcessFR2-2-r17* | *CA-ParametersNR-v1700* | N/A | N/A | Candidate component values: {1,2,3,4,5,8,16,32} | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-10 | Reduced beam switching time delay | Support of reduced beam switching time delay d = 56 symbols for 480 kHz SCS |  | *reduced-BeamSwitchTiming-FR2-2-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | N/A | If this capability is not reported and the UE supports both FG 24-4 and 24-5, the default value of 112 symbols is assumed | Optional with capability signalling |
| 24. NR\_ext\_to\_71GHz | 24-11a | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs when configured with DL CA with Rel-17 PDCCH monitoring capability on all the serving cells | 24-4 or 24-5 | *pdcch-MonitoringCA-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Candidate values: {4, 5, …, 16} | Optional with capability signaling |
| 24. NR\_ext\_to\_71GHz | 24-11c | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | *pdcch-BlindDetectionMixedList1-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15  Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15  Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R17: {4, 5, …, 16} | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11d | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | *pdcch-BlindDetectionMixedList2-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15  Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15  Range of pdcch-BlindDetectionCA-R16 + pdcch-BlindDetectionCA-R17: {3, 4, 5, …, 16} | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11e | Number of carriers for CCE/BD scaling with DL CA with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionCA-R15, pdcch-BlindDetectionCA-R16, pdcch-BlindDetectionCA-R17) | 24-4 or 24-5 | *pdcch-BlindDetectionMixedList3-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Candidate values for pdcch-BlindDetectionCA-R15: 1 to 15  Candidate values for pdcch-BlindDetectionCA-R16: 1 to 15  Candidate values for pdcch-BlindDetectionCA-R17: 1 to 15  Range of pdcch-BlindDetectionCA-R15 + pdcch-BlindDetectionCA-R16+ pdcch-BlindDetectionCA-R17: {3,4, 5, …, 16} | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11f | Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells | - Capability on the number of CCs for monitoring a maximum number of BDs and non-overlapped CCEs for MCG and for SCG when configured for NR-DC operation with Rel-17 PDCCH monitoring capability on all the serving cells  - Supported combination of (pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17) | 24-4 or 24-5 | *pdcch-BlindDetectionMCG-SCG-List-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Maximum number of supported combinations is {1,…,16}  If the UE reports pdcch-BlindDetectionCA-r17,  - Candidate values for pdcch-BlindDetectionMCG-UE-r17 is 1 to pdcch-BlindDetectionCA-r17-1  - Candidate values for pdcch-BlindDetectionSCG-UE-r17 is 1 to pdcch-BlindDetectionCA-r17-1  - pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17 >= pdcch-BlindDetectionCA-r17  Otherwise, the value of pdcch-BlindDetectionMCG-UE-r17 or of pdcch-BlindDetectionSCG-UE-r17 is {1, 2, 3} | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11g | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17) | 24-4 or 24-5 | *pdcch-BlindDetectionMixedList1-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Maximum number of supported combinations is {1,…,16}  One combination of (pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17) corresponds to one combination of (pdcch-BlindDetectionCA-r15, pdcch-BlindDetectionCA-r17)  If the UE reports pdcch-BlindDetectionCA-r15,  - Candidate values for pdcch-BlindDetectionMCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15  - Candidate values for pdcch-BlindDetectionSCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15  - pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15>= pdcch-BlindDetectionCA-r15  Otherwise,  - Candidate values for pdcch-BlindDetectionMCG-UE-r15 is {0, 1, 2, 3}  - Candidate values for pdcch-BlindDetectionSCG-UE-r15 is {0, 1, 2, 3}  If the UE reports pdcch-BlindDetectionCA-r17,  - Candidate values for pdcch-BlindDetectionMCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17  - Candidate values for pdcch-BlindDetectionSCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17  - pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17>= pdcch-BlindDetectionCA-r17  Otherwise,  - Candidate values for pdcch-BlindDetectionMCG-UE-r17 is {0, 1, 2, 3}  - Candidate values for pdcch-BlindDetectionSCG-UE-r17 is {0, 1, 2, 3} | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11h | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17 and Rel. 16 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17) | 24-4 or 24-5 | *pdcch-BlindDetectionMixedList2-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Maximum number of supported combinations is {1,…,16}  One combination of (pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17) corresponds to one combination of (pdcch-BlindDetectionCA-r16, pdcch-BlindDetectionCA-r17)  If the UE reports pdcch-BlindDetectionCA-r16,  - Candidate values for pdcch-BlindDetectionMCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16  - Candidate values for pdcch-BlindDetectionSCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16  - pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r16>= pdcch-BlindDetectionCA-r16  Otherwise,  - Candidate values for pdcch-BlindDetectionMCG-UE-r16 is {0, 1}  - Candidate values for pdcch-BlindDetectionSCG-UE-r16 is {0, 1}  If the UE reports pdcch-BlindDetectionCA-r17,  - Candidate values for pdcch-BlindDetectionMCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17  - Candidate values for pdcch-BlindDetectionSCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17  - pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17>= pdcch-BlindDetectionCA-r17  Otherwise,  - Candidate values for pdcch-BlindDetectionMCG-UE-r17 is {0, 1, 2}  - Candidate values for pdcch-BlindDetectionSCG-UE-r17 is {0, 1, 2} | Optional with capability |
| 24. NR\_ext\_to\_71GHz | 24-11i | Number of carriers for CCE/BD scaling for MCG and for SCG when configured for NR-DC operation with mix of Rel. 17, Rel. 16 and Rel. 15 PDCCH monitoring capabilities on different carriers | Supported combination(s) of (pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15, pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17) | 24-4 or 24-5 | *pdcch-BlindDetectionMixedList3-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Maximum number of supported combinations is {1,…,16}  One combination of (pdcch-BlindDetectionMCG-UE-r15, pdcch-BlindDetectionSCG-UE-r15,pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16, pdcch-BlindDetectionMCG-UE-r17, pdcch-BlindDetectionSCG-UE-r17) corresponds to one combination of (pdcch-BlindDetectionCA-r15, pdcch-BlindDetectionCA-r16, pdcch-BlindDetectionCA-r17)  If the UE reports pdcch-BlindDetectionCA-r15,  - Candidate values for pdcch-BlindDetectionMCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15  - Candidate values for pdcch-BlindDetectionSCG-UE-r15 is 0 to pdcch-BlindDetectionCA-r15  - pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r15>= pdcch-BlindDetectionCA-r15  Otherwise,  - Candidate values for pdcch-BlindDetectionMCG-UE-r15 is {0, 1}  - Candidate values for pdcch-BlindDetectionSCG-UE-r15 is {0, 1}  If the UE reports pdcch-BlindDetectionCA-r16,  - Candidate values for pdcch-BlindDetectionMCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16  - Candidate values for pdcch-BlindDetectionSCG-UE-r16 is 0 to pdcch-BlindDetectionCA-r16  - pdcch-BlindDetectionMCG-UE-r15 + pdcch-BlindDetectionSCG-UE-r16>= pdcch-BlindDetectionCA-r16  Otherwise,  - Candidate values for pdcch-BlindDetectionMCG-UE-r16 is {0, 1}  - Candidate values for pdcch-BlindDetectionSCG-UE-r16 is {0, 1}  If the UE reports pdcch-BlindDetectionCA-r17,  - Candidate values for pdcch-BlindDetectionMCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17  - Candidate values for pdcch-BlindDetectionSCG-UE-r17 is 0 to pdcch-BlindDetectionCA-r17  - pdcch-BlindDetectionMCG-UE-r17 + pdcch-BlindDetectionSCG-UE-r17>= pdcch-BlindDetectionCA-r17  Otherwise,  - Candidate values for pdcch-BlindDetectionMCG-UE-r17 is {0, 1}  - Candidate values for pdcch-BlindDetectionSCG-UE-r17 is {0, 1} | Optional with capability |

### 6.1.3 NR\_IIOT\_URLLC\_enh

Table 6.1.3-1: Layer-1 feature list for NR\_IIOT\_URLLC\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 25. NR\_IIOT\_URLLC\_enh | 25-1 | SPS HARQ-ACK deferral in case of TDD collision | 1. Identify HARQ-ACK bits of active SPS configurations for deferral in the initial PUCCH slot  2. Determination of the target PUCCH slot for SPS HARQ-ACK deferral  3. Multiplexing and transmission of deferred SPS HARQ-ACK information in the target PUCCH slot  4. Handling of the collision for the same HARQ process due to deferred SPS HARQ-ACK | 5-18 | *sps-HARQ-ACK-Deferral-r17*  *{*  *non-SharedSpectrumChAccess-r17,*  *sharedSpectrumChAccess-r17*  *}* | *Phy-ParametersCommon* | No  (TDD only) | No | Reporting type of FG 25-1 is per UE with licensed/unlicensed and TN/NTN differentiation, detail signalling is up to RAN2  Note: the differentiation as mentioned above are not common differentiation types, and are not described in 38.306 Annex. RAN1 does not imply to formally introduce these as new differentiations. RAN2 can decide the signalling as long as the intention is reflected | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-2 | Repetitions for PUCCH format 0, and 2 over multiple slots with K = 2, 4, 8 | Repetitions for PUCCH format 0 and 2 over multiple slots with K = 2, 4, 8 | 4-23 | *pucch-Repetition-F0-2-r17* | *BandNR* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-3 | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots with configured K = 2, 4, 8 | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots with RRC configured repetition factor K = 2, 4, 8  Note: The support of FG 25-3 doesn’t imply an increase of the maximum number of PUCCHs per slot that supported by the UE | 4-23  11-3 | *pucch-Repetition-F0-1-2-3-4-RRC-Config-r17* | *FeatureSetUplink-v1720* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-3a | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots using dynamic repetition indication | Repetitions for PUCCH format 0, 1, 2, 3 and 4 over multiple PUCCH subslots based on dynamic repetition indication.  Note: Dynamic PUCCH repetition factor indication is only supported for HARQ-ACK | 25-3 | *pucch-Repetition-F0-1-2-3-4-DynamicIndication-r17* | *FeatureSetUplink-v1720* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-3b | Inter-subslot frequency hopping for PUCCH repetitions | 1. Support inter-subslot frequency hopping for PUCCH repetition operation of PUCCH Formats 0, 1, 2, 3 and 4 for 7OS slot-based PUCCH configurations.  2. Support inter-subslot frequency hopping for PUCCH repetition operation of PUCCH Format 0 and Format 2 for 2OS slot-based PUCCH configurations | 25-3 | *interSubslotFreqHopping-PUCCH-r17* | *FeatureSetUplink-v1720* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-4 | One-shot HARQ ACK feedback triggered by DCI format 1\_2 | 1. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 scheduling a PDSCH  2. Support feedback of type 3 HARQ-ACK codebook, triggered by a DCI 1\_2 without scheduling a PDSCH using a reserved FDRA value | 10-16  11-1 | *oneShotHARQ-feedbackTriggeredByDCI-1-2-r17* | *BandNR* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-5 | PHY priority handling for one-shot HARQ ACK feedback | Support transmission of type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI | 10-16  11-4 | *oneShotHARQ-feedbackPhy-Priority-r17* | *BandNR* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-6 | Enhanced type 3 HARQ-ACK codebook feedback | 1. Support feedback of enhanced type 3 HARQ-ACK codebook, triggered by a DCI 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  2. Support configuration of up to 8 enhanced type 3 HARQ-ACK codebooks.  3. Support feedback of a dynamically selected enhanced type 3 HARQ-ACK codebook based on triggering information in DCI 1\_1 and DCI 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  4. Support transmission of enhanced type 3 HARQ-ACK codebook using the first or second PUCCH configuration based on PHY priority indication in the triggering DCI (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4)  5. Supported maximum number of actual PUCCH transmissions for type 3 or enhanced type 3 HARQ-ACK codebook feedback within a slot | 10-16 | *enhancedType3-HARQ-CodebookFeedback-r17*  *{*  *enhancedType3-HARQ-Codebooks-r17,*  *maxNumberPUCCH-Transmissions-r17*  *}* | *BandNR* | N/A | N/A | For component 2, the UE indicates its capability in the number of enhanced type 3 HARQ-ACK codebooks: {1, 2, 4, 8}  For component 3, the dynamic indication is only supported if the UE for component 2 supports more than one enhanced type 3 HARQ-ACK codebook to be configured  Candidate values for component 5 is: {1, 2, 3, 4, 5, 6, 7}. | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-7 | Triggered HARQ-ACK codebook re-transmission | 1. Support HARQ-ACK re-transmission from an earlier PUCCH slot based on the triggering information in DCI format 1\_1 and DCI format 1\_2 (for a UE supporting DCI format 1\_2, 11-1)  2. Support the related PHY priority handling in terms of HARQ-ACK codebook selection and the applicable PUCCH configuration (for a UE supporting two HARQ-ACK codebooks / PUCCH config in 11-4)  3. Supported minimum value M for the HARQ re-tx offset  4. Supported maximum value N for the HARQ re-tx offset |  | *triggeredHARQ-CodebookRetx-r17*  *{*  *minHARQ-Retx-Offset-r17,*  *maxHARQ-Retx-Offset-r17*  *}* | *BandNR* | N/A | N/A | Candidate values for component 3 is: M = {-7, -5, …, 1}  Candidate values for component 4 is: N= {4, 6, …, 24}  Note: The minimum requirement for Component 3 and Component 4 of FG 25-7 is valid for HARQ CBs consisted of HARQ Processes with a single HARQ bit per HARQ Process ID | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-8 | Semi-static HARQ-ACK codebook for sub-slot PUCCH | Semi-static (Type 1) HARQ-ACK codebook for sub-slot based PUCCH configuration | 4-11, 11-3 | *semiStaticHARQ-ACK-CodebookSub-SlotPUCCH-r17* | *FeatureSetUplink-v1720* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-9 | Semi-static PUCCH cell switching for a single PUCCH group only | 1. Semi-static PUCCH cell switching using configured time-domain domain pattern of applicable PUCCH cell / carrier for a single PUCCH group only. This component indicates one of the candidate values {only primary PUCCH group can support PUCCH cell switch, only secondary PUCCH group can support PUCCH cell switch, either primary or secondary PUCCH group can support PUCCH cell switch}  2. For the PUCCH group supporting semi-static PUCCH cell switch, for a BC, the UE reports one or multiple of supported configuration(s) of PUCCH group config, where each supported configuration includes the following information  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD} |  | *semiStaticPUCCH-CellSwitchSingleGroup-r17*  *{*  *pucch-Group-r17,*  *pucch-Group-Config-r17*  *}* | *CA-ParametersNR-v1720* | N/A  (TDD only) | N/A | Note: this feature applies to cells in the same TAG only  If UE supporting this FG also supports both FGs 6-9 and 6-9a or both FGs 22-7b and 22-7c or FGs 22-6 or 22-6a when UE is not configured with two NR PUCCH groups, the UE supports the cases of both same and different numerologies between switchable cells. Otherwise, the UE supports the case of same numerology between switchable cells | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-9a | Semi-static PUCCH cell switching for two PUCCH groups | Semi-static PUCCH cell switching using configured time-domain domain pattern of applicable PUCCH cell / carrier  For the BC, the UE reports one or multiple of supported configuration(s) of {primary PUCCH group config, secondary PUCCH group config} where for each supported configuration,  - The “primary PUCCH group config” includes following information:  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD}  - The “secondary PUCCH group config” includes following information:  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD} |  | *semiStaticPUCCH-CellSwitchTwoGroups-r17* | *CA-ParametersNR-v1720* | N/A  (TDD only) | N/A | Note: this feature applies to cells in the same TAG only  If UE supporting this FG also supports both FGs 6-9 and 6-9a or both FGs 22-7b and 22-7c, the UE supports the cases of both same and different numerologies between switchable cells. Otherwise, the UE supports the case of same numerology between switchable cells | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-10 | PUCCH cell switching based on dynamic indication for same length of overlapping PUCCH slots/sub-slots for a single PUCCH group only | 1. PUCCH cell switching based on dynamic indication in the DCI scheduling the PUCCH for same length (in physical time) of overlapping PUCCH slots/sub-slots for a single PUCCH group only. This component indicates one of the candidate values {only primary PUCCH group can support PUCCH cell switch, only secondary PUCCH group can support PUCCH cell switch, either primary or secondary PUCCH group can support PUCCH cell switch}  2. For the PUCCH group supporting PUCCH cell switching based on dynamic indication in the DCI scheduling the PUCCH for same length (in physical time) of overlapping PUCCH slots/sub-slots, for a BC, the UE reports one or multiple of supported configuration(s) of PUCCH group config, where each supported configuration includes the following information  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD} |  | *dynamicPUCCH-CellSwitchSameLengthSingleGroup-r17*  *{*  *pucch-Group-r17,*  *pucch-Group-Config-r17*  *}* | *CA-ParametersNR-v1720* | N/A (TDD only) | N/A | Note: this feature applies to cells in the same TAG only  If UE supporting this FG also supports both FGs 6-9 and 6-9a or both FGs 22-7b and 22-7c or FGs 22-6 or 22-6a when UE is not configured with two NR PUCCH groups, the UE supports the cases of both same and different numerologies between switchable cells. Otherwise, the UE supports the case of same numerology between switchable cells | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-10a | PUCCH cell switching based on dynamic indication for different length of overlapping PUCCH slots/sub-slots for a single PUCCH group only | 1. PUCCH cell switching based on dynamic indication in the DCI scheduling the PUCCH for different length (in physical time) of overlapping PUCCH slots/sub-slots for a single PUCCH group only. This component indicates one of the candidate values {only primary PUCCH group can support PUCCH cell switch, only secondary PUCCH group can support PUCCH cell switch, either primary or secondary PUCCH group can support PUCCH cell switch}  2. For the PUCCH group supporting PUCCH cell switching based on dynamic indication in the DCI scheduling the PUCCH for different length (in physical time) of overlapping PUCCH slots/sub-slots, for a BC, the UE reports one or multiple of supported configuration(s) of PUCCH group config, where each supported configuration includes the following information  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD} |  | *dynamicPUCCH-CellSwitchDiffLengthSingleGroup-r17*  *{*  *pucch-Group-r17,*  *pucch-Group-Config-r17*  *}* | *CA-ParametersNR-v1720* | N/A  (TDD only) | N/A | Note: this feature applies to cells in the same TAG only  If UE supporting this FG also supports both FGs 6-9 and 6-9a or both FGs 22-7b and 22-7c or FGs 22-6 or 22-6a when UE is not configured with two NR PUCCH groups, the UE supports the cases of both same and different numerologies between switchable cells. Otherwise, the UE supports the case of same numerology between switchable cells | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-10b | PUCCH cell switching based on dynamic indication for same length of overlapping PUCCH slots/sub-slots for two PUCCH groups | PUCCH cell switching based on dynamic indication in the DCI scheduling the PUCCH for same length (in physical time) of overlapping PUCCH slots/sub-slots for two PUCCH groups  For the BC, the UE reports one or multiple of supported configuration(s) of {primary PUCCH group config, secondary PUCCH group config} where for each supported configuration,  - The “primary PUCCH group config” includes following information:  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD}  - The “secondary PUCCH group config” includes following information:  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD |  | *dynamicPUCCH-CellSwitchSameLengthTwoGroups-r17* | *CA-ParametersNR-v1720* | N/A  (TDD only) | N/A | Note: this feature applies to cells in the same TAG only  If UE supporting this FG also supports both FGs 6-9 and 6-9a or both FGs 22-7b and 22-7c, the UE supports the cases of both same and different numerologies between switchable cells. Otherwise, the UE supports the case of same numerology between switchable cells | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-10c | PUCCH cell switching based on dynamic indication for different length of overlapping PUCCH slots/sub-slots for two PUCCH groups | PUCCH cell switching based on dynamic indication in the DCI scheduling the PUCCH for different length (in physical time) of overlapping PUCCH slots/sub-slots for two PUCCH groups  For the BC, the UE reports one or multiple of supported configuration(s) of {primary PUCCH group config, secondary PUCCH group config} where for each supported configuration,  - The “primary PUCCH group config” includes following information:  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD}  - The “secondary PUCCH group config” includes following information:  - one or multiple carrier type pairs that can support PUCCH cell switch, where the carrier type are selected from {FR1 licensed TDD, FR2 licensed TDD} |  | *dynamicPUCCH-CellSwitchDiffLengthTwoGroups-r17* | *CA-ParametersNR-v1720* | N/A  (TDD only) | N/A | Note: this feature applies to cells in the same TAG only  If UE supporting this FG also supports both FGs 6-9 and 6-9a or both FGs 22-7b and 22-7c, the UE supports the cases of both same and different numerologies between switchable cells. Otherwise, the UE supports the case of same numerology between switchable cells | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-11 | 4-bits subband CQI | Subband CQI reporting with 4 bits per subband |  | *cqi-4-BitsSubbandTN-NonSharedSpectrumChAccess-r17* | *Phy-ParametersFRX-Diff* | No | No | This FG is reported for TN and licensed | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-11a | 4-bits subband CQI for NTN and unlicensed | Subband CQI reporting with 4 bits per subband for NTN and unlicensed |  | *cqi-4-BitsSubbandNTN-SharedSpectrumChAccess-r17* | *BandNR* | N/A | N/A | This FG is reported for NTN and unlicensed | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-12 | UE initiating a semi-static channel occupancy with configurations dependent on gNB semi-static channel access configurations | 1. Support initiating a semi-static channel access occupancy by the UE where the corresponding period is the same as, integer multiple of, or inter-factor of the period configured for a semi-static channel occupancy that can be initiated by gNB.  2. Sensing to initiate a semi-static CO or transmit after a gap greater than 16us from any transmission burst within a UE-initiated CO  3. Determination of COT initiator assumption based on rules for configured UL  4. Validating COT initiator assumption indicated in UL scheduling DCI | 10-1a | *ul-Semi-StaticChAccessDependentConfig-r17* | *SharedSpectrumChAccessParamsPerBand-v1710* | N/A | N/A | The signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-13 | UE initiating a semi-static channel occupancy with independent configurations from gNB semi-static channel access configurations | Support initiating a semi-static channel access occupancy by the UE where the corresponding period is independently configured from the period configured for a semi-static channel occupancy that can be initiated by gNB. | 10-1a, 25-12 | *ul-Semi-StaticChAccessIndependentConfig-r17* | *SharedSpectrumChAccessParamsPerBand-v1710* | N/A | N/A | The signaling is per band but is only expected for a band where shared spectrum channel access must be used | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-14 | PHY prioritization of overlapping low-priority DG-PUSCH and high-priority CG-PUSCH | 1. Support PHY prioritization for the case where low-priority DG-PUSCH collides with high-priority CG-PUSCH  2. Configuration of PHY priority level for CG PUSCH, and dynamic indication of priority level for dynamic PUSCH with a single DCI format  3. Maximum number of supported carriers on the band across a set of contiguous carriers for the reported FS of that band |  | *phy-PrioritizationLowPriorityDG-HighPriorityCG-r17* | *FeatureSetUplink-v1720* | N/A | N/A | Candidate value set for component 3: {1, 2, …, 16} | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-15 | PHY prioritization of overlapping high-priority DG-PUSCH and low-priority CG-PUSCH | 1. Support PHY prioritization of overlapping high-priority dynamic grant PUSCH and low-priority configured grant PUSCH on a BWP of a serving cell  2. Configuration of PHY priority level for CG PUSCH, and dynamic indication of priority level for dynamic PUSCH with a single DCI format  3. Additional number of symbols (d1) needed beyond the PUSCH preparation time for cancelling a low priority UL transmission.  4. Additional number of symbols (d3) needed on top of Rel-16 cancellation time (which results N2+d1+d3 in total cancellation time).  5. Maximum number of supported carriers on the band across a set of contiguous carriers for the reported FS of that band |  | *phy-PrioritizationHighPriorityDG-LowPriorityCG-r17*  *{*  *pusch-PreparationLowPriority-r17,*  *additionalCancellationTime-r17*  *{*  *scs-15kHz-r17,*  *scs-30kHz-r17,*  *scs-60kHz-r17,*  *scs-120kHz-r17*  *},*  *maxNumberCarriers-r17*  *}* | *FeatureSetUplink-v1720* | N/A | N/A | Candidate value set for component 3: {0, 1, 2}  Candidate value set for component 4: d3 = {0, 1, …, 2𝜇+1} symbol(s) upon UE capability report, where 𝜇=0,1,2,3 for SCS=15/30/60/120kHz, respectively.  Candidate value set for component 5: {1, 2, …, 16} | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-16 | HARQ-ACK with different priorities multiplexing on a PUCCH/PUSCH | 1. Support multiplexing a high-priority HARQ-ACK and a low-priority HARQ-ACK into a PUCCH. Support separate coding for the two HARQ-ACKs.  3. Support multiplexing a low-priority HARQ-ACK, a high-priority HARQ-ACK and a high-priority SR into a PUCCH.  4. Support multiplexing a low-priority HARQ-ACK in a high-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.  5. Support multiplexing a high-priority HARQ-ACK in a low-priority PUSCH (conveying UL-SCH only). Support separate beta\_offset values for this priority combination.  6. Support multiplexing a low-priority HARQ-ACK, a high-priority PUSCH, a high-priority HARQ-ACK and/or CSI.  7. Support multiplexing a high-priority HARQ-ACK, a low-priority PUSCH, a low-priority HARQ-ACK and/or CSI. | 11-4 | *mux-HARQ-ACK-DiffPriorities-r17* | *BandNR* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-18 | Parallel PUCCH and PUSCH transmission across CCs in inter-band CA | Support simultaneous PUCCH and PUSCH transmissions of different priority on different cells for inter-band CA. | 6-6 | *parallelTxPUCCH-PUSCH-r17* | *CA-ParametersNR-v1700* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-19 | RTT-based Propagation delay compensation based on CSI-RS for tracking and SRS | Support RTT-based Propagation delay compensation for time synchronization of the Uu interface based on CSI-RS for tracking and SRS | 2-51, 2-53 | *rtt-BasedPDC-CSI-RS-ForTracking-r17* | *FeatureSetDownlink-v1720* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-19a | RTT-based Propagation delay compensation based on DL PRS for RTT-based PDC and SRS | 1. Support RTT-based Propagation delay compensation for time synchronization of the Uu interface based on DL PRS and SRS  2. Max number of DL PRS Resources in DL PRS Resource Set for PDC  Values = {1, 2, 4, 8, 16, 32, 64}  Note: 16, 32, 64 are only applicable to FR2 bands  3. Max number of DL PRS resources that UE can process in a slot.  a) FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  b) FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz | 2-53 | *rtt-BasedPDC-PRS-r17*  *{*  *maxNumberPRS-Resource-r17,*  *maxNumberPRS-ResourceProcessedPerSlot-r17,*  *{*  *scs-15kHz-r17,*  *scs-30kHz-r17,*  *scs-60kHz-r17,*  *scs-120kHz-r17*  *},*  *}* | *FeatureSetDownlink-v1720* | N/A | N/A |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-19b | Support of PRS as spatial relation RS for SRS | Support of PRS as spatial relation RS for SRS | 25-19a | *prs-AsSpatialRelationRS-For-SRS-r17* | *FeatureSetDownlink-v1730* | N/A | N/A (FR2 only) |  | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-20 | Propagation delay compensation based on legacy TA procedure | Support propagation delay compensation based on legacy TA procedure |  | *ta-BasedPDC-TN-NonSharedSpectrumChAccess-r17* | *Phy-ParametersCommon* | no | no | This FG is reported for TN and licensed | Optional with capability signaling |
| 25. NR\_IIOT\_URLLC\_enh | 25-20a | Propagation delay compensation based on legacy TA procedure for NTN and unlicensed | Support propagation delay compensation based on legacy TA procedure for NTN and unlicensed |  | *ta-BasedPDC-NTN-SharedSpectrumChAccess-r17* | *BandNR* | N/A | N/A | This FG is reported for NTN and unlicensed | Optional with capability signaling |

### 6.1.4 NR\_NTN\_solutions

Table 6.1.4-1: Layer-1 feature list for NR\_NTN\_solutions

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 26. NR\_NTN\_solutions | 26-1 | Uplink Time and Frequency pre-compensation and timing relationship enhancements | 1. Support of UE specific TA calculation based on its GNSS-acquired position and the serving satellite ephemeris.  2. Support of common TA calculation according to the parameters provided by the network (UE considers common TA as 0 if the parameters are not provided)  3. For TA update in RRC\_CONNECTED state, support of combination of both open (i.e. UE autonomous TA estimation, and common TA estimation) and closed (i.e., received TA commands) control loops  4. Support of pre-compensation of the calculated TA in its uplink transmissions  5. Support of estimating UE-gNB RTT and delaying the start of RAR window by UE-gNB RTT  6. Support of frequency pre-compensation to counter shift the Doppler experienced on the service link  7. Support of determining timing of the scheduling of PUSCH, PUCCH and PDCCH ordered PRACH, CSI reference resource, transmission of aperiodic SRS activation of TA command, first PUSCH transmission in CG Type 2 with cell-specific K\_offset if indicated  8. Support of determining timing of the UE action and assumption on a downlink configuration carried by MAC CE command by K\_mac if it is indicated and determining the timing of PDCCH monitoring in recovery search space using K-mac during beam failure recovery procedure  9. Support of UE receiving cell-specific K\_offset/K\_mac in system information |  | *uplinkPreCompensation-r17* | *BandNR* | No | No | An NTN UE is required to at least support UE specific TA and frequency calculation based at least on its GNSS-acquired position and the serving satellite ephemeris  Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional with capability signalling  For UE supports NR communication via satellite, UE must indicate this FG is supported. |
| 26. NR\_NTN\_solutions | 26-4 | UE reporting of information related to TA pre-compensation | 1. Support UE reporting of information related to TA pre-compensation | 26-1 | *uplink-TA-Reporting-r17* | *BandNR* | No | No | Note: The exact content of UE reporting of information about the TA pre-compensation is up to RAN2  Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optionalwith capability signalling |
| 26. NR\_NTN\_solutions | 26-5 | Increasing the number of HARQ processes | 1. The maximal supported HARQ process number is X for UL and Y for DL |  | *max-HARQ-ProcessNumber-r17* | *BandNR* | No | No | Candidate component values for (X,Y): {(16,32),(32,16),(32,32)}  Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional with capability signalling |
| 26. NR\_NTN\_solutions | 26-6 | Type-2 HARQ codebook enhancement | 1. Support of type-2 HARQ codebook enhancements when there are feedback-disabled HARQ processes | harq-FeedbackDisabled | *type2-HARQ-Codebook-r17* | *BandNR* | No | No | Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional with capability signalling |
| 26. NR\_NTN\_solutions | 26-6a | Type-1 HARQ codebook enhancement | 1. Support of Type-1 HARQ codebook enhancements when there are feedback-disabled HARQ processes | harq-FeedbackDisabled | *type1-HARQ-Codebook-r17* | *BandNR* | No | No | Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional with capability signalling |
| 26. NR\_NTN\_solutions | 26-6b | Type-3 HARQ codebook enhancement | 1. Support of Type-3 HARQ codebook enhancements when there are feedback-disabled HARQ processes | harq-FeedbackDisabled | *type3-HARQ-Codebook-r17* | *BandNR* | No | No | Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional with capability signalling |
| 26. NR\_NTN\_solutions | 26-8 | Support of polarization signalling in NR NTN | 1. Support polarization indication reception in SIB indicating DL and/or UL polarization information using respective polarization type parameters to indicate: RHCP or LHCP or linear  2. Support polarization signalling for target serving cell in handover command message  3. Support polarization signalling for non-serving cell in RRM measurement configuration |  | n/a | n/a | No | No | Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional without capability signalling |
| 26. NR\_NTN\_solutions | 26-9 | UE-specific K\_offset | 1. Support of reception of UE-specific K\_offset via MAC-CE  Support of determining the timing of PUSCH, PUCCH, CSI reference resource, transmission of aperiodic SRS, activation of TA command, first PUSCH transmission in CG Type 2 with UE-specific Koffset | 26-1, 26-4 | *ue-specific-K-Offset-r17* | *BandNR* | No | No | Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional with capability signalling |
| 26. NR\_NTN\_solutions | 26-10 | K1 range extension | 1. Support of extended K1 value range of (0..31) for unpaired spectrum |  | *k1-RangeExtension-r17* | *BandNR* | No | No | Note: This UE feature group is applicable only for bands in Table 5.2.2-1 in TS 38.101-5 and HAPS operation bands in Clause 5.2 of TS 38.104 | Optional with capability signalling |

### 6.1.5 NR\_pos\_enh

Table 6.1.5-1: Layer-1 feature list for NR\_pos\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] or TS 37.355 [9] | Parent IE in TS 38.331 [2] or TS 37.355 [9] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 27. NR\_pos\_enh | 27-1-1 | UE-RxTEGs for UE-assisted DL TDOA and/or Multi-RTT positioning | 1. Support of UE-RxTEGs for UE-assisted DL TDOA and/or Multi-RTT positioning  2. The maximum number of UE-RxTEG, which is supported and reported by UE for UE assisted DL TDOA and/or Multi-RTT positioning | 13-1, one or more of {13-3, 13-4} | *nr-UE-RxTEG-ID-MaxSupport-r17* | *LPP*  *NR-UE-TEG-ID-CapabilityPerBand-r17* | n/a | n/a | Component 1 candidate values: {UE-assisted DL TDOA, Multi-RTT positioning, UE-assisted DL TDOA and Multi-RTT positioning}  Component 2 candidate values: {1, 2, 3, 4, 6, 8}  Note: a single value is reported when both multi-RTT and DL-TDOA are supported  Need for location server to know if the feature is supported  If the UE does not include RxTEG-ID associated with a measurement, no assumption can be made on the UE Rx timing errors for this measurement  Note: The “per band” reporting on this capability does not imply, that the RxTEG IDs in the measurement report are grouped per band; In the measurement report, the RxTEG ID can span from 0, up to 31 | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-1-2 | Support of UE-TxTEGs for UL TDOA | The maximum number of UE-TxTEG for SRS resource for positioning, which is supported and reported by UE for UL TDOA | 13-8 | *nr-UE-TxTEG-ID-MaxSupport-r17* | *RRC*  *BandNR*  *LPP*  *NR-UE-TEG-ID-CapabilityPerBand-r17* | n/a | n/a | The candidate values are {1,2,3,4,6,8}  Need for location server to know if the feature is supported  Note: It should support the serving gNB to request the UE to provide the association information of UL SRS resources for positioning with Tx TEGs to the serving gNB for UL TDOA  Note: If the UE does not include TxTEG-ID associated with a SRS resource for positioning, no assumption can be made on the UE Tx timing error for this SRS resource for positioning. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-1-2a | Support of UE-TxTEGs for Multi-RTT positioning | The maximum number of UE-TxTEG, which is supported and reported by UE for Multi-RTT positioning | 13-4, 13-8 | *nr-UE-TxTEG-ID-MaxSupport-r17* | *LPP*  *NR-UE-TEG-ID-CapabilityPerBand-r17* | n/a | n/a | The candidate values are {1,2,3,4,6,8}  Need for location server to know if the feature is supported  If the UE does not include TxTEG-ID associated with a measurement, no assumption can be made on the UE Tx timing errors for this SRS resource for positioning  Note: It should support the LMF to request the UE to provide the association information of UL SRS resources for positioning with Tx TEGs directly to the LMF for Multi-RTT if Multi-RTT is supported by UE | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-1-3 | Support of UE-RxTxTEGs for Multi-RTT | The maximum number of UE-RxTxTEG, which is supported and reported by UE for Multi-RTT positioning | 13-4 and 13-8 | *nr-UE-RxTxTEG-ID-MaxSupport-r17* | *LPP*  *NR-UE-TEG-ID-CapabilityPerBand-r17* | n/a | n/a | The candidate values are {1, 2, 4, 6, 8, 12, 16, 24, 32, 36, 48, 64}  Need for location server to know if the feature is supported  If the UE does not include RxTxTEG-ID associated with a measurement, no assumption can be made on the UE RxTx timing errors for this measurement  Note: The “per band” reporting on this capability does not imply, that the RxTxTEG IDs in the measurement report are grouped per band; In the measurement report, the RxTxTEG ID can span from 0, up to 255 | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-1-4 | Support of UE Rx TEGs for measuring the same DL PRS resource | The maximum number of different UE-RxTEGs that a UE can support to measure the same DL PRS of a TRP | 27-1-1 | *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* | *LPP*  *NR-UE-TEG-ID-CapabilityPerBand-r17* | n/a | n/a | The candidate values are {2, 3, 4, 6, 8}  Need for location server to know if the feature is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-1-4a | Support of UE Rx TEGs for measuring the same DL PRS resource simultaneously | The maximum number of UE Rx TEGs for measuring the same DL PRS resource simultaneously | 27-1-4 | *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul-r17* | *LPP*  *NR-UE-TEG-ID-CapabilityPerBand-r17* | n/a | n/a | The candidate values are {1,2,3,4,6,8}  Need for location server to know if the feature is supported. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-2-1 | DL PRS RSRPP measurement report of the first path for UE-assisted DL-AoD | 1.) Support of measuring and reporting the PRS RSRPP of the first path for DL-AoD positioning method  2.) The maximum number of first path PRS RSRPP per TRP | 13-5 | *maxDL-PRS-FirstPathRSRP-MeasPerTRP-r17* | *LPP*  *DL-AoD-MeasCapabilityPerBand-r16* | n/a | n/a | Component 2 candidate values: 1, 2,4,8,16,24  Need for location server to know if the feature is supported  The maximum number of first path PRS RSRP per TRP should be less than or equal to the maximum number of PRS RSRP (27-2-2) | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-2-2 | DL PRS RSRP reporting for more than 8 measurements for UE-assisted DL-AoD positioning | Support reporting K> 8 DL PRS RSRP measurements per TRP. | 13-5 | *maxDL-PRS-RSRP-MeasurementFR1-v1730*  *maxDL-PRS-RSRP-MeasurementFR2-v1730* | *LPP*  *NR-DL-AoD-MeasurementCapability-r16* | n/a | Yes | The candidate values are {16, 24}  Note: Multiple RSRPs corresponding to same or different Rx Beam index should be able to be reported for a given PRS resource for different timestamps.  Need for location server to know if the feature is supported  The maximum number of reported DL PRS RSRP in the capability signaling should be no less than the maximum number of reported DL PRS RSRPP of the first path in the capability signaling | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-3-1 | M-sample measurements in RRC\_CONNECTED | The capability to support reporting a measurement based on measuring M=1 or 2 samples (instances) of a DL PRS resource set | 13-1 | *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED-r17* | *LPP*  *PRS-ProcessingCapabilityPerBand-r16* | n/a | n/a | Need for location server to know if the feature is supported  Note: this feature is supported for both UE-assisted and UE based positioning | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-3-2 | DL PRS measurement outside MG and in a PRS processing window | 1. Supported PRS processing types subject to the UE determining that DL PRS to be higher priority for PRS measurement outside MG and in a PRS processing window  2. Support of priority handing options of PRS: Option1, Option2 or Option3  − Option 1: Support of "st1" and "st3" defined in clause 5.1.6.5 of TS 38.214 [20]  − Option 2: Support of "st1", "st2", and "st3" defined in clause 5.1.6.5 of TS 38.214 [20]  - Option 3: Support of "st1" only defined in clause 5.1.6.5 of TS 38.214 [20] | 13-1 | *prs-ProcessingWindowType1A-r17*  *prs-ProcessingWindowType1B-r17*  *prs-ProcessingWindowType2-r17* | *RRC*  *BandNR*  *LPP*  *PRS-ProcessingCapabilityPerBand-r16* | n/a | n/a | Component 1 candidate values: One or more of {Type 1A, Type 1B, Type 2}  Component 2 candidate values: {option1, option2, option3}  Need for location server to know if the feature is supported  Note: Component 2 can be reported per supported band for each type supported by the UE, details left to RAN2  Note:  - Type 1A refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from all DL CCs (per UE) are affected across LTE and NR  - Type 1B refers to the determination of prioritization between DL PRS and other DL signals/channels in all OFDM symbols within the PRS processing window. The DL signals/channels from a certain band are affected  - Type 2 refers to the determination of prioritization between DL PRS and other DL signals/channels only in DL PRS symbols within the PRS processing window  Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability options  Note: Within a PRS processing window, UE measurement is inside the active DL BWP with PRS having the same numerology as the active DL BWP  Note: Support of configuration of PRS processing window in RRC and support of using DL MAC CE to activate/deactivate the PRS processing window for PRS measurements is part of the FG , but no dedicated signaling is required.  A UE that supports FG 27-3-3 must indicate this FG is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-3-3 | DL PRS Processing Capability outside MG - buffering capability | 1. DL PRS buffering capability  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  2a. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE  2b. Duration of DL PRS symbols N2 in units of ms a UE can process inT2 ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE  3. Max number of DL PRS resources that UE can process in a slot  4. Maximum DL PRS bandwidth in MHz, which is supported and reported by UE for PRS measurement outside MG within the PPW | 27-3-2 | *PRS-ProcessingCapabilityOutsideMGinPPWperType-r17* | *RRC*  *BandNR*  *LPP*  *PRS-ProcessingCapabilityPerBand-r16* | n/a | n/a | Component 1 candidate values: {Type 1, Type 2}  Component 2a candidate values:   1. T: {1, 2, 4, 8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms 2. N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms   Candidate 2b component values:  a) N2: {0.125, 0.25, 0.5, 1, 2, 3, 4, 5, 6, 8, 12} ms  b) T2: {4, 5, 6, 8} ms  Component 3 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Component 4 candidate values:  FR1 bands: {5, 10, 20, 40, 50, 80, 100}  FR2 bands: {50, 100, 200, 400}  Need for location server to know if the feature is supported  Note 1:The (N, T) UE capabilities are interpreted as legacy (N, T) in FG 13-1, and the UE is expected to receive the PRS within the PRS processing window and but the processing of the received PRS may be outside a PRS processing window.    The (N2, T2) UE capabilities are interpreted such that the UE is capable of measuring up to N2 ms PRS within a PPW and is capable of completing the PRS processing within the PPW, e.g., if the time duration from the last symbol of the measured PRS resource(s) inside the PPW, to the end of PPW is not smaller than T2 ms    Note 3: UE shall support either component 2a and component 2b , but not both for each supported type in a band  Note 4: A UE shall declare PRS processing capabilities of each of the supported Type-1A, Type-1B, Type-2 capabilities in case it supports multiple types in a band  A UE that supports FG 27-3-2 must indicate this FG is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-4-1 | LOS/NLOS Indicator for UE-assisted positioning | 1. Support reporting LoS/NLoS indicator type to LMF  2. LOS/NLOS indicator granularity | one of 13-5,13-6, or 13-11 | *nr-los-nlos-AssistanceDataSupport-r17* | *LPP*  *NR-DL-AoD-ProvideCapabilities-r16*  *NR-DL-TDOA-ProvideCapabilities-r16* | n/a | n/a | Component 1 candidate values: {hard value, hard+soft value}  Component 2 candidate values: {trpSpecific, resourceSpecific, both}  Note: a single value is reported when both multi-RTT and DL-TDOA are supported  Need for location server to know if the feature is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-6 | DL PRS processing capabilities in RRC inactive state | 1. DL PRS buffering capability  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  2. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE  3. Max number of DL PRS resources that UE can process in a slot |  | *dl-PRS-BufferType-RRC-Inactive-r17*  *durationOfPRS-Processing-RRC-Inactive-r17*  *{*  *durationOfPRS-ProcessingSymbols-r17,*  *durationOfPRS-ProcessingSymbolsInEveryTms-r17*  *}*  *maxNumOfDL-PRS-ResProcessedPerSlot-RRC-Inactive-r17* | *LPP*  *PRS-ProcessingCapabilityPerBand-r16* | n/a | n/a | Component 1 candidate values: {Type 1, Type 2}  Component 2 candidate values:  T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 3 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz  Need for location server to know if the feature is supported  Note: Having the PRS processing capabilities in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-7 | Multiple measurement instances which can be included in a single measurement report | Support of multiple measurement instances which can be included in a single measurement report |  | *multiMeasInSameMeasReport-r17* | *LPP*  *NR-DL-TDOA-ProvideCapabilities-r16*  *NR-DL-AoD-ProvideCapabilities-r16*  *NR-Multi-RTT-ProvideCapabilities-r16* | No | No |  | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-8 | Support of PRS TEG association information for UE-based DL-TDOA | Support of reception of association between PRS and TRP Tx TEG for UE-based positioning | 13-1 | *nr-PosCalcAssistanceSupport-r17* | *LPP*  *NR-DL-TDOA-ProvideCapabilities-r16* | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-9 | Support of lower Rx beam sweeping factor | 1. Support of the lower Rx beam sweeping factor than 8 for FR2  2. Number of Rx beam sweeping factors |  | *supportedLowerRxBeamSweepingFactor-FR2-r17* | *LPP*  *PRS-ProcessingCapabilityPerBand-r16* | n/a | n/a  FR2 only | Component 2 candidate values: {1,2,4,6}  Need for location server to know if the feature is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-10 | Support of UL MAC CE based MG activation request for PRS measurements | 1. Support of using UL MAC CE to request measurement gap activation/deactivation for PRS measurements: The information in the UL MAC CE for MG activation request by the UE can be one ID associated with the preconfiguration of the MG  2. Support of preconfiguration of MGs in RRC signaling for PRS measurements: Each MG in the preconfiguration is associated with an ID | 27-11 | *mg-ActivationRequestPRS-Meas-r17* | *RRC*  *MAC-ParametersCommon* | No | No |  | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-10a | Low latency MG activation request for PRS measurements | support of low latency MG activation request for PRS measurements | 27-10, 27-11 | *mg-ActivationRequest-r17* | *LPP*  *NR-DL-TDOA-ProvideCapabilities-r16*  *NR-DL-AoD-ProvideCapabilities-r16*  *NR-Multi-RTT-ProvideCapabilities-r16* | No | No | Need for location server to know if the feature is supported  Note: RAN1 understands that FG 27-10a is intended only for the LMF to know, and that the current prerequisite FGs of FG 27-10a are capabilities only for the gNB to know. It is up to RAN2 to decide whether such a FG dependency is meaningful from signaling description perspective, and whether and how it can be captured in RAN2 specifications. | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-11 | Support of DL MAC CE based MG activation for PRS measurements | 1. Support of preconfiguration of MGs in RRC signaling for PRS measurements: Each MG in the preconfiguration is associated with an ID  2. Support of using DL MAC CE to activate/deactivate the MG for PRS measurements: The DL MAC CE for MG activation indicates the ID associated with the preconfigured MG |  | |  | | --- | | *mg-ActivationCommPRS-Meas-r17* | | *RRC*  *MAC-ParametersCommon* | No | No |  | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-12 | LOS/NLOS indicator for UE-based positioning assistance data | Support reception of the assistance data containing the LOS/NLOS indicator.  1. LOS/NLOS indicator type  2. LOS/NLOS indicator granularity |  | *nr-los-nlos-IndicatorSupport-r17* | *NR-DL-TDOA-ProvideCapabilities-r16*  *NR-DL-AoD-ProvideCapabilities-r16*  *NR-Multi-RTT-ProvideCapabilities-r16* | No | No | Component 1 candidate values: {hardValue+softValue, hardValue}  Component 2 candidate values: {resourceSpecific, trpSpecific}  Need for location server to know if the feature is supported. | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-13 | Additional path reporting for UE-assisted DL-TDOA | 1. Support of additional detected path timing reporting for K>2 additional paths for UE-assisted DL-TDOA  2. Support of RSRPP reporting for additional paths if UE supports FG 27-13a |  | *additionalPathsExtSupport-r17* | *LPP*  *NR-DL-TDOA-ProvideCapabilities-r16* | No | No | Component 1 candidate values: {4, 6, 8}  Need for location server to know if the feature is supported. | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-13a | First path RSRPP reporting for UE-assisted DL-TDOA | 1. Support of RSRPP reporting for first path | 13-1 | *supportOfDL-PRS-FirstPathRSRP-r17* | *LPP*  *DL-TDOA-MeasCapabilityPerBand-r17* | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-14 | Additional path reporting for Multi-RTT | 1. Support of additional detected path timing reporting for K>2 additional paths for Multi-RTT  2. Support of RSRPP reporting for additional paths if UE supports FG 27-14a |  | *additionalPathsExtSupport-r17* | *LPP*  *NR-Multi-RTT-ProvideCapabilities-r16* | No | No | Component 1 candidate values: {4, 6, 8}  Need for location server to know if the feature is supported. | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-14a | First path RSRPP reporting for Multi-RTT | 1. Support of RSRPP reporting for first path | 13-1 | *supportOfDL-PRS-FirstPathRSRP-r17* | *LPP*  *Multi-RTT-MeasCapabilityPerBand-r17* | n/a | n/a | Need for location server to know if the feature is supported. | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-15 | Positioning SRS transmission in RRC\_INACTIVE state for initial UL BWP | 1. Max number of SRS Resource Sets for positioning supported by UE  2. Max number of P/SPSRS Resources for positioning  3. Max number of P/SPSRS Resources for positioning per slot  4. Max number of periodic SRS Resources for positioning  5. Max number of periodic SRS Resources for positioning per slot |  | *RRC*  *srs-AllPosResourcesRRC-Inactive-r17*  *LPP*  *posSRS-RRC-Inactive-InInitialUL-BWP-r17* | *RRC*  *BandNR*  *LPP*  *NR-UL-SRS-Capability* | n/a | n/a | Component 1 candidate values: {1, 2, 4, 8, 12, 16}  Component 2 candidate values: {1,2,4,8,16,32,64}  Component 3 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Component 4 candidate values: {1,2,4,8,16,32,64}  Component 5 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Note: OLPC for SRS for positioning based on SSB from the last serving cell (the cell that releases UE from connection) is part of this FG. No dedicated capability signaling is intended for this component  Need for location server to know if the feature is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15b | Positioning SRS transmission in RRC\_INACTIVE state configured outside initial UL BWP | 1. Maximum SRS bandwidth supported for each SCS that UE supports within a single CC  2. Max number of SRS Resource Sets for positioning supported by UE  3. Max number of periodic SRS Resources for positioning  4. Max number of periodic SRS Resources for positioning per slot  5. Support of different numerology between the SRS and the initial UL BWP  6. Support of SRS operation without restriction on the BW: BW of the SRS may not include BW of the CORESET#0 and SSB  7. Max number of P/SP SRS Resources for positioning  8. Max number of P/SP SRS Resources for positioning per slot  9. Support a different center frequency between the SRS for positioning and the initial UL BWP  10. Switching time between SRS Tx and other Tx in initial UL BWP or Rx in initial DL BWP | 27-15 | *posSRS-RRC-Inactive-OutsideInitialUL-r17*  *posSRS-RRC-Inactive-OutsideInitialUL-BWP-r17* | *RRC*  *BandNR*  *LPP*  *SRS-CapabilityPerBand-r16* | n/a | n/a | Component 1 candidate values:   1. FR1 bands: {5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100} 2. FR2 bands: {50, 100, 200, 400}   Component 2 candidate values: {1, 2, 4, 8, 12, 16}  Component 3 candidate values: {1,2,4,8,16,32,64}  Component 4 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Component 7 candidate values: {1,2,4,8,16,32,64}  Component 8 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Component 10 candidate values: {100us, 140us, 200us, 300us, 500us}  Note 1: The SRS should have a locationAndBandwidth, SCS, CP, defined the same way as a legacy BWP.  Note 2: If component 9 is not signaled, the UE only supports same center frequency between the SRS for positioning and initial UL BWP  Note 3: If component 5 is not signaled, the UE only supports same numerology between the SRS and the initial UL BWP  Note 4: If component 6 is not signaled, the UE supports only SRS BW that include the BW of the CORESET #0 and SSB  Note 5: Component 6 is not applicable to FDD or SUL bands  Need for location server to know if the feature is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15a | Support of positioning SRS transmission in RRC\_INACTIVE state for initial BWP with semi-persistent SRS | 1. Max number of semi-persistent SRS Resources for positioning  2. Max number of semi-persistent SRS Resources for positioning per slot | 27-15 | *RRC*  *srs-SemiPersistent-PosResourcesRRC-Inactive-r17*  *{*  *maxNumOfSemiPersistentSRSposResources-r17, maxNumOfSemiPersistentSRSposResourcesPerSlot-r17*  *}*  *LPP*  *posSRS-SP-RRC-Inactive-InInitialUL-BWP-r17* | *RRC*  *BandNR*  *LPP*  *SRS-CapabilityPerBand-r16* | n/a | n/a | Component 1 candidate values: {1,2,4,8,16,32,64}  Component 2 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Need for location server to know if the feature is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15c | Support of positioning SRS transmission in RRC\_INACTIVE state outside initial BWP with semi-persistent SRS | 1. Max number of semi-persistent SRS Resources for positioning  2. Max number of semi-persistent SRS Resources for positioning per slot | 27-15 | *RRC*  *maxNumOfSemiPersistentSRSposResources-r17*  *LPP*  *posSRS-RRC-Inactive-OutsideInitialUL-BWP-r17* | *RRC*  *PosSRS-RRC-Inactive-OutsideInitialUL-BWP-r17*  *LPP*  *SRS-CapabilityPerBand-r16* | n/a | n/a | Component 1 candidate values: {1,2,4,8,16,32,64}  Component 2 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Need for location server to know if the feature is supported | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-16 | OLPC for positioning SRS in RRC\_INACTIVE state - gNB | Same as RRC  OLPC-SRS-Pos-r16 | 27-15 | *olpc-SRS-PosRRC-Inactive-r17* | *RRC*  *BandNR*  *LPP*  *SRS-CapabilityPerBand-r16* | n/a | n/a |  | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-16a | OLPC for positioning SRS in RRC\_INACTIVE state – location server | Same as LPP  OLPC-SRS-Pos-r16 | 27-15 | *olpc-SRS-PosRRC-Inactive-r17* | *RRC*  *SRS-CapabilityPerBand-r16*  *LPP*  *SRS-CapabilityPerBand-r16* | n/a | n/a | Need for location server to know if the feature is supported.  Support of OLPC in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-17 | PRS processing in RRC\_INACTIVE | Support of PRS processing in RRC\_INACTIVE | 13-1 | *prs-ProcessingRRC-Inactive-r17* | *RRC*  *BandNR* | n/a | n/a | Note: UE supporting this feature shall support at least one from DL RSTD, DL PRS-RSRP, or UE Rx – Tx time difference measurement | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18a | Support of PRS measurement in RRC\_INACTIVE state for DL-TDOA | Support of PRS measurement in RRC\_INACTIVE state for DL-TDOA - location server | 13-3, 27-6 | *dl-PRS-MeasRRC-Inactive-r17* | *LPP*  *DL-TDOA-MeasCapabilityPerBand-r17* | n/a | n/a | Need for location server to know if the feature is supported.  Note: Applicable for both UE-assisted and UE-based DL-TDOA  Note: PRS capabilities for DL-TDOA measurement and reporting described in FGs in 13-3, 13-3a, 13-3b, 13-6, 13-13 are the same for RRC Inactive.  Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18b | Support of PRS measurement in RRC\_INACTIVE state for DL-AoD | Support of PRS measurement in RRC\_INACTIVE state for DL-AoD - location server | 13-2, 27-6 | *dl-PRS-MeasRRC-Inactive-r17* | *LPP*  *DL-AoD-MeasCapabilityPerBand-r16* | n/a | n/a | Need for location server to know if the feature is supported.  Note: Applicable for both UE-assisted and UE-based DL-AoD  Note: PRS capabilities for DL-AOD measurement and reporting described in FGs 13-2, 13-2a, 13-2b, 13-5, 13-13 are the same for RRC Inactive.  Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18c | Support of PRS measurement in RRC\_INACTIVE state for Multi-RTT | 1. Support of PRS measurement in RRC\_INACTIVE state for Multi-RTT - location server | 13-4, 13-11, 27-6 | *dl-PRS-MeasRRC-Inactive-r17* | *LPP*  *Multi-RTT-MeasCapabilityPerBand-r17* | n/a | n/a | Need for location server to know if the feature is supported.  Note: PRS capabilities for Multi-RTT measurement and reporting described in FGs in 13-4, 13-4a, 13-4b, 13-11, 13-11a, 13-14 are the same for RRC Inactive  Support of PRS processing measurement in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-19 | Spatial relation for positioning SRS in RRC\_INACTIVE state - gNB | Same as RRC  SpatialRelationsSRS-Pos-r16 | 27-15 | *spatialRelationsSRS-PosRRC-Inactive-r17* | *RRC*  *BandNR* | n/a | FR2 only |  | Optional with capability signalling |
| 27. NR\_pos\_enh | 27-19a | Spatial relation for positioning SRS in RRC\_INACTIVE state – location server | Same as LPP  SpatialRelationsSRS-Pos-r16 | 27-15 | *spatialRelationsSRS-PosRRC-Inactive-r17* | *LPP*  *SRS-CapabilityPerBand-r16* | n/a | FR2 only | Need for location server to know if the feature is supported.  Support of spatial relation in RRC\_INACTIVE state does not imply that LMF is aware of or controlling UE RRC state | Optional with capability signalling |
| 27. NR\_pos\_enh | 27-20 | PRS subset association for UE assisted DL-AoD | 1. Support of assistance data enhancement to indicate a subset of PRS resources for each PRS resource for the purpose of prioritization of DL-AoD reporting.  2. Supported resource set relationship for the target PRS resource and the associated subset |  | *dl-PRS-ResourcePrioritySubset-Sup-r17* | *LPP*  *NR-DL-AoD-ProvideCapabilities-r16* | n/a | n/a | Component 2 candidate values: {sameSet, DifferentSet, sameOrDifferentSet}  Need for location server to know | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-21 | PRS boresight direction for UE-assisted DL-AoD | Support of assistance data enhancement to indicate the boresight direction of a PRS resource for UE-assisted DL-AoD. |  | *nr-DL-PRS-BeamInfoSup-r17* | *LPP*  *NR-DL-AoD-ProvideCapabilities-r16* | n/a | n/a | Need for location server to know | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-22 | PRS beam pattern for UE-based DL-AoD | Support of PRS beam pattern for DL-AoD |  | *nr-PosCalcAssistanceSupport-r17* | *LPP*  *NR-DL-AoD-ProvideCapabilities-r16* | n/a | n/a | Need for location server to know | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-23 | Support of more than one activated PRS processing windows across all active DL BWPs | 1. Number of supported activated PRS processing windows | 27-3-2 | *supportedActivatedPRS-ProcessingWindow-r17* | *RRC*  *Phy-ParametersCommon* | No | No | Candidate values:{2, 3, 4} | Optional with capability signaling |

### 6.1.6 NR\_RedCap

Table 6.1.6-1: Layer-1 feature list for NR\_RedCap

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 28. NR\_RedCap | 28-1 | RedCap UE | 1. Maximum FR1 RedCap UE bandwidth is 20 MHz.  2. Maximum FR2 RedCap UE bandwidth is 100 MHz.  3. Early indication of RedCap UE in Msg.1 for 4-step RACH  4. Separate initial UL BWP for RedCap UEs  - It includes the configuration(s) needed for RedCap UE to perform random access  - Enabling/disabling of frequency hopping for common PUCCH resources  5. Separate initial DL BWP for RedCap UEs  - It includes CSS/CORESET for random access  - For separate initial DL BWP used for paging, CD-SSB is included  - For separate initial DL BWP only used for RACH, SSB may or may not be included  - For separate initial DL BWP used in connected mode as BWP#0 configuration option 1, CD-SSB is included  6. 1 UE-specific RRC configured DL BWP per carrier  7. 1 UE-specific RRC configured UL BWP per carrier  8. RRC reconfiguration of any parameters related to BWP  9. UE-specific RRC configured DL BWP with CD-SSB or NCD-SSB  10. NCD-SSB based measurements in RRC-configured DL BWP |  | *supportOfRedCap-r17* | *RedCapParameters-r17* | No | No | RedCap UEs do not support carrier aggregation or dual connectivity.  It is up to RAN2 whether/how to capture the capabilities for early indication of RedCap UE in Msg 3 and Msg A  A UE supporting this FG is not required to support FG 6-1 | Optional with capability signaling  RedCap UE must indicate this FG is supported |
| 28. NR\_RedCap | 28-1a | RRC-configured DL BWP without CD-SSB or NCD-SSB | RRC-configured DL BWP without CD-SSB or NCD-SSB | 28-1 | *bwp-WithoutCD-SSB-OrNCD-SSB-RedCap-r17* | *BandNR* | N/A | N/A |  | Optional with capability signaling |
| 28. NR\_RedCap | 28-3 | Half-duplex FDD operation type A for RedCap UE | 1. Half-duplex FDD operation (instead of full-duplex FDD operation) type A for RedCap UE | 28-1 | *halfDuplexFDD-TypeA-RedCap-r17* | *BandNR* | FDD only | FR1 only |  | Optional with capability signaling |

### 6.1.7 NR\_UE\_pow\_sav\_enh

Table 6.1.7-1: Layer-1 feature list for NR\_UE\_pow\_sav\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 29. NR\_UE\_pow\_sav\_enh | 29-1 | Paging enhancement | 1. Support receiving paging early indication in DCI format 2\_7  2. Support receiving UE subgroup indication in DCI format 2\_7  3. The set of OFDM symbols within a slot where UE can monitor the PEI PDCCH in Type 2A CSS is the same as the requirement for paging PDCCH in Type 2 CSS for IDLE and INACTIVE mode UEs |  | *pei-SubgroupingSupportBandList-r17* | *UE-RadioPagingInfo-r17* | N/A | N/A |  | Optional with capability signalling |
| 29. NR\_UE\_pow\_sav\_enh | 29-2 | TRS resources for idle/inactive UEs | TRS occasions for idle/inactive UEs  1. Support reading TRS configuration from SIB  2. Support receiving L1 indication for TRS availability |  | n/a | n/a | N/A | N/A | Receiving L1 indication via DCI format 2\_7 is supported only if the UE supports receiving DCI format 2\_7 | Optional without capability signalling |
| 29. NR\_UE\_pow\_sav\_enh | 29-3a | PDCCH skipping | Support of up to 2-bit indication of PDCCH skipping by scheduling DCI if SSSG is not configured |  | *pdcch-SkippingWithoutSSSG-r17* | *BandNR* | N/A | N/A |  | Optional with capability signaling |
| 29. NR\_UE\_pow\_sav\_enh | 29-3b | 2 search space sets group switching | Support of 1-bit indication of SSSG switching between 2 SSSGs by scheduling DCI, and timer based SSSG switching, if PDCCHSkippingDurationList is not configured |  | *sssg-Switching-1BitInd-r17* | *BandNR* | N/A | N/A | UE supports search space set group switching capability-1 according to Table 10.4-1 of 38.213 | Optional with capability signaling |
| 29. NR\_UE\_pow\_sav\_enh | 29-3c | 3 search space sets group switching | Support of 2-bit indication of SSSG switching among 3 SSSGs by scheduling DCI and timer based SSSG switching, if PDCCHSkippingDurationList is not configured | 29-3b | *sssg-Switching-2BitInd-r17* | *BandNR* | N/A | N/A | UE supports search space set group switching capability-1 according to Table 10.4-1 of 38.213 | Optional with capability signaling |
| 29. NR\_UE\_pow\_sav\_enh | 29-3d | 2 search space sets group switching with PDCCH skipping | Support of 2-bit indication of SSSG switching between 2 SSSGs, PDCCH skipping by scheduling DCI, and timer based SSSG switching | 29-3a, 29-3b | *pdcch-SkippingWithSSSG-r17* | *BandNR* | N/A | N/A | UE supports search space set group switching capability-1 according to Table 10.4-1 of 38.213 | Optional with capability signaling |
| 29. NR\_UE\_pow\_sav\_enh | 29-3e | Support Search space set group switching capability 2 for FR1 | Search space set group switching Capability-2 according to Table 10.4-1 of 38.213 for SSSG switching. | 29-3b | *searchSpaceSetGrp-switchCap2-r17* | *BandNR* | N/A | N/A (FR1 only) | For UE supporting this FG and FG 29-3b, 29-3c, and/or 29-3d, search space set group switching Capability-2 is applied to the FGs | Optional with capability signaling |

### 6.1.8 NR\_cov\_enh

Table 6.1.8-1: Layer-1 feature list for NR\_cov\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 30. NR\_cov\_enh | 30-1 | Increased maximum number of PUSCH Type A repetitions | Maximum value of K (the number of repetitions) = 32  For DG PUSCH, the number of repetitions is indicated in a TDRA list. A row index of the TDRA list is indicated by a DCI.  For Type 1 CG PUSCH, the number of repetitions is indicated by repK-r17  For Type 2 CG PUSCH, the number of repetitions is indicated in a TDRA list or by repK-r17. | One of {5-14, 5-16, 11-6} | *maxNumberPUSCH-TypeA-Repetition-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-2 | PUSCH Type A repetitions based on available slots | Transmission occasions for repetitions for dynamic and configured grant PUSCH are determined on the basis of available slots. | One of {5-14, 5-16, 5-17} | *puschTypeA-RepetitionsAvailSlot-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-3 | TB processing over multi-slot PUSCH | Support of TB processing over multi-slot PUSCH for DG and Type 2 CG without repetition in RRC connected mode. |  | *tb-ProcessingMultiSlotPUSCH-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-3a | Repetition of TB processing over multi-slot PUSCH | Support repetition of TB processing over multi-slot PUSCH in RRC connected mode. | 30-3 | *tb-ProcessingRepMultiSlotPUSCH-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4 | The maximum duration for DM-RS bundling | The maximum duration during which UE is able to maintain power consistency and phase continuity to support DM-RS bundling for PUSCH/PUCCH |  | *maxDurationDMRS-Bundling-r17*  *{*  *fdd-r17,*  *tdd-r17*  *}* | *BandNR* | N/A | N/A | Candidate values for the maximum duration for FDD are {4, 8, 16, 32}  Candidate values for the maximum duration for TDD are {2, 4, 8, 16}  NOTE: DM-RS bundling is only applicable for UL transmissions with pi/2 BPSK, BPSK, and QPSK modulation orders for the corresponding physical channels. | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4a | DM-RS bundling for PUSCH repetition type A | Support DM-RS bundling for PUSCH repetition type A over consecutive symbols | 30-4 and one of {5-14, 5-16, 5-17} | *dmrs-BundlingPUSCH-RepTypeA-r17* | *BandNR* | N/A | N/A | This capability is applicable to following multiple carrier scenarios in addition to single carrier scenarios   * FR1+FR2 UL CA, FR1+FR2 DC, and EN-DC with NR on FR2. DMRS bundling configuration is limited to one uplink NR carrier in total on all FRs at a time. * FR1 inter-band DL CA with a “single” uplink band configured, meaning no switching to transmit SRS on another carrier. * DL CA with “additional” UL carrier configured with SRS only (i.e. no PUCCH/PUSCH configured) * FR1 inter-band UL CA with DMRS bundling * SUL with DMRS bundling   For the last three scenarios listed above, DMRS bundling can be applied with the following conditions:   * Concurrent transmissions scheduled/configured over multiple carriers are not expected by UE * Only configuration of a single TAG * Only applicable for the back-to-back case (i.e., zero gap between two transmissions within an actual TDW) * Only one band can be configured with DMRS bundling at a time * Note 1: Under the above conditions, phase continuity and power consistency within any actual TDW on one carrier is not impacted by operations on a different carrier. * Note 2: Under the above conditions, the events defined in section 6.1.7 of TS38.214 [20] for the carrier with DMRS bundling are not triggered by any transmission within any actual TDW on the other carrier. * Note 3: If the modulation scheme higher than QPSK is scheduled for transmission on any carrier configured with DMRS bundling, DMRS bundling is not applicable according to UE feature 30-4 (i.e., the error case and up to UE implementation) | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4b | DM-RS bundling for PUSCH repetition type B | Support DM-RS bundling for PUSCH repetition type B over consecutive symbols | 30-4, 11-5 | *dmrs-BundlingPUSCH-RepTypeB-r17* | *BandNR* | N/A | N/A | This capability is applicable to following multiple carrier scenarios in addition to single carrier scenarios   * FR1+FR2 UL CA, FR1+FR2 DC, and EN-DC with NR on FR2. DMRS bundling configuration is limited to one uplink NR carrier in total on all FRs at a time. * FR1 inter-band DL CA with a “single” uplink band configured, meaning no switching to transmit SRS on another carrier. * DL CA with “additional” UL carrier configured with SRS only (i.e. no PUCCH/PUSCH configured) * FR1 inter-band UL CA with DMRS bundling * SUL with DMRS bundling   For the last three scenarios listed above, DMRS bundling can be applied with the following conditions:   * Concurrent transmissions scheduled/configured over multiple carriers are not expected by UE * Only configuration of a single TAG * Only applicable for the back-to-back case (i.e., zero gap between two transmissions within an actual TDW) * Only one band can be configured with DMRS bundling at a time * Note 1: Under the above conditions, phase continuity and power consistency within any actual TDW on one carrier is not impacted by operations on a different carrier. * Note 2: Under the above conditions, the events defined in section 6.1.7 of TS38.214 [20] for the carrier with DMRS bundling are not triggered by any transmission within any actual TDW on the other carrier. * Note 3: If the modulation scheme higher than QPSK is scheduled for transmission on any carrier configured with DMRS bundling, DMRS bundling is not applicable according to UE feature 30-4 (i.e., the error case and up to UE implementation) | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4c | DM-RS bundling for TB processing over multi-slot PUSCH | Support DM-RS bundling for TB processing over multi-slot PUSCH over consecutive symbols | 30-4, 30-3 | *dmrs-BundlingPUSCH-multiSlot-r17* | *BandNR* | N/A | N/A | Note: If a UE reports support of FG 30-3a and 30-4c, the UE supports DMRS bundling for the repetitions of TBoMS  This capability is applicable to following multiple carrier scenarios in addition to single carrier scenarios   * FR1+FR2 UL CA, FR1+FR2 DC, and EN-DC with NR on FR2. DMRS bundling configuration is limited to one uplink NR carrier in total on all FRs at a time. * FR1 inter-band DL CA with a “single” uplink band configured, meaning no switching to transmit SRS on another carrier. * DL CA with “additional” UL carrier configured with SRS only (i.e. no PUCCH/PUSCH configured) * FR1 inter-band UL CA with DMRS bundling * SUL with DMRS bundling   For the last three scenarios listed above, DMRS bundling can be applied with the following conditions:   * Concurrent transmissions scheduled/configured over multiple carriers are not expected by UE * Only configuration of a single TAG * Only applicable for the back-to-back case (i.e., zero gap between two transmissions within an actual TDW) * Only one band can be configured with DMRS bundling at a time * Note 1: Under the above conditions, phase continuity and power consistency within any actual TDW on one carrier is not impacted by operations on a different carrier. * Note 2: Under the above conditions, the events defined in section 6.1.7 of TS38.214 [20] for the carrier with DMRS bundling are not triggered by any transmission within any actual TDW on the other carrier. * Note 3: If the modulation scheme higher than QPSK is scheduled for transmission on any carrier configured with DMRS bundling, DMRS bundling is not applicable according to UE feature 30-4 (i.e., the error case and up to UE implementation) | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4d | DMRS bunding for PUCCH repetitions | Support DM-RS bundling for PUCCH repetitions for PUCCH formats 1/3/4 over consecutive symbols | 30-4, 4-23 | *dmrs-BundlingPUCCH-Rep-r17* | *BandNR* | N/A | N/A | This capability is applicable to following multiple carrier scenarios in addition to single carrier scenarios   * FR1+FR2 UL CA, FR1+FR2 DC, and EN-DC with NR on FR2. DMRS bundling configuration is limited to one uplink NR carrier in total on all FRs at a time. * FR1 inter-band DL CA with a “single” uplink band configured, meaning no switching to transmit SRS on another carrier. * DL CA with “additional” UL carrier configured with SRS only (i.e. no PUCCH/PUSCH configured) * FR1 inter-band UL CA with DMRS bundling * SUL with DMRS bundling   For the last three scenarios listed above, DMRS bundling can be applied with the following conditions:   * Concurrent transmissions scheduled/configured over multiple carriers are not expected by UE * Only configuration of a single TAG * Only applicable for the back-to-back case (i.e., zero gap between two transmissions within an actual TDW) * Only one band can be configured with DMRS bundling at a time * Note 1: Under the above conditions, phase continuity and power consistency within any actual TDW on one carrier is not impacted by operations on a different carrier. * Note 2: Under the above conditions, the events defined in section 6.1.7 of TS38.214 [20] for the carrier with DMRS bundling are not triggered by any transmission within any actual TDW on the other carrier. * Note 3: If the modulation scheme higher than QPSK is scheduled for transmission on any carrier configured with DMRS bundling, DMRS bundling is not applicable according to UE feature 30-4 (i.e., the error case and up to UE implementation) | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4e | Enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | Support enhanced inter-slot frequency hopping with inter-slot bundling for PUSCH | 30-4a or 30-4b or 30-4c | *interSlotFreqHopInterSlotBundlingPUSCH-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4f | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | Enhanced inter-slot frequency hopping for PUCCH repetitions with DMRS bundling | 30-4d | *interSlotFreqHopPUCCH-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4g | Restart DM-RS bundling | Support restarting DM-RS bundling after the events triggered by DCI or MAC CE that violate power consistency and phase continuity  Note: Events which are triggered by DCI or MAC CE, but do not require UE capability to resume maintaining power consistency and/or phase continuity as specified in subclause 6.1.7 of TS 38.214 [20] v17.3.0 are excluded from this feature | 30-4 | *dmrs-BundlingRestart-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-4h | DM-RS bundling for non-back-to-back transmission | Support DM-RS bundling for non-back-to-back transmission for consecutive slots for PUSCH and PUCCH only for corresponding supported back-to-back transmission FGs (30-4a, 30-4b, 30-4c, or 30-4d) | 30-4a, 30-4b, 30-4c, or 30-4d | *dmrs-BundlingNonBackToBackTX-r17* | *BandNR* | N/A | N/A | Note: This capability is only applicable when UE is configured with single uplink carrier within a frequency range. | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-5 | Slot based dynamic PUCCH repetition indication | Support slot based dynamic PUCCH repetition indication for PUCCH formats 0/1/2/3/4  support slot based dynamic PUCCH repetition for PUCCH formats 0/1/2/3/4 | 4-23 or 25-2 | *slotBasedDynamicPUCCH-Rep-r17* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 30. NR\_cov\_enh | 30-6 | Repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI | Support of repetition of PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI |  | *pusch-RepetitionMsg3-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |

### 6.1.9 NR\_IAB\_enh

Table 6.1.9-1: Layer-1 feature list for NR\_IAB\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 31. NR\_IAB\_enh | 31-1 | Guard symbols | 1) Support Rel-17 DesiredGuardSymbols reporting  2) Support Rel-17 ProvidedGuardSymbols reception | one or more of {31-4, 31-5} | *guardSymbolReportReception-IAB-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact  Note: If an IAB node does not support a certain timing mode, the reported/provided values shall be ignored | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-2 | IAB-DU beam restriction indication | Support restricted IAB-DU Beam Indication reception |  | *restricted-IAB-DU-BeamReception-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-3 | IAB-MT beam recommendation indication | Support recommended IAB-MT Beam Indication transmission  1) IAB-MT DL beam  2) IAB-MT UL beam |  | *recommended-IAB-MT-BeamTransmission-r17* | *Phy-ParametersCommon* | no | no | IAB-MT impact | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-4 | Case 6 timing alignment | 1) Support Case 6 timing alignment indication reception  2) Support signalling to the parent-node that Case 6 Timing Mode is required for simultaneous transmission |  | *case6-TimingAlignmentReception-IAB-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-5 | Case 7 timing alignment | 1.) Support Case7 timing offset indication reception  2.) Support Case 7 timing at parent-node indication reception |  | *case7-TimingAlignmentReception-IAB-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-6 | DL TX power adjustment | 1.) Support Desired DL TX Power Adjustment reporting  2.) Support DL TX Power Adjustment reception |  | *dl-tx-PowerAdjustment-IAB-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-7 | Desired UL TX power adjustment | Support Desired IAB-MT PSD range reporting |  | *desired-ul-tx-PowerAdjustment-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-8 | Dynamic indication of FDM soft resource availability | Support monitoring DCI Format 2\_5 scrambled by AI-RNTI for indication of FDM soft resource availability to an IAB node |  | *fdm-SoftResourceAvailability-DynamicIndication-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling |
| 31. NR\_IAB\_enh | 31-9 | Simultaneous transmission and reception from multiple parent nodes | Support simultaneous transmission and reception from multiple parent nodes |  | *simultaneousRxTx-IAB-MultipleParents-r17* | *CA-ParametersNRDC-v1700* | No | No | IAB-MT impact | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-10 | Updated T\_delta range | Support updated T\_delta range reception |  | *updated-T-DeltaRangeRecption-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling. |
| 31. NR\_IAB\_enh | 31-11 | Directional Collision Handling in DC operation | Support for directional collision handling between MCG and SCG cell(s) of the dual parent nodes for simultaneous operation in inter-donor and/or intra-donor DC operation |  | *directionalCollisionDC-IAB-r17* | *Phy-ParametersCommon* | No | No | IAB-MT impact | Optional with capability signalling |

### 6.1.10 NR\_SL\_enh

Table 6.1.10-1: Layer-1 feature list for NR\_SL\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 32. NR\_SL\_enh | 32-2a | Receiving NR sidelink of PSFCH | 1) UE can receive PSFCH with HARQ-ACK information in NR sidelink.  2) UE can receive up to N PSFCH(s) resources in a slot | 32-2b, at least one of 15-2 or 15-3 or 32-4 or 32-4a | *rx-sidelinkPSFCH-r17* | *BandParametersSidelinkEUTRA-NR-v1710* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Candidate values for N are {5, 15, 25, 32, 35, 45, 50, 64}  If UE reports more than one FGs of 15-11, FG32-2a and 32-5b-2, the reported value N in each FG is the total number and the same among those FGs | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-2b | Receiving NR sidelink of S-SSB | 1) UE can receive S-SSB in NR sidelink.  2) UE supports synchronization to a reference UE |  | n/a | n/a | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional without capability signalling. |
| 32. NR\_SL\_enh | 32-4 | Transmitting NR sidelink mode 2 with partial sensing | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with partial sensing configured by NR Uu or preconfiguration. Up to B sidelink processes are supported.  2) UE can transmit PSSCH according to the normal 64QAM MCS table.  3) UE supports PT-RS transmission in FR2.  4) UE can perform periodic-based partial sensing and resource allocation operation.  5) UE can perform contiguous partial sensing and resource allocation operation.  6) UE can transmit using the subcarrier spacing and CP length defined for a given band in RAN4  8) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  10) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR2  11) DL pathloss based open loop power control when mode 2 is configured by NR Uu | one of {15-4, 32-2b, 32-4b} | *sl-TransmissionMode2-PartialSensing-r17* | *BandParametersSidelinkDiscovery-r17 or BandParametersSidelinkEUTRA-NR-v1710* | N/A. | N/A. | Note: Random selection in the exceptional pool is supported.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Candidate values for B are {8,16}  If UE reports more than one FGs of 15-3, 32-4 and 32-4a, the reported value B in each FG is the total number of SL processes and the same among those FGs.  Note: Component 6 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Component-6 candidate value set in FR1:  {{15 kHz}, {30 kHz}, {60 kHz}, {15, 30 kHz}, {30, 60 kHz}, {15, 60 kHz}, {15, 30, 60 kHz}}  Component-6 candidate value set in FR2:  {{60 kHz}, {120 kHz}, {60, 120 kHz}}  Component-6 candidate value set for CP length: {NCP,NCP and ECP}  (ECP only applies to SCS of 60 kHz)  Note: Component 10 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 11 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-4a | Transmitting NR sidelink mode 2 with random resource selection | 1) UE can transmit PSCCH/PSSCH using NR sidelink mode 2 with random resource selection configured by NR Uu or preconfiguration. Up to B sidelink processes are supported.  2) UE can transmit PSSCH according to the normal 64QAM MCS table.  3) UE supports PT-RS transmission in FR2.  4) UE can transmit using the subcarrier spacing and CP length defined for a given band in RAN4  5) Supports 14-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {12, 9} for slots w/wo PSFCH. If UE signals support of ECP, support 12-symbol SL slot with all DMRS patterns corresponding to {#PSSCH symbols} = {10,7} for slots w/wo PSFCH.  6) UE can transmit using 30 kHz and normal CP subcarrier spacing in FR1, 120 kHz subcarrier spacing with normal CP FR2  7) DL pathloss based open loop power control when mode 2 is configured by NR Uu | one of {15-4, 32-2b, 32-4b} | *sl-TransmissionMode2-* *RandomResourceSelection-r17* | *BandSidelink-r16* | N/A. | N/A. | Note: Random selection in the exceptional pool is supported.  Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Candidate values for B are {8,16}  If UE reports more than one FGs of 15-3, 32-4 and 32-4a, the reported value B in each FG is the total number of SL processes and the same among those FGs.  Note: Component 4 is not required to be signalled in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Component-4 candidate value set in FR1:  {{15 kHz}, {30 kHz}, {60 kHz}, {15, 30 kHz}, {30, 60 kHz}, {15, 60 kHz}, {15, 30, 60 kHz}}  Component-4 candidate value set in FR2:  {{60 kHz}, {120 kHz}, {60, 120 kHz}}  Component-4 candidate value set for CP length: {NCP,NCP and ECP}  (ECP only applies to SCS of 60 kHz)  Note: Component 6 is only required in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 7 is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-4b | Synchronization sources for NR sidelink transmission | 1) UE supports GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to false.  2) UE can transmit NR sidelink based on the synchronization to an gNB  3) UE additionally supports gNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb if the UE supports Components 1 and 2  4) UE additionally supports gNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true if the UE supports Components 1 and 2.  5) UE can transmit S-SSB in NR sidelink if it supports 15-2 or 15-3 or 32-4 or 32-4a  6) UE supports synchronization to a reference UE if it supports 15-1. |  | *sync-Sidelink-v1710* | *BandSidelink-r16* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Component 1 is only required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Note: Components 2/3/4 are not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-4c | eNB type synchronization sources for NR sidelink transmission | 1) UE can transmit NR sidelink based on the synchronization to an eNB.  2) If UE supports component 1 in FG 32-4b, UE additionally supports eNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to gnbEnb.  3) If UE supports component 1 in FG 32-4b, UE additionally supports eNB and GNSS as the synchronization reference according to the synchronization procedure with sl-SyncPriority set to GNSS and sl-NbAsSync set to true. | 32-4b | *enb-sync-Sidelink-v1710* | *BandSidelink-r16* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-5a-1 | Transmitting Inter-UE coordination scheme 1 in NR sidelink mode 2 | 1) UE can transmit inter-UE coordination information of preferred resource set/non-preferred resource set in NR sidelink mode 2.  2) UE can receive an explicit request for inter-UE coordination information of both preferred resource set and non-preferred resource set. | one of {15-4, 32-2b, 32-4b} | *tx-IUC-Scheme1-Mode2Sidelink-r17* | *BandParametersSidelink-v1710* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1” in FG 32-5a-1/32-5a-2/32-5a-3/32-5b-1/32-5b-2 | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-5a-2 | Receiving Inter-UE coordination information of preferred resource set in NR sidelink mode 2 | 1) UE can receive inter-UE coordination information of preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.  2) UE can transmit an explicit request for inter-UE coordination information of preferred resource set only. | one of {15-4, 32-2b, 32-4b} | *rx-IUC-Scheme1-PreferredMode2Sidelink-r17* | *BandSidelinkPC5-r16* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1” in FG 32-5a-1/32-5a-2/32-5a-3/32-5b-1/32-5b-2 | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-5a-3 | Receiving Inter-UE coordination information of non-preferred resource set in NR sidelink mode 2 | 1) UE can receive inter-UE coordination information of non-preferred resource set and use the received information in its own resource (re-)selection in NR sidelink mode 2.  2) UE can transmit an explicit request for inter-UE coordination information of non-preferred resource set only. | one of {15-4, 32-2b, 32-4b} | *rx-IUC-Scheme1-NonPreferredMode2Sidelink-r17* | *BandSidelinkPC5-r16* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1” in FG 32-5a-1/32-5a-2/32-5a-3/32-5b-1/32-5b-2 | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-5b-1 | Transmitting Inter-UE coordination scheme 2 in NR sidelink mode 2 | 1) UE can transmit inter-UE coordination information of presence of expected/potential resource conflict in NR sidelink mode 2.  2) UE can transmit up to M PSFCH(s) resources in a slot | 32-5b-2, one of {15-4, 32-2b, 32-4b} | *tx-IUC-Scheme2-Mode2Sidelink-r17* | *BandParametersSidelink-v1710* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Candidate values for M are {4, 8, 16}  If UE reports more than one FGs of 15-11 and 32-5b-1, the reported value M in each FG is the total number and the same among those FGs. | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-5b-2 | Receiving Inter-UE coordination scheme 2 in NR sidelink mode 2 | 1) UE can receive inter-UE coordination information of presence of expected/potential resource conflict and use the received information in its own resource re-selection in NR sidelink mode 2.  2) UE can receive up to N PSFCH(s) resources in a slot. | one of {15-4, 32-2b, 32-4b} | *rx-IUC-Scheme2-Mode2Sidelink-r17* | *BandSidelink-r16* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1  Candidate values for N are {5, 15, 25, 32, 35, 45, 50, 64}  If UE reports more than one FGs of 15-11, 32-2a and 32-5b-2, the reported value N in each FG is the total number and the same among those FGs. | Optional with capability signalling. |
| 32. NR\_SL\_enh | 32-6-1 | Reception of Scheme 1 inter-UE coordination information over 2nd SCI | 1) UE can receive Scheme 1 inter-UE coordination transmission over 2nd SCI that is used in addition to the MAC-CE carrying the same inter-UE coordination information in the same transmission. | At least one of 32-5a-2 and 32-5a-3 | *rx-IUC-Scheme1-SCI-r17* | *SidelinkParametersNR-r16* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling |
| 32. NR\_SL\_enh | 32-6-2 | Reception of Scheme 1 explicit request over 2nd SCI | 1) UE can receive an explicit request for inter-UE coordination information of both preferred resource set and non-preferred resource set over 2nd SCI that is used in addition to the MAC-CE carrying the explicit request in the same transmission | 32-5a-1 | *rx-IUC-Scheme1-SCI-ExplicitReq-r17* | *SidelinkParametersNR-r16* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling |
| 32. NR\_SL\_enh | 32-7 | Determination of expected conflict in Scheme 2 based on RSRP difference | 1) UE can determine a conflict for overlapping resource reservation between UE-B and another UE based on RSRP difference of the two reservations | 32-5b-1 | *scheme2-ConflictDeterminationRSRP-r17* | *BandSidelinkPC5-r16* | N/A. | N/A. | Note: configuration by NR Uu is not required to be supported in a band indicated with only the PC5 interface in 38.101-1 Table 5.2E.1-1 | Optional with capability signalling |

### 6.1.11 NR\_MBS

Table 6.1.11-1: Layer-1 feature list for NR\_MBS

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 33. NR\_MBS | 33-1 | Broadcast | 1. Support of group-common PDCCH/PDSCH for broadcast with CRC scrambled by MCCH-RNTI.  2. Support of group-common PDCCH/PDSCH for broadcast with CRC scrambled by G-RNTI(s) for MTCH.  3. Support of CFR configuration for broadcast.  4. Support of CORESET and common search space for broadcast.  5. Support of DCI format 4\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.  6. Support of inter-slot TDM between unicast PDSCH and MCCH group-common PDSCH or MTCH group-common PDSCH, or between MCCH group-common PDSCH and MTCH group-common PDSCH, or among unicast PDSCH and MCCH group-common PDSCH and MTCH group-common PDSCH in different slots.  7. Support MCCH change notification indication via DCI.  8. support of higher layer configured slot-level repetition up to 8 for MTCH  9. One G-RNTI per UE is supported for broadcast reception  10. Support of FDMed MCCH and PBCH  11. Support of up to 64QAM for FR1/FR2 |  | n/a | n/a | N/A | N/A | It is up to RAN2 whether/how to introduce the capability for support of N > 1 G-RNTIs for broadcast for a UE | Optional without capability signalling |
| 33. NR\_MBS | 33-1-1 | DCI indicated slot-level repetition up to 16 for broadcast MTCH | Support up to 16 times dynamic slot-level repetition for broadcast MTCH. | 33-1 | *dci-BroadcastWith16Repetitions-r17* | *FeatureSetDownlinkPerCC-v1730* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-1-2 | FDM-ed unicast PDSCH and group-common PDSCH for broadcast | 1. Support FDM between one unicast PDSCH and one group-common PDSCH for broadcast in RRC CONNECTED mode in a slot. | 33-1 | *fdm-BroadcastUnicast-r17* | *FeatureSetDownlinkPerCC-v1720* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2 | Dynamic scheduling for multicast for PCell | 1. Support of group-common PDCCH/PDSCH for multicast with CRC scrambled by G-RNTI for PCell.  2. Support of CFR configuration for multicast.  3. Support of CORESET and common search space configuration for multicast.  4. Support of DCI format 4\_1 with CRC scrambled with G-RNTI for multicast.  5. Support of inter-slot TDM between group-common PDSCH for multicast and other PDSCHs in different slots.  6. Support {2, 4, 8} times semi-static slot-level repetition for group-common PDSCH for multicast |  | *dynamicMulticastPCell-r17* | *FeatureSetDownlink-v1700* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2a | Support of ACK/NACK based HARQ-ACK feedback andRRC-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | 1) Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling  2) Support of PTM retransmission for multicast  3) support of Type-1 and Type-2 HARQ-ACK CB for multicast feedback only  4) Support of shared PUCCH resource configurations with unicast  5) Support of Type-2 HARQ-ACK codebook for multicast on PUSCH/PUCCH with max number X of G-RNTIs | 33-2 | *ack-NACK-FeedbackForMulticast-r17* | *CA-ParametersNR-v1720* | N/A | N/A | Candidate values of X is {1, 2, 3, 4} with X no larger than max number of G-RNTIs of FG33-2e  Note: the value of X should be common across FG33-2a, 33-3-3a and 33-3-3b if reported | Optional with capability signalling |
| 33. NR\_MBS | 33-2b | DCI-based enabling/disabling ACK/NACK-based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling ACK/NACK based HARQ-ACK feedback configured per G-RNTI by RRC signaling via DCI format 4\_2 | 33-2a, 33-2f | *ack-NACK-FeedbackForMulticastWithDCI-Enabler-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2d | PTP retransmission for multicast dynamic scheduling | Support of PTP retransmission for multicast on the same cell as multicast initial transmission | 33-2a | *ptp-Retx-Multicast-r17* | *CA-ParametersNR-v1720* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2e | Multiple G-RNTIs for group-common PDSCHs | Capability on number of G-RNTI for multicast | 33-2 | *maxNumberG-RNTI-r17* | *BandNR* | [Yes] | Yes | Reporting type of FG 33-2e is per UE with [FDD/TDD,] FR1/FR2, licensed/unlicensed, and TN/NTN differentiation, detail signalling is up to RAN2 | Optional with capability signalling |
| 33. NR\_MBS | 33-2f | Dynamic multicast with DCI format 4\_2 | Support of DCI format 4\_2 with CRC scrambled with G-RNTI for multicast | 33-2 | *dynamicMulticastDCI-Format4-2-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2g | MIMO layers for multicast PDSCH | Supported maximal number of MIMO layers for multicast PDSCH | 33-2 | *maxNumberMIMO-LayersMulticastPDSCH-r17* | *FeatureSetDownlinkPerCC-v1700* | N/A | N/A | Candidate values: {2,4,8}  Note: If UE supports up to 8 layers, the UE supports TB2 | Optional with capability signalling |
| 33. NR\_MBS | 33-2h | Dynamic scheduling for multicast for SCell | Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI for SCell. | 33-2 | *dynamicMulticastSCell-r17* | *FeatureSetDownlinkPerCC-v1700* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-2i | Supported maximal modulation order for multicast PDSCH | 1. For FR1, up to 1024QAM is supported, candidate values {256QAM, 1024QAM}  2. For FR2, up to 256QAM is supported, candidate values {64QAM, 256QAM} | 33-2 | *maxModulationOrderForMulticast-r17*  *{*  *fr1-r17,*  *fr2-r17*  *}* | *BandNR* | N/A | N/A | Note: A UE shall support the corresponding mandatory maximum modulation for unicast. | Optional with capability signalling |
| 33. NR\_MBS | 33-2j | Supported maximum modulation order used for maximum data rate calculation for multicast PDSCH | 1. For FR1, up to 1024QAM is supported as maximum modulation order used for maximum data rate calculation for multicast PDSCH, candidate values {256QAM, 1024QAM}  2. For FR2, up to 256QAM is supported as maximum modulation order used for maximum data rate calculation for multicast PDSCH, candidate values {64QAM, 256QAM} | 33-2 | *maxModulationOrderForMulticastDataRateCalculation-r17* | *FeatureSetDownlinkPerCC-v1720* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-3-1 | Dynamic Slot-level repetition for group-common PDSCH | 1. Support up to X times dynamic slot-level repetition for group-common PDSCH for multicast. | 33-2 | *dynamicSlotRepetitionMulticastTN-NonSharedSpectrumChAccess-r17* | *BandNR* | Yes | Yes | Candidate values for X is: {8, 16}  This FG is reported for TN and licensed. | Optional with capability signalling |
| 33. NR\_MBS | 33-3-1a | Dynamic Slot-level repetition for group-common PDSCH for NTN and unlicensed | 1. Support up to X times dynamic slot-level repetition for group-common PDSCH for multicast for NTN and unlicensed | 33-2 | *dynamicSlotRepetitionMulticastNTN-SharedSpectrumChAccess-r17* | *BandNR* | N/A | N/A | Candidate values for X is: {8, 16}  This FG is reported for NTN and unlicensed | Optional with capability signalling |
| 33. NR\_MBS | 33-3-2 | FDM-ed unicast PDSCH and one group-common PDSCH for multicast | 1. Support FDM between one unicast PDSCH and one group-common PDSCH for multicast in RRC CONNECTED mode in a slot. | 33-2 | *fdm-MulticastUnicast-r17* | *FeatureSetDownlinkPerCC-v1720* | N/A | N/A | Note: this FG does not support FDMed SPS | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3 | Intra-slot TDM-ed unicast PDSCH and group-common PDSCH | 1. Support TDM between one unicast PDSCH and one group-common PDSCH in a slot.  2. Support TDM between M (M>1) TDMed unicast PDSCHs and one group-common PDSCH in a slot per CC  3. Support TDM among N (N>1) group-common PDSCHs in a slot per CC  4. Support TDM between K (K>1) TDMed unicast PDSCHs and L (L>1) TDMed group-common PDSCHs in a slot per CC  5. The UE maximum number of TDMed PDSCH receptions capability in a slot per CC is kept as for Rel-15/Rel-16, i.e., {2/4/7} based on UE FG5-11/5-11a/5-11b.  - Note:  Group-common PDSCH(s) are counted as unicast PDSCH(s).  - Note: The max number of (M+1), N, (K+L) are determined based on the numbers reported by FG5-11 and/or FG5-11a and/or FG5-11b.  6. up to one broadcast PDSCH is supported in a slot.  7. For any two consecutive slots n and n+1, if there are more than 1 broadcast/multicast/unicast PDSCH in either slot, whether to require the minimum time separation between starting time of any two broadcast/multicast/unicast PDSCHs within the duration of these slots is 4 OFDM symbol for 30kHz and 7 OFDM symbol for 60kHz | 33-1 and/or 33-2, 5-11 and/or 5-11a and/or 5-11b | *intraSlotTDM-UnicastGroupCommonPDSCH-r17* | *FeatureSetDownlinkPerCC-v1730* | N/A | N/A | Candidate value for component 7: require the minimum time separation time {yes, no} | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3a | FDM-ed Type-1 and Type-2 HARQ-ACK codebooks for multiplexing HARQ-ACK for unicast and HARQ-ACK for multicast | 1. Support of FDM-ed Type-1 HARQ-ACK codebooks for multiplexing HARQ-ACK for unicast and ACK/NACK-based HARQ-ACK for multicast on PUCCH or PUSCH  2. Support of Type-2 HARQ-ACK codebooks for multiplexing HARQ-ACK for unicast and HARQ-ACK for multicast on PUCCH or PUSCH with max number X of G-RNTIs | 33-3-2, at least one of {33-2a, 33-4, 33-5-1a, 33-5-1f} | *fdm-CodebookForMux-UnicastMulticastHARQ-ACK-r17* | *CA-ParametersNR-v1730* | N/A | N/A | Note1: FDM-ed Type-1 HARQ-ACK codebook is generated by concatenating the Type-1 sub-codebook for unicast and the Type-1 sub-codebook for multicast.  Note2: The Type-2 HARQ-ACK codebook is generated by concatenating the Type-2 sub-codebook for unicast and the Type-2 sub-codebook for multicast.  Candidate values of X is {1, 2, 3, 4} with X no larger than max number of G-RNTIs of FG33-2e  Note: the value of X should be common across FG33-2a, 33-3-3a and 33-3-3b if reported | Optional with capability signalling |
| 33. NR\_MBS | 33-3-3b | Mode 2 TDM-ed Type-1 and Type-2 HARQ-ACK codebook for multiplexing HARQ-ACK for unicast and HARQ-ACK for multicast | 1. Support of Mode 2 TDM-ed Type-1 HARQ-ACK codebook for multiplexing HARQ-ACK for unicast and ACK/NACK-based HARQ-ACK for multicast on PUCCH or PUSCH  2. Support of Type-2 HARQ-ACK codebooks for multiplexing HARQ-ACK for unicast and HARQ-ACK for multicast on PUCCH or PUSCH with max number X of G-RNTIs | 33-2a or 33-4 or 33-5-1a or 33-5-1f | *mode2-TDM-CodebookForMux-UnicastMulticastHARQ-ACK-r17* | *CA-ParametersNR-v1730* | N/A | N/A | Note1: Mode 2 TDM-ed Type-1 HARQ-ACK codebook is generated based on the union TDRA tables from unicast and multicast and the union of k1 sets from unicast and multicast.  Note2: The Type-2 HARQ-ACK codebook is generated by concatenating the Type-2 sub-codebook for unicast and the Type-2 sub-codebook for multicast.  Candidate values of X is {1, 2, 3, 4} with X no larger than max number of G-RNTIs of FG33-2e  Note: the value of X should be common across FG33-2a, 33-3-3a and 33-3-3b if reported | Optional with capability signalling |
| 33. NR\_MBS | 33-3-4 | Mode 1 for type1 codebook generation | Supports type1-Codebook-Generation-Mode configured as mode 1 | 33-3-3b | *mode1-ForType1-CodebookGeneration-r17* | *CA-ParametersNR-v1730* | N/A | N/A | This FG is for multiplexing HARQ-ACK for unicast and HARQ-ACK for multicast on PUCCH or PUSCH | Optional with capability signalling |
| 33. NR\_MBS | 33-3-5 | Feedback multiplexing for unicast PDSCH and group-common PDSCH for multicast with same priority and different codebook type | Support of multiplexing HARQ-ACK for unicast and for multicast with the same priority and different HARQ-ACK codebook types in a PUCCH or in a PUSCH | 33-2a or 33-4 or 33-5-1a or 33-5-1f | *mux-HARQ-ACK-UnicastMulticast-r17* | *CA-ParametersNR-v1730* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-4 | NACK-only based HARQ-ACK feedback for multicast with ACK/NACK transforming | 1. Support NACK-only based HARQ-ACK feedback for dynamic scheduling for multicast, including:  a) A single TB with NACK-only feedback transmitted in PUCCH  b) multiple TB with NACK-only feedback transmitted in PUCCH by transforming into ACK/NACK bits  2. Support of shared PUCCH resource configurations with unicast  3. One or multiple TB with NACK-only feedback transmitted in PUSCH by transforming into ACK/NACK bits  4. One or multiple TB with NACK-only feedback transmitted in PUCCH by transforming into ACK/NACK bits when multiplexing with other UCI | 33-2a | *nack-OnlyFeedbackForMulticast-r17* | *CA-ParametersNR-v1720* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-4a | NACK-only based HARQ-ACK feedback for multicast corresponding to a specific sequence or a PUCCH transmission | 1. Support NACK-only based HARQ-ACK feedback for dynamic scheduling for multicast, including:  a) Up to 4 TBs with NACK-only feedback transmitted in PUCCH by select one PUCCH resource.  2. Support of separate PUCCH resource configurations from unicast  3. Single TB with NACK-only feedback transmitted in PUCCH  4. up to 4TBs with NACK-only feedback transmitted in PUSCH by transforming into ACK/NACK bits | 33-4 | *nack-OnlyFeedbackSpecificResourceForMulticast-r17* | *CA-ParametersNR-v1720* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-4-1 | DCI-based enabling/disabling NACK-only based feedback for dynamic scheduling for multicast | Support of DCI-based enabling/disabling NACK-only based HARQ-ACK feedback configured per G-RNTI by RRC signalling via DCI format 4\_2 | 33-4 and 33-2f | *nack-OnlyFeedbackForMulticastWithDCI-Enabler-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1 | SPS group-common PDSCH for multicast on PCell | 1. Support one SPS group-common PDSCH configuration for multicast  2. Support {2, 4, 8} times semi-static slot-level repetition for SPS group-common PDSCH | 33-2 | *sps-Multicast-r17* | *FeatureSetDownlink-v1720* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1a | Support of ACK/NACK based HARQ-ACK feedback and RRC-based enabling/disabling ACK/NACK-based feedback for SPS group-common PDSCH for multicast | 1. Support of ACK/NACK based HARQ-ACK feedback, and support of enabling/disabling ACK/NACK based HARQ-ACK feedback configured by RRC signalling for SPS group-common PDSCH without PDCCH scheduling, [SPS group-common PDSCH activation, and SPS release PDCCH]  2. Support of PTM retransmission for SPS multicast associated with G-CS-RNTI  3. Support of Type-1 and Type-2 HARQ-ACK CB for SPS multicast feedback only  4. Support of shared SPS-PUCCH-AN-List configuration from unicast SPS | 33-5-1 | *ack-NACK-FeedbackForSPS-Multicast-r17* | *CA-ParametersNR-v1720* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1b | DCI-based enabling/disabling ACK/NACK-based feedback for SPS group-common PDSCH for multicast | Support of DCI-based enabling/disabling ACK/NACK based HARQ-ACK feedback configured per G-CS-RNTI for multicast by RRC signaling via DCI format 4\_2 | 33-5-1a, 33-5-1i | *ack-NACK-FeedbackForSPS-MulticastWithDCI-Enabler-r17* | *BandNR* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1d | PTP retransmission for SPS group-common PDSCH for multicast | Support of PTP retransmission associated with CS-RNTI for SPS multicast on the cell same as multicast initial transmission | 33-5-1a | *ptp-Retx-SPS-Multicast-r17* | *CA-ParametersNR-v1720* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1e | Dynamic Slot-level repetition for SPS group-common PDSCH for multicast | Support up to X times dynamic slot-level repetition for SPS group-common PDSCH for multicast. | 33-5-1 | *Not implemented yet* |  | [No] | [No] | Candidate values for X is: {8, 16} | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1f | NACK-only based HARQ-ACK feedback for multicast RRC-based enabling/disabling NACK-only based feedback for SPS group-common PDSCH for multicast | 1) Support NACK-only based HARQ-ACK feedback, and support of enabling/disabling NACK-only based HARQ-ACK feedback configured by RRC signalling for SPS group-common PDSCH without PDCCH scheduling  2) Support of PTM retransmission associated with G-CS-RNTI for SPS multicast | 33-5-1 | *Not implemented yet* |  | [No] | [No] |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1g | DCI-based enabling/disabling NACK-only based feedback for SPS group-common PDSCH for multicast | Support of DCI-based enabling/disabling NACK-only based HARQ-ACK feedback configured per G-CS-RNTI for multicast by RRC signaling via DCI format 4\_2 | 33-5-1f, 33-5-1i | *Not implemented yet* |  | [No] | [No] |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1h | Multiple G-CS-RNTIs for SPS group-common PDSCHs | Max number of G-CS-RNTIs for SPS multicast | 33-5-1 | *maxNumberG-CS-RNTI-r17* | *BandNR* | [Yes] | Yes | Reporting type of FGs 33-5-1h is per UE with [FDD/TDD,] FR1/FR2, licensed/unlicensed, and TN/NTN differentiation, detail signalling is up to RAN2 | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1i | Multicast SPS scheduling with DCI format 4\_2 | 1.Support of DCI format 4\_2 with CRC scrambled with G-CS-RNTI for multicast SPS scheduling  2. Retransmission scheduled by DCI format 4\_2 with CRC scrambled with G-CS-RNTI | 33-5-1 | *Not implemented yet* |  | FFS | FFS |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-1j | NACK-only based HARQ-ACK feedback for multicast corresponding to a specific sequence or a PUCCH transmission for SPS group-commmon PDSCH for multicast | 1. Support NACK-only based HARQ-ACK feedback for SPS PDSCH for multicast, including:  a) Multiple TBs with NACK-only feedback transmitted in PUCCH by select one PUCCH resource.  2. Support of separate SPS-PUCCH-AN-List from unicast | 33-5-1f | *nack-OnlyFeedbackSpecificResourceForSPS-Multicast-r17* | *CA-ParametersNR-v1730* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-2 | Multiple SPS group-common PDSCH configuration on PCell | 1. Support up to 8 SPS group-common PDSCH configuration per CFR for multicast  2. Support M>=1 activated SPS group-common PDSCH configurations per CFR for multicast  3. The total number of SPS configurations for both multicast and unicast is no larger than 8 in a BWP of a serving cell, and activated SPS group-common PDSCH configurations is no larger than M.  4. The total number of SPS configurations for both multicast and unicast in a cell group is no larger than 32 | 33-5-1 | *Not implemented yet* |  | [No] | [No] | Candidate value set for M is {1, 2, …, 8} | Optional with capability signalling |
| 33. NR\_MBS | 33-5-3 | One SPS group-common PDSCH configuration for multicast for Scell | 1. Support one SPS group-common PDSCH configuration for multicast for Scell.  2. Support {2, 4, 8} times semi-static slot-level repetition for SPS group-common PDSCH for Scell. | 33-5-1, 33-2h | *sps-MulticastSCell-r17* | *FeatureSetDownlinkPerCC-v1730* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-5-4 | Up to 8 SPS group-common PDSCH configurations per CFR for multicast for SCell | 1. Support up to 8 SPS group-common PDSCH configuration per CFR for multicast for Scell.  2. Support M>=1 activated SPS group-common PDSCH configurations per CFR for multicast for Scell.  3. The total number of SPS configurations for both multicast and unicast is no larger than 8 in a BWP of a serving cell, and activated SPS group-common PDSCH configurations is no larger than M.  4. The total number of SPS configurations for both multicast and unicast in a cell group is no larger than 32. | 33-5-3 | *sps-MulticastSCellMultiConfig-r17* | *FeatureSetDownlinkPerCC-v1730* | N/A | N/A | Candidate value set for M is {1, 2, …, 8} | Optional with capability signalling |
| 33. NR\_MBS | 33-6-1 | DL priority indication for multicast in DCI | 1. Support of priority indicator field configured in DCI formats 4\_2 with CRC scrambled with G-RNTI for multicast.  2. Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed different priorities for multicast and multicast at a UE | 33-2a, 33-2f | *priorityIndicatorInDCI-Multicast-r17* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-1a | DL priority configuration for SPS multicast | Support of priority indicator field configured in DCI format 4\_2 for multicast HARQ-ACK feedback of SPS multicast | 33-6-1 | *priorityIndicatorInDCI-SPS-Multicast-r17* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-2 | Two HARQ-ACK codebooks simultaneously constructed for supporting HARQ-ACK codebooks with different priorities for unicast and multicast at a UE | 1. Supports two HARQ-ACK codebooks with different priorities to be simultaneously constructed different priorities for unicast and multicast at a UE. | 33-6-1 | *twoHARQ-ACK-CodebookForUnicastAndMulticast-r17* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 33. NR\_MBS | 33-6-3 | More than one PUCCH for HARQ-ACK transmission for multicast or for unicast and multicast within a slot | 1. Supports two non-overlapping slot-based PUCCHs for ACK/NACK based HARQ-ACK feedback for multicast or for unicast and multicast with different priorities in a slot. | 33-6-1, 33-6-2 | *multiPUCCH-HARQ-ACK-ForMulticastUnicast-r17* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 33. NR\_MBS | 33-8-1 | PUCCH resource configuration for multicast feedback for dynamically scheduled multicast | Support of a PUCCH-Config for multicast HARQ-ACK feedback, separate from that of unicast configurations | 33-2a | *Not implemented yet* |  | [No] | [No] |  | Optional with capability signalling |
| 33. NR\_MBS | 33-8-2 | Up to 2 PUCCH resources configuration for multicast feedback for dynamically scheduled multicast | Support of a PUCCH-ConfigurationList for multicast HARQ-ACK feedback, separate from that of unicast configurations | 33-8-1, 33-6-1 | *multiPUCCH-ConfigForMulticast-r17* | *CA-ParametersNR-v1730* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-8-3 | PUCCH resource configuration for multicast feedback for SPS GC-PDSCH | Support of a SPS-PUCCH-AN-List for multicast HARQ-ACK feedback of all multicast SPS configuration(s), separate from that of SPS unicast configurations | 33-5-1a | *pucch-ConfigForSPS-Multicast-r17* | *CA-ParametersNR-v1730* | N/A | N/A |  | Optional with capability signalling |
| 33. NR\_MBS | 33-9 | Supporting unicast PDCCH to release SPS group-common PDSCH | Supports unicast PDCCH scrambled with CS-RNTI to release SPS group-common PDSCH | 33-5-1, 12-2 | *Not implemented yet* |  | [No] | [No] |  | Optional with capability signalling |
| 33. NR\_MBS | 33-10 | Support group-common PDSCH RE-level rate matching for multicast | 1) Support of SP ZP-CSI-RS for group-common PDSCH RE-mapping patterns  2) Support of P ZP-CSI-RS for group-common PDSCH RE-mapping patterns  3) Support p-ZP-CSI-RS-ResourceSet configured in PDSCH-Config-Multicast same as or different from the p-ZP-CSI-RS-ResourceSet configured in PDSCH-Config  Note 1: The total number of semi-persistent ZP-CSI-RS-ResourceSet that a UE can be configured with is the same as for unicast in Rel-16  4) Support of AP ZP-CSI-RS for group-common PDSCH RE-mapping patterns | 2-33a, 33-2 | *re-LevelRateMatchingForMulticast-r17* | *BandNR* | [Yes] | Yes | Reporting type of FG 33-10 is per UE with [FDD/TDD,] FR1/FR2, licensed/unlicensed, and TN/NTN differentiation, detail signalling is up to RAN2 | Optional with capability signalling |

### 6.1.12 NR\_DSS

Table 6.1.12-1: Layer-1 feature list for NR\_DSS

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 34. NR\_DSS | 34-2 | Cross-carrier scheduling from SCell to PCell/PSCell (Type B) | Support of Cross-carrier scheduling (CCS) from sSCell to PCell/PSCell (Type B)  1) Cross-carrier scheduling from sSCell to PCell/PSCell with CIF  2) sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and search space sets on 3. PCell/PSCell can be configured so that the UE monitors them in overlapping slot of PCell/PSCell and sSCell  3) Configuration of scaling factor α for BD and CCE limit handling and PDCCH overbooking handling on P(S)Cell  4) The number of unicast DCI limits for PCell/PSCell scheduling  - Processing K1 unicast DCI scheduling DL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)  - Processing K2 unicast DCI scheduling UL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)  - N is based on pair of (PCell/PSCell SCS, sSCell SCS): N=1 for(15,15), (30,30), (60,60) and N=2 for (15,30), (30,60) and N=4 for (15, 60)  5) Same numerology between sSCell and P(S)Cell or sSCell SCS is larger than P(S)Cell SCS  6) USS set(s) for DCI format 0\_1,1\_1 configured on sSCell for CCS from sSCell to PCell/PSCell and USS set(s) for DCI format 0\_2,1\_2 configured on sSCell for CCS from sSCell to PCell/PSCell if UE supports FG 11-1 (dci-Format1-2And0-2-r16)  7) PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to Pcell/PSCell  8) frame boundary alignment between PCell/PSCell and sSCell | 6-5 | *crossCarrierSchedulingSCell-SpCellTypeB-r17* | *CA-ParametersNR-v1700* | No | Applicable to FR1 only | Candidate value set: One or more of supported SCS combinations ({P(S)Cell SCS in kHz, sSCell SCS in kHz}) from following set are indicated by the UE: {15,15}, {15,30}, (15, 60), {30,30}, {30,60},{60,60})  Candidate value set 2: frequency band pair(s) for {PCell/PSCell, sSCell}  Component 4 candidate values: (K1, K2) = {(1,1) for FDD P(S)Cell; (K1, K2) = (1,2) for TDD P(S)Cell}  Component 7 candidate values:  Value 1: within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot.  Value 2: within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slot  Note: The CCS from sSCell to Pcell is applicable to FR1 only but there can be other Scells in FR2 configured for the UE  Note: The SCell configured with Cross-carrier scheduling to PCell/PSCell is referred to as ‘sSCell’  Note: Candidate value set 2 only applies for the following value sets of components 1: {30,30}, {30,60},{60,60}  Note: A UE supporting this FG does not imply that the UE can be configured with sSCell in shared spectrum  Note: Parameters in CSI-MeasConfig of P(S)Cell and sSCell are configured such that combination of P(S)Cell and sSCell configurations does not result in exceeding any of the UE’s capabilities for A-/SP-CSI reporting on PUSCH on P(S)Cell | Optional with capability signalling |
| 34. NR\_DSS | 34-1 | Cross-carrier scheduling from SCell to PCell/PSCell with search space restrictions (Type A) | Support of Cross-carrier scheduling from sSCell to PCell/PSCell with search space restrictions (Type A)  1) Cross-carrier scheduling from sSCell to PCell/PSCell with CIF  2) Search space restrictions: sSCell USS set(s) (for CCS from sSCell to PCell/PSCell) and following search space sets on PCell/PSCell can only be configured such that UE does not monitor them in overlapping slot of PCell/PSCell and sSCell  - USS sets for DCI formats 0\_1,1\_1,0\_2,1\_2  - USS sets for DCI formats 0\_0,1\_0  - Type3-CSS set(s) for DCI formats 1\_0/0\_0 with C-RNTI/CS-RNTI/MCS-C-RNTI  3) Configuration of scaling factor α for BD and CCE limit handling and PDCCH overbooking handling on P(S)Cell  4) The number of unicast DCI limits for PCell/PSCell scheduling  - Processing K1 unicast DCI scheduling DL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)  - Processing K2 unicast DCI scheduling UL on PCell/PSCell per PCell/PSCell slot and its aligned N consecutive sSCell slot(s)  - N is based on pair of (PCell/PSCell SCS, sSCell SCS): N=1 for(15,15), (30,30), (60,60) and N=2 for (15,30), (30,60) and N=4 for (15, 60)  5) Same numerology between sSCell and P(S)Cell or sSCell SCS is larger than P(S)Cell SCS  6) USS set(s) for DCI format 0\_1,1\_1 configured on sSCell for CCS from sSCell to Pcell/PSCell and USS set(s) for DCI format 0\_2,1\_2 configured on sSCell for CCS from sSCell to PCell/PSCell if UE supports FG 11-1 (dci-Format1-2And0-2-r16)  7) sSCell USS set(s) (for CCS from sSCell to Pcell/PSCell) and Type0/0A/1/2 CSS sets on Pcell/PSCell can be configured so that the UE monitors them in overlapping slot of Pcell/PSCell and sSCell  - no simultaneous monitoring between ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’  - simultaneous monitoring of ‘USS sets (for P(S)Cell scheduling) on sSCell’ and ‘Type 0/0A/1/2/CSS sets on P(S)Cell for DCI formats with CRC not scrambled by C-RNTI/MCS-C-RNTI/CS-RNTI’  8) PDCCH monitoring occasion(s) on sSCell for cross-carrier scheduling to PCell/PSCell  9) frame boundary alignment between PCell/PSCell and sSCell | 6-5 | *crossCarrierSchedulingSCell-SpCellTypeA-r17* | *CA-ParametersNR-v1700* | No | Applicable to FR1 only | Candidate value set: One or more of supported SCS combinations ({P(S)Cell SCS in kHz, sSCell SCS in kHz}) from following set are indicated by the UE: {15,15}, {15,30}, {15, 60}, {30,30}, {30,60},{60,60})  Candidate value set 2: frequency band pair(s) for {PCell/PSCell, sSCell}  Component 4 candidate values: (K1, K2) = {(1,1) for FDD P(S)Cell; (K1, K2) = (1,2) for TDD P(S)Cell}  Component 8 candidate values:  Value 1: within the first 3 OFDM symbols of sSCell slot overlapping with the first 3 OFDM symbols of PCell/PSCell slot.  Value 2: within the first 3 OFDM symbols of any sSCell slot overlapping with PCell/PSCell slot  Note: The CCS from sSCell to PCell is applicable to FR1 only but there can be other SCells in FR2 configured for the UE  Note: The SCell configured with Cross-carrier scheduling to PCell/PSCell is referred to as ‘sSCell’  Note: Candidate value set 2 only applies for the following value sets of components 1: {30,30}, {30,60},{60,60}  Note: A UE supporting this FG does not imply that the UE can be configured with sSCell in shared spectrum  Note: Parameters in CSI-MeasConfig of P(S)Cell and sSCell are configured such that combination of P(S)Cell and sSCell configurations does not result in exceeding any of the UE’s capabilities for A-/SP-CSI reporting on PUSCH on P(S)Cell | Optional with capability signalling |
| 34. NR\_DSS | 34-1a | DCI formats on PCell/PSCell USS set(s) | Support of monitoring DCI formats 0\_1,1\_1,0\_2 (if supported),1\_2 (if supported) on PCell/PSCell USS set(s) | 34-1 | *dci-FormatsPCellPSCellUSS-Sets-r17* | *CA-ParametersNR-v1700* | No | Applicable to FR1 only |  | Optional with capability signalling |
| 34. NR\_DSS | 34-3 | Disabling scaling factor α when sSCell is deactivated | Support of disabling scaling factor α for Cross-carrier scheduling (CCS) from sSCell to PCell/PSCell (Type A or Type B) when sSCell is deactivated (scaling factor α is not applied for PDCCH overbooking/BD/CCE limit computation when sSCell is deactivated) | 34-1 or 34-2 | *disablingScalingFactorDeactSCell-r17* | *CA-ParametersNR-v1700* | No | Applicable to FR1 only |  | Optional with capability signalling |
| 34. NR\_DSS | 34-4 | Disabling scaling factor α when sSCell is dormant | Support of disabling scaling factor α for Cross-carrier scheduling (CCS) from sSCell to PCell/PSCell (Type A or Type B) when sSCell is switched to dormant BWP (scaling factor α is not applied for PDCCH overbooking/BD/CCE limit computation when sSCell is switched to dormant BWP) | 34-1 or 34-2 | *disablingScalingFactorDormantSCell-r17* | *CA-ParametersNR-v1700* | No | Applicable to FR1 only |  | Optional with capability signalling |
| 34. NR\_DSS | 34-5 | Non-aligned frame boundaries between PCell/PSCell and sSCell | CA with non-aligned frame boundaries for PCell/PSCell and sSCell in inter-band CA | 34-1 or 34-2 | *non-AlignedFrameBoundaries-r17*  *{*  *scs15kHz-15kHz-r17,*  *scs15kHz-30kHz-r17,*  *scs15kHz-60kHz-r17,*  *scs30kHz-30kHz-r17,*  *scs30kHz-60kHz-r17,*  *scs60kHz-60kHz-r17*  *}* | *CA-ParametersNR-v1700* | No | Applicable to FR1 only | Candidate value set 1: One or more of supported SCS combinations ({P(S)Cell SCS in kHz, sSCell SCS in kHz}) from following set are indicated by the UE: {15,15}, {15,30}, (15, 60), {30,30}, {30,60}, {60,60})  Candidate value set 2: frequency band pair(s) for {Pcell/PSCell, sSCell} | Optional with capability signalling |

### 6.1.13 LTE\_NR\_DC\_enh2

Table 6.1.13-1: Layer-1 feature list for LTE\_NR\_DC\_enh2

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 35. LTE\_NR\_DC\_enh2 | 35-1 | Aperiodic CSI-RS for tracking for fast SCell activation | 1) Aperiodic CSI-RS for tracking for fast SCell activation is triggered by enhanced SCell activation/deactivation MAC CE  2) Aperiodic CSI-RS for tracking for fast SCell activation is triggered within the BWP indicated by firstActiveDownlinkBWP-Id for the SCell  3) Maximum number of aperiodic CSI-RS resource set configurations for tracking for fast SCell activation that can be configured to UE per CC in a reported band  4) Maximum number of aperiodic CSI-RS resource set configurations for tracking for fast SCell activation that can be configured to UE across CCs in a reported band | 6-5 | *aperiodicCSI-RS-FastScellActivation-r17*  *{*  *maxNumberAperiodicCSI-RS-PerCC-r17,*  *maxNumberAperiodicCSI-RS-AcrossCCs-r17*  *}* | *BandNR* | N/A | N/A | Component 3 candidate values: {8,16,32,48,64,128,255}  Component 4 candidate values: {8,16,32,64,128,256,512,1024}  Note: component 3 and 4 candidate values refer to the number of RS configurations for fast SCell activation that can be indicated by the MAC CE  The NZP-CSI-RS configured as RS for tracking for fast SCell activation are not considered when counting the maximum NZP-CSI-RS configurations of FG2-33 | Optional with capability signalling |
| 35. LTE\_NR\_DC\_enh2 | 35-2 | Aperiodic CSI-RS bandwidth for tracking for fast SCell activation for 10MHz UE channel bandwidth | 1) Indicates the UE supported TRS bandwidths for fast SCell activation, in addition to 52 RBs, for a 10MHz UE channel bandwidth. This only applies for the BWPs configured with 52 RBs size and 15kHz SCS, in FDD bands. | 35-1 | *aperiodicCSI-RS-AdditionalBandwidth-r17* | *BandNR* | FDD only | FR1 only | Candidate values of Set 1: 28, 32, 36, 40, 44, 48 RBs  Candidate values of Set 2: 32, 36, 40, 44, 48 RBs | Optional with capability signalling |

### 6.1.14 NR\_DL1024QAM\_FR1

Table 6.1.14-1: Layer-1 feature list for NR\_DL1024QAM\_FR1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 36. NR\_DL1024QAM\_FR1 | 36-1 | 1024QAM for PDSCH for FR1 | Support 1024QAM for PDSCH for FR1 including 1024QAM modulation scheme as defined in TS 38.211, MCS and CQI feedback tables based on 1024QAM modulation order as defined in TS 38.214 [20]. | pdsch-256QAM-FR1 | *pdsch-1024QAM-FR1-r17* | *BandNR* | N/A | Applicable only to FR1 | Note from WI objective: DL PDSCH 1024QAM for FR1 should be defined as a per-band UE capability | Optional with capability signalling |
| 36. NR\_DL1024QAM\_FR1 | 36-1a | 1024QAM for PDSCH for FR1 with maximum 2 MIMO layers restriction | Support 1024QAM for PDSCH with maximum 2 MIMO layers for FR1 including 1024QAM modulation scheme as defined in TS 38.211, MCS and CQI feedback tables based on 1024QAM modulation order as defined in TS 38.214 [20]. | pdsch-256QAM-FR1 | *pdsch-1024QAM-2MIMO-FR1-r17* | *BandNR* | N/A | Applicable only to FR1 | Note from WI objective: DL PDSCH 1024QAM for FR1 should be defined as a per-band UE capability | Optional with capability signalling |
| 36. NR\_DL1024QAM\_FR1 | 36-2 | scalingFactor for 1024QAM | Indicates the scaling factor to be applied to the band in the max data rate calculation for 1024-QAM as defined in 4.1.2 when support of 1024-QAM is signalled for the band | 36-1 or 36-1a | *scalingFactor-1024QAM-FR1-r17* | *FeatureSetDownlink-v1700* | N/A | Applicable only to FR1 | Candidate component values:  {0.4, 0.75, 0.8, 1.0}  If absent, the scaling factor 1 is applied to the band in the max data rate calculation for 1024-QAM. | Optional with capability signaling |

### 6.1.15 [NR\_RF\_FR1\_enh]

Table 6.1.15-1: Layer-1 feature list for [NR\_RF\_FR1\_enh]

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 37. [NR\_RF\_FR1\_enh] | 37-x |  |  |  |  |  |  |  |  |  |

NOTE: Placeholder as there are no RAN1 UE features for Rel-17 Tx switching agreed until RAN1#109-e.

### 6.1.16 [NR\_SmallData\_INACTIVE]

Table 6.1.16-1: Layer-1 feature list for [NR\_SmallData\_INACTIVE]

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 38. [NR\_SmallData\_INACTIVE] | 38-x |  |  |  |  |  |  |  |  |  |

NOTE: Placeholder as there are no RAN1 UE features for SDT agreed until RAN1#109-e.

### 6.1.17 TEI17

Table 6.1.17-1: Layer-1 feature list for TEI17

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 39. TEI17 | 39-1 | Parallel SRS and PUCCH/PUSCH transmission across CCs in intra-band non-contiguous CA | Parallel SRS and PUCCH/PUSCH transmission across CCs in intra-band non-contiguous CA |  | *parallelTxSRS-PUCCH-PUSCH-intraBand-r17* | *CA-ParametersNR-v1720* | No | Yes | This feature is the same as *parallelTxSRS-PUCCH-PUSCH*, but for intra-band non-contiguous CA | Optional with capability signaling |
| 39. TEI17 | 39-2 | Parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in intra-band non-contiguous CA | Parallel PRACH and SRS/PUCCH/PUSCH transmissions across CCs in intra-band non-contiguous CA |  | *parallelTxPRACH-SRS-PUCCH-PUSCH-intraBand-r17* | *CA-ParametersNR-v1720* | No | Yes | This feature is the same as *parallelTxPRACH-SRS-PUCCH-PUSCH*, but for intra-band non-contiguous CA. This feature is enabled by a new UE-specific RRC parameter *intraBandNC-PRACH-simulTx-r17* | Optional with capability signaling |
| 39. TEI17 | 39-3-1 | Stay on the target CC for SRS carrier switching | Stay on the target CC when remaining SRS resource set(s) for SRS carrier switching exists | 2-56 | *stayOnTargetCC-SRS-CarrierSwitch-r17* | *CA-ParametersNR-v1730* | n/a | n/a | Note1: When UE supports this capability, if the time period between the SRS resource sets is smaller than the total required RF switching time to the source CC and back to the target CC and a higher priority UL transmission and/or DL reception is not scheduled on the source CC in the time period between the two SRS resources sets, the UE stays in the target CC in the period between the SRS resource sets; otherwise, the UE switches back to the source CC after transmitting each SRS resource set  Note2: If the UE does not indicate this capability, the UE falls back to Rel-15 behavior, that is UE switches back to source CC between the SRS resource sets | Optional with capability signaling |
| 39. TEI17 | 39-3-2 | Affected bands for inter-band CA during SRS carrier switching | 1. Indicate which other bands in the band combination are affected by the SRS switch.  2. The dropping rules / timelines apply to the indicated bands when SRS carrier switching on target CC and other UL on source CC are overlapped in the same symbol. | 2-56 | *srs-SwitchingAffectedBandsListNR-r17* | *BandParameters-v1730* | n/a | n/a | Note: If this new indication is missing, the UE defaults to Rel-15 behavior.  For each “source-target” pair (as indicated by *srs-SwitchingTimesListNR*), the UE can indicate which other bands in the band combination are affected by the SRS switch. | Optional with capability signaling |
| 39. TEI17 | 39-4 | Parallel MsgA and SRS/PUCCH/PUSCH transmissions across CCs in intra-band non-contiguous CA | Parallel MsgA and SRS/PUCCH/PUSCH transmissions across CCs in intra-band non-contiguous CA | 9-3 | *parallelTxMsgA-SRS-PUCCH-PUSCH-intraBand-r17* | *CA-ParametersNR-v1720* | No | Yes | This feature is the same as *parallelTxMsgA-SRS-PUCCH-PUSCH-r16*, but for intra-band non-contiguous CA. | Optional with capability signaling |

## 6.2 Layer-2 and Layer-3 features

### 6.2.0 General

Tables 6.2.1-1 to 6.2.19-1 provide the list of Layer-2 and Layer-3 features, and the corresponding UE capability field name, as specified in TS 38.331 [2].

### 6.2.1 NR\_MBS

Table 6.2.1-1: Layer-2 and Layer-3 feature list for NR\_MBS-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 25. NR\_MBS-Core | 25-1 | Additional maximum number of MRBs for multicast | Indicates the additional maximum number of MRBs that the UE supports for MBS multicast reception as specified in TS 38.331 [2]. |  | *maxMRB-Add-r17* | *MBS-Parameters-r17* | No | No |  | Optional with capability signalling |
| 25-2 | Broadcast reception | It is optional for UE to support broadcast reception (RAN1 FG 33-1) as specified in TS 38.331 [2]. A UE that supports the feature shall also support:  - 4 broadcast MRBs as the minimum number;  - PDCP 12 bits SN;  - ROHC with profiles 0x0000, 0x0001 and 0x0002;  - 4 ROHC context sessions;  - RLC UM with 6 bits SN;  - RLC UM with 12 bits SN;  - DRX with long DRX cycle for MBS broadcast as specified in TS 38.321 [10]. |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 25-3 | SCell based MBS broadcast reception | Indicates whether the UE supports MBS reception via broadcast in RRC\_CONNECTED, on one frequency indicated in an MBSInterestIndication message, when an SCell is configured and activated on that frequency, as specified in TS 38.331 [2]. |  | *broadcastSCell-r17* | *FeatureSetDownlinkPerCC-v1700* | No | No | The UE is not required to receive MBS via broadcast on PCell and SCell simultaneously. | Optional with capability signalling |

### 6.2.2 LTE\_NR\_DC\_enh2

Table 6.2.2-1: Layer-2 and Layer-3 feature list for LTE\_NR\_DC\_enh2-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331 [2]** | **Parent IE in TS 38.331 [2]** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 26. LTE\_NR\_DC\_enh2-Core | 26-1 | Activation/Deactivation of SCG | Indicates whether the UE supports activation (with or without RACH) and deactivation on SCG in NR-DC, upon SCG addition and upon reconfiguration of the SCG, as specified in TS 38.331 [2]. | support of NR-DC as specified in TS 38.331 [2]. | *scg-ActivationDeactivationNRDC-r17* | *CA-ParametersNRDC-v1700* | No | No | For the UE supporting this feature, it is mandatory to report *maxNumberCSI-RS-BFD* and *maxNumberSSB-BFD* for all NR bands of this band combination where the UE supports SpCell. | Optional with capability signalling |
| 26-2 | Activation/Deactivation of SCG | Indicates whether the UE supports activation (with or without RACH) and deactivation on SCG in NR-DC, upon reception of an *RRCReconfiguration* included in an *RRCResume* message, as specified in TS 38.331 [2]. | support of NR-DC and of *resumeWithSCG-Config-r16* as specified in TS 38.331 [2]. | *scg-ActivationDeactivationResumeNRDC-r17* | *CA-ParametersNRDC-v1700* | No | No | For the UE supporting this feature, it is mandatory to report *maxNumberCSI-RS-BFD* and *maxNumberSSB-BFD* for all NR bands of this band combination where the UE supports SpCell. | Optional with capability signalling |
| 26-3 | Activation/Deactivation of SCG | Indicates whether the UE supports activation (with or without RACH) and deactivation on SCG in EN-DC, upon SCG addition and upon reconfiguration of the SCG, as specified in TS 38.331 [2]. | support of EN-DC as specified in TS 36.331 [12] | *scg-ActivationDeactivationENDC-r17* | *MRDC-Parameters-v1700* | No | No | For the UE supporting this feature, it is mandatory to report *maxNumberCSI-RS-BFD* and *maxNumberSSB-BFD* for all NR bands of this band combination where the UE supports SpCell. | Optional with capability signalling |
| 26-4 | Activation/Deactivation of SCG | Indicates whether the UE supports activation (with or without RACH) and deactivation on SCG in EN-DC, upon reception of an *RRCReconfiguration* included in an *RRCConnectionResume* message, as specified in TS 38.331 [2] and TS 36.331 [12]. | support of EN-DC and support of *resumeWithSCG-Config-r16* as specified in TS 36.331 [12] | *scg-ActivationDeactivationResumeENDC-r17* | *MRDC-Parameters-v1700* | No | No | For the UE supporting this feature, it is mandatory to report *maxNumberCSI-RS-BFD* and *maxNumberSSB-BFD* for all NR bands of this band combination where the UE supports SpCell. | Optional with capability signalling |
| 26-5 | CPAC | Indicates whether the UE supports conditional PSCell addition in NR-DC. |  | *condPSCellAdditionNRDC-r17* | *CA-ParametersNRDC-v1700* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in conditional PSCell addition in NR-DC. | Optional with capability signalling |
| 26-6 | CPAC | Indicates whether the UE supports conditional PSCell addition in EN-DC. |  | *condPSCellAdditionENDC-r17* | *MRDC-Parameters-v1700* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in conditional PSCell addition in EN-DC. | Optional with capability signalling |
| 26-7 | CPAC | Indicates whether the UE supports MN initiated conditional PSCell change in NR-DC, which is configured by NR *conditionalReconfiguration* using MN configured measurement as triggering condition. |  | *mn-InitiatedCondPSCellChangeNRDC-r17* | *BandNR* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in MN initiated conditional PSCell change in NR-DC. UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Optional with capability signalling |
| 26-8 | CPAC | Indicates whether the UE supports SN initiated inter-SN conditional PSCell change in NR-DC, which is configured by NR *conditionalReconfiguration* using SN configured measurement as triggering condition. |  | *sn-InitiatedCondPSCellChangeNRDC-r17* | *BandNR* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in SN initiated inter-SN conditional PSCell change in NR-DC. UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively. | Optional with capability signalling |
| 26-9 | CPAC | Indicates whether the UE supports inter SN conditional PSCell change between FDD and TDD cells in NR-DC. | *mn-InitiatedCondPSCellChangeNRDC-r17* is set for FDD band(s) and TDD band(s), or *sn-InitiatedCondPSCellChangeNRDC-r17* is set for FDD band(s) and TDD band(s) | *inter-SN-condPSCellChangeFDD-TDD-NRDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No |  | Optional with capability signalling |
| 26-10 | CPAC | Indicates whether the UE supports inter SN conditional PSCell change between FR1 and FR2 cells. | *mn-InitiatedCondPSCellChangeNRDC-r17* is set for FR1 band(s) and FR2 band(s), or *sn-InitiatedCondPSCellChangeNRDC-r17* is set for FR1 band(s) and FR2 band(s). | *inter-SN-condPSCellChangeFR1-FR2-NRDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No |  | Optional with capability signalling |
| 26-11 | CPAC | Indicates whether the UE supports inter SN conditional PSCell change between FDD and TDD cells in EN-DC. | *mn-InitiatedCondPSCellChange-FR1FDD-ENDC-r17* is supported and at least one *of mn-InitiatedCondPSCellChange-FR1TDD-ENDC-r17* and *mn-InitiatedCondPSCellChange-FR2TDD-ENDC-r17* is supported,  - or *sn-InitiatedCondPSCellChange-FR1FDD-ENDC-r17* is supported and at least one of *sn-InitiatedCondPSCellChange-FR1TDD-ENDC-r17* and *sn-InitiatedCondPSCellChange-FR2TDD-ENDC-r17* is supported. | *inter-SN-condPSCellChangeFDD-TDD-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No |  | Optional with capability signalling |
| 26-12 | CPAC | Indicates whether the UE supports inter SN conditional PSCell change between FR1 and FR2 cells in EN-DC. | *mn-InitiatedCondPSCellChange-FR2TDD-ENDC-r17* is supported and at least one of *mn-InitiatedCondPSCellChange-FR1TDD-ENDC-r17* and *mn-InitiatedCondPSCellChange-FR1FDD-ENDC-r17* is supported,  - or *sn-InitiatedCondPSCellChange-FR2TDD-ENDC-r17* is supported and at least one of *sn-InitiatedCondPSCellChange-FR1TDD-ENDC-r17* and *sn-InitiatedCondPSCellChange-FR1FDD-ENDC-r17* is supported. | *inter-SN-condPSCellChangeFR1-FR2-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No |  | Optional with capability signalling |
| 26-13 | CPAC | Indicates whether the UE supports MN initiated conditional PSCell change within all supported FR1-FDD bands in EN-DC, which is configured by E-UTRA *conditionalReconfiguration* field using MN configured measurement as triggering condition. |  | *mn-InitiatedCondPSCellChange-FR1FDD-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in MN initiated conditional PSCell change in EN-DC. | Optional with capability signalling |
| 26-14 | CPAC | Indicates whether the UE supports MN initiated conditional PSCell change within all supported FR1-TDD bands in EN-DC, which is configured by E-UTRA *conditionalReconfiguration* field using MN configured measurement as triggering condition. |  | *mn-InitiatedCondPSCellChange-FR1TDD-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in MN initiated conditional PSCell change in EN-DC. | Optional with capability signalling |
| 26-15 | CPAC | Indicates whether the UE supports MN initiated conditional PSCell change within all supported FR2-TDD bands in EN-DC, which is configured by E-UTRA *conditionalReconfiguration* field using MN configured measurement as triggering condition. |  | *mn-InitiatedCondPSCellChange-FR2TDD-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in MN initiated conditional PSCell change in EN-DC. | Optional with capability signalling |
| 26-16 | CPAC | Indicates whether the UE supports SN initiated inter-SN conditional PSCell change within all supported FR1-FDD bands in EN-DC, which is configured by E-UTRA *conditionalReconfiguration* field using SN configured measurement as triggering condition. |  | *sn-InitiatedCondPSCellChange-FR1FDD-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in SN initiated inter-SN conditional PSCell change in EN-DC. | Optional with capability signalling |
| 26-17 | CPAC | Indicates whether the UE supports SN initiated inter-SN conditional PSCell change within all supported FR1-TDD bands in EN-DC, which is configured by E-UTRA *conditionalReconfiguration* field using SN configured measurement as triggering condition. |  | *sn-InitiatedCondPSCellChange-FR1TDD-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in SN initiated inter-SN conditional PSCell change in EN-DC. | Optional with capability signalling |
| 26-18 | CPAC | Indicates whether the UE supports SN initiated inter-SN conditional PSCell change within all supported FR2-TDD bands in EN-DC, which is configured by E-UTRA *conditionalReconfiguration* field using SN configured measurement as triggering condition. |  | *sn-InitiatedCondPSCellChange-FR2TDD-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No | The UE supporting this feature shall also support 2 trigger events for same execution condition in SN initiated inter-SN conditional PSCell change in EN-DC. | Optional with capability signalling |

### 6.2.3 LTE\_NR\_MUSIM

Table 6.2.3-1: Layer-2 and Layer-3 feature list for LTE\_NR\_MUSIM-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331 [2]** | **Parent IE in TS 38.331 [2]** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 27. LTE\_NR\_MUSIM-Core | 27-1 | MUSIM NW Switching- MUSIM Gap request | Indicates whether the UE supports providing MUSIM assistance information with MUSIM gap preference and related MUSIM gap configuration, as defined in TS 38.331 [2]. UE supporting this feature supports 3 periodic gaps and 1 aperiodic gap. |  | *musim-GapPreference-r17* | *UE-NR-Capability-v1700* | No | No |  | Optional with capability signalling |
|  | 27-2 | MUSIM NW Switching-leaving RRC\_CONNECTED state-request | Indicates whether the UE supports providing MUSIM assistance information with indication of leaving RRC\_CONNECTED state as defined in TS 38.331 [2]. |  | *musim-LeaveConnected-r17* | *UE-NR-Capability-v1700* | No | No |  | Optional with capability signalling |
|  | 27-3 | Paging cause in RAN paging message | It is mandatory for a UE to support paging cause in RAN paging if UE supports paging cause in CN paging. |  | *n/a* | *n/a* | n/a | n/a |  | Conditionally mandatory without capability signalling |

### 6.2.4 NR\_IAB\_enh

Table 6.2.4-1: Layer-2 and Layer-3 feature list for NR\_IAB\_enh-Core

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331 [2]** | **Parent IE in TS 38.331 [2]** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 28. NR\_IAB\_enh-Core | 28-1 | RLF handling | Indicates whether the IAB-MT supports BH RLF detection indication and BH RLF recovery indication handling as specified in TS 38.331 [2] and in TS 38.340 [11] |  | *bh-RLF-DetectionRecovery-Indication-r17* | *UE-NR-Capability-v17* | No | No |  | Optional with capability signalling for IAB-MT |
|  | 28-2 | BAP Header Rewirting | 1) Indicates whether the IAB-MT supports BAP header rewriting for inter-donor-DU re-routing, as specified in TS 38.340 [11] and TS 38.300 [16]. IAB-donor-DUs can belong to the same or different IAB-donor CUs.  2) Indicates whether the IAB-MT supports BAP header rewriting based for inter-donor CU routing, including inter-donor- CU partial migration, inter-donor-CU RLF recovery, and inter-donor- CU routing for topology redundancy, as specified in TS 38.340 [11] and TS38.300 [16]. |  | *1) bapHeaderRewriting-Rerouting-r17*  *2) bapHeaderRewriting-Routing-r17* | *BAP-Parameters-r17* | No | No |  | Optional with capability signalling for IAB-MT |
|  | 28-3 | LCG Extension | Indicates whether the IAB-MT supports extended logical channel group as specified in TS 38.321 [10]. A UE supporting this feature shall also support Extended Buffer Status Report formats. |  | *lcg-ExtensionIAB-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling for IAB-MT |
|  | 28-4 | F1AP over NR RRC | Indicates whether the IAB-MT supports F1-C signalling over *DLInformationTransfer* and *ULInformationTransfer* messages via MN when IAB-MT operates in NR-DC and MN is the non-F1-termination node or via SN when IAB-MT operates in NR-DC and SN is the non-F1-termination node, as specified in TS 37.401 and TS 37.340. |  | *f1c-OverNR-RRC-r17* | *NRDC-Parameters-v17* | No | No |  | Optional with capability signalling for IAB-MT |

### 6.2.5 NR\_IIOT\_URLLC\_enh

Table 6.2.5-1: Layer-2 and Layer-3 feature list for NR\_IIOT\_URLLC\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331 [2]** | **Parent IE in TS 38.331 [2]** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 29. NR\_IIOT\_URLLC\_enh-Core | 29-1 | Enhancements in unlicensed controlled environments | 1) Indicates whether the UE supports simultaneous configuration of LCH based prioritization and *cg-RetransmissionTimer-r16* as specified in TS 38.321 [10].  2) Indicate whether the UE supports the HARQ process ID selection based on LCH priority as specified in TS 38.321 [10]. | 1) *lch-priorityBasedPrioritization-r16* and *configuredGrantWithReTx-r16*  2) *jointPrioritizationCG-Retx-Timer-r17* | 1) *jointPrioritizationCG-Retx-Timer-r17*  2) *intraCG-Prioritization-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 29-2 | Survival time | Indicates whether the UE supports services with survival time requirement using configured grant resource and PDCP duplication, as specified in TS 38.321 [10]. | *pdcp-DuplicationMCG-orSCG-DRB* or *pdcp-DuplicationSplitDRB;*  *configuredUL-GrantType1-v1650* or *configuredUL-GrantType2-v1650* | *survivalTime-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 29-3 | gNB-side RTT-based PDC | Indicates whether the UE supports gNB-side RTT-based PDC, as specified in TS 38.300 [yy]. |  | *gNB-SideRTT-BasedPDC-r17* | *UE-NR-Capability* | No | No |  | Optional with capability signalling |
| 29-4 | Simultaneous transmission of SR and PUSCH in different PUCCH groups | Indicates whether the UE supports simultaneous transmission of SR and PUSCH in different PUCCH groups as specified in TS 38.321 [10]. |  | *simultaneousSR-PUSCH-DiffPUCCH-groups-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |

### 6.2.6 NR\_SmallData\_INACTIVE

Table 6.2.6-1: Layer-2 and Layer-3 feature list for NR\_SmallData\_INACTIVE

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 30. NR\_SmallData\_INACTIVE | 30-1 | RA-SDT | Indicates whether the UE supports transmission of data and/or signalling over allowed radio bearers in RRC\_INACTIVE state via Random Access procedure (i.e., RA-SDT) with 4-step RA type and if UE supports *twoStepRACH-r16,* with 2-step RA type, as specified in TS 38.331 [2]. |  | *ra-SDT-r17* | *UE-NR-Capability-v1700* | No | No |  | Optional with capability signaling |
| 30-2 | CG-SDT | Indicates whether the UE supports transmission of data and/or signalling over allowed radio bearers in RRC\_INACTIVE state via configured grant type 1 (i.e. CG-SDT), as specified in TS 38.331 [2]. |  | *cg-SDT-r17* | *BandNR* | N/A | N/A | UE shall set the capability value consistently for NTN bands. | Optional with capability signalling |
| 30-3 | SRB-SDT | Indicates whether the UE supports the usage of signaling radio bearer SRB2 over RA-SDT or CG-SDT, as specified in TS 38.331 [2]. | A UE supporting this feature shall also support *ra-SDT-r17* or *cg-SDT-r17*. | *srb-SDT-r17* | *UE-NR-Capability-v1700* | No | No |  | Optional with capability signalling |
| 30-4 | CG-SDT | Indicates whether the UE supports PUSCH repetitions for CG-SDT | A UE can include this feature only if the UE indicates the support *cg-SDT-r17*.  A UE supporting this feature shall also indicate the support of *type1-PUSCH-RepetitionMultiSlots* or *pusch-RepetitionTypeB-r16*. | *pusch-Repetition-CG-SDT-r17* | *Phy-ParametersCommon* | No | No |  | Optional with capability signaling |

### 6.2.7 NR\_SL\_Relay

Table 6.2.7-1: Layer-2 and Layer-3 feature list for NR\_SL\_Relay

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331 [2]** | **Parent IE in TS 38.331 [2]** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 31. NR\_SL\_Relay-Core | 31-1 | Band combination list supporting transmission and reception of relay discovery | Defines the supported band combinations of NR sidelink relay discovery message transmission and reception by the UE. This parameter is used by the remote UE and relay UE, and for the case of L2 and L3 relay. |  | *supportedBandCombinationListSidelinkRelayDiscovery-r17* | *RF-Parameters* | No | No |  | Optional with capability signalling |
| 31-2 | Band combination list supporting transmission and reception of non-relay discovery | Defines the supported band combinations of NR sidelink non-relay discovery message transmission and reception by the UE. |  | *supportedBandCombinationListSidelinkNonRelayDiscovery-r17* | *RF-Parameters* | No | No |  | Optional with capability signalling |
| 31-3 | Basic NR L2 sidelink relay UE operation | Indicates whether basic NR L2 sidelink relay UE operation is supported by the UE. |  | *relayUE-Operation-L2-r17* | *SidelinkParametersNR-r16* | No | No |  | Optional with capability signalling |
| 31-4 | Basic NR L2 sidelink remote UE operation | Indicate whether basic NR L2 sidelink remote UE operation is supported by the UE. |  | *remoteUE-Operation-L2-r17* | *SidelinkParametersNR-r16* | No | No |  | Optional with capability signalling |
| 31-5 | Remote UE performs handover to idle/inactive relay UE | Indicate whether L2 sidelink remote UE supports direct to indirect path switch with target relay in RRC\_IDLE or RRC\_INACTIVE state. |  | *remoteUE-PathSwitchToIdleInactiveRelay-r17* | *SidelinkParametersNR-r16* | No | No |  | Optional with capability signalling |
| 31-6 | UE supports simultaneous transmission/reception of PC5 data (Relay discovery) and Uu uplink/downlink respectively | Indicates, for a particular Uu band combination, the PC5 Relay discovery band combination(s) on which the UE supports simultaneous transmission/reception of PC5 data (Relay discovery) and Uu uplink/downlink respectively. |  | *supportedBandCombListPerBC-SL-RelayDiscovery-r17* | *BandCombination-v1700* | No | No |  | Optional with capability signalling |
| 31-7 | UE supports simultaneous transmission/reception of PC5 data (non-Relay discovery) and Uu uplink/downlink respectively | Indicates, for a particular Uu band combination, the PC5 non-Relay discovery band combination(s) on which the UE supports simultaneous transmission/reception of PC5 data (non-Relay discovery) and Uu uplink/downlink respectively. |  | *supportedBandCombListPerBC-SL-NonRelayDiscovery-r17* | *BandCombination-v1700* | No | No |  | Optional with capability signalling |
| 31-8 | Support L3 sidelink relay UE operation | It is optional for UE to support L3 sidelink relay UE operation |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 31-9 | Support L3 sidelink remote UE operation | It is optional for UE to support L3 sidelink remote UE operation |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |

### 6.2.8 NR\_Slice

Table 6.2.8-1: Layer-2 and Layer-3 feature list for NR\_Slice

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 32. NR\_Slice-Core | 32-1 | Slice based cell reselection | Indicates whether the UE supports slice-based cell reselection Information in SIB and on RRC release for slice-based cell reselection in RRC \_IDLE and RRC INACTIVE as defined in TS 38.304 [19]. |  | *sliceInfoforCellReselection-r17* | *UE-NR-Capability-v17* | No | No |  | Optional with capability signalling |
|  | 32-2 | Random access prioritisation for Slicing | It is optional for UE to support slice-based prioritisation for random access as specified in TS 38.321 [10] |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
|  | 32-3 | Random access partitioning for Slicing | It is optional for UE to support slice-based RACH partitioning specified in TS 38.321 [10]. |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |

### 6.2.9 NR\_UE\_pow\_sav\_enh

Table 6.2.9-1: Layer-2 and Layer-3 feature list for NR\_UE\_pow\_sav\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 33. NR\_UE\_pow\_sav\_enh-Core | 33-1 | RLM relaxation | Indicates whether the UE supports RLM relaxation criteria and requirement as specified in TS 38.133. |  | *rlm-Relaxation-r17* | *BandNR* | No | Yes |  | Optional with capability signalling |
| 33-2 | BFD relaxation | Indicates whether the UE supports BFD relaxation criteria and requirement as specified in TS 38.133. |  | *bfd-Relaxation-r17* | *BandNR* | No | Yes |  | Optional with capability signalling |

### 6.2.10 NR\_NTN\_solutions

Table 6.2.10-1: Layer-2 and Layer-3 feature list for NR\_NTN\_solutions

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331 [2]** | **Parent IE in TS 38.331 [2]** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 34. NR\_NTN\_solutions-Core | 34-1 | Support of non Terrestrial Network | Indicates whether the UE supports NR NTN access. |  | *nonTerrestrialNetwork-r17* | *UE-NR-Capability-v1700* | No | No | If the UE indicates this capability the UE shall support the following NTN essential features, i.e., timer extension in MAC/RLC/PDCP layers and RACH adaptation to handle long RTT, acquiring NTN specific SIB and more than one TAC per PLMN broadcast in one cell. | Optional with capability signalling |
| 34-2 | Disabling HARQ feedback for downlink transmission | Indicates whether the UE supports disabled HARQ feedback for downlink transmission. | *34-1* | *harq-FeedbackDisabled-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 34-3 | HARQ mode B for uplink transmission | Indicates whether the UE supports HARQ mode B and the corresponding LCR restrictions for uplink transmission | *34-1* | *uplink-Harq-ModeB-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 34-4 | Location based CHO | Indicates whether the UE supports location based CHO | *34-1, and condHandover-r16 is set for NTN bands.* | *locationBasedCondHandover-r17* | *BandNR* | No | No | UE shall set the capability value consistently for all FDD-FR1 NTN bands. | Optional with capability signalling |
| 34-5 | Time based CHO | Indicates whether the UE supports time based CHO | *34-1, and condHandover-r16 is set for NTN bands.* | *timeBasedCondHandover-r17* | *BandNR* | No | No | UE shall set the capability value consistently for all FDD-FR1 NTN bands. | Optional with capability signalling |
| 34-6 | Event A4 based CHO | Indicates whether the UE supports Event A4 based CHO | *34-1, and condHandover-r16 is set for NTN bands.* | *eventA4BasedCondHandover-r17* | *BandNR* | No | No | UE shall set the capability value consistently for all FDD-FR1 NTN bands. | Optional with capability signalling |
| 34-7 | SR triggered by a TA report | Indicates whether the UE supports triggering of SR when a TA report is triggered and there are no available UL-SCH resources. | *34-1* | *sr-TriggeredBy-TA-Report-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 34-8 | Supported NTN scenario(s) | Indicates whether the UE supports the NTN features in GSO scenario or NGSO scenario. If a UE does not include this field but includes nonTerrestrialNetwork-r17, the UE supports the NTN features for both GSO and NGSO scenarios, and also supports mobility between GSO and NGSO scenarios. | *34-1* | *ntn-ScenarioSupport-r17* | *UE-NR-Capability-v1700* | No | No |  | Optional with capability signalling |
| 34-9 | Time-based measurement initiation | It’s optional for UE to start neighbour cell measurements before the broadcast cell service stop-time |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 34-10 | Location-based measurement initiation | It’s optional for UE to perform location-based measurement initiation for neighbour cells |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 34-11 | SMTC adjustment in idle/inactive | It’s optional for UE to perform SMTC adjustment in RRC\_IDLE/RRC\_INACTIVE |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 34-12 | Reporting of service link propagation delay difference between serving cell and neighbour cell(s) | Indicates whether the UE supports the reporting of service link propagation delay difference between serving cell and neighbour cell(s). | *34-1* | *serviceLinkPropDelayDiffReporting-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 34-13 | Location-based measurement report trigger | Indicates whether the UE supports location-based triggered measurement reporting (i.e., event D1) | *34-4* | *eventD1-MeasReportTrigger-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 34-14 | RRC\_INACTIVE in NTN | Indicates whether the UE supports RRC\_INACTIVE in NTN | *34-1* | *inactiveStateNTN-r17* | *NTN-Parameters-r17* | No | No |  | Conditional mandatory with capability signalling |
| 34-15 | RA-SDT in NTN | Indicates whether the UE supports transmission of data and/or signalling over allowed radio bearers in RRC\_INACTIVE state in NTN via Random Access procedure (i.e., RA-SDT) with 4-step RA type and if UE supports *twoStepRACH-r16* for NTN, with 2-step RA type. | *34-1* | *ra-SDT-NTN-r17* | *NTN-Parameters-r17* | No | No |  | Optional with capability signalling |
| 34-16 | SRB-SDT in NTN | Indicates whether the UE supports the usage of signalling radio bearer SRB2 over RA-SDT or CG-SDT in NTN. | *34-1 and {34-15 or 30-2 in NTN bands}* | *srb-SDT-NTN -r17* | *NTN-Parameters-r17* | No | No |  | Optional with capability signalling |
| 34-17 | TA reporting during initial access | It is mandatory to support TA reporting during initial access for UEs supporting uplink-TA-Reporting-r17 as specified in TS 38.321 [10]. |  | *n/a* | *n/a* | n/a | n/a |  | Conditional mandatory without capability signalling |

### 6.2.11 NR\_pos\_enh

Table 6.2.11-1: Layer-2 and Layer-3 feature list for NR\_pos\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 37.355 [9] | Parent IE in TS 37.355 [9] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 35. NR\_pos\_enh-Core | 35-1 | Scheduled Location Time | Indicates whether the target device supports scheduled location requests. |  | *scheduledLocationRequestSupported-r17* | *OTDOA-ProvideCapabilities or*  *A-GNSS-ProvideCapabilities or*  *ECID-Provide-Capabilities or*  *TBS-ProvideCapabilities or*  *Sensor-ProvideCapabilities or*  *WLAN-ProvideCapabilities or*  *BT-ProvideCapabilities or*  *NR-ECID-ProvideCapabilities or*  *NR-DL-TDOA-ProvideCapabilities or*  *NR-DL-AoD-ProvideCapabilities or*  *NR-Multi-RTT-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling |
| 35-2 | 10 ms ganularity for response time | Indicates whether the '*ten-milli-seconds*' response time unit is supported by the target device. |  | *ten-ms-unit-ResponseTime-r17* | NR-ECID-ProvideCapabilities or  NR-DL-TDOA-ProvideCapabilities or  NR-DL-AoD-ProvideCapabilities or  *NR-Multi-RTT-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling |
|  | 35-3 | PRS validity area | Indicates whether the target device supports validity conditions for pre-configured assistance data. |  | *nr-dl-prs-AssistanceDataValidity-r17* | *NR-DL-TDOA-ProvideCapabilities or*  *NR-DL-AoD-ProvideCapabilities or*  *NR-Multi-RTT-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-4a | On-demand PRS for DL-TDOA | Indicates whether the target device supports on-demand DL-PRS requests for DL-TDOA. |  | *nr-DL-TDOA-On-Demand-DL-PRS-Support-r17* | *NR-DL-TDOA-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-4b | On-demand PRS request for DL-AoD | Indicates whether the target device supports on-demand DL-PRS requests for DL-AoD. |  | *nr-DL-AoD-On-Demand-DL-PRS-Support-r17* | *NR-DL-AoD-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-4c | On-demand PRS request for multi-RTT | Indicates whether the target device supports on-demand DL-PRS requests for Multi-RTT. |  | *nr-Multi-RTT-On-Demand-DL-PRS-Support-r17* | *NR-Multi-RTT-ProvideCapabilities* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-5 | Service parameters for GNSS Integrity | Indicates whether the target device supports the IE *GNSS-Integrity-ServiceParameters.* |  | *gnss-Integrity-ServiceParametersSupport-r17* | *GNSS-CommonAssistanceDataSupport* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-6 | Service alert for GNSS Integrity | Indicates whether the target device supports the IE *GNSS-Integrity-ServiceAlert.* |  | *gnss-Integrity-ServiceAlertSupport-r17* | *GNSS-CommonAssistanceDataSupport* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-7 | Orbit parameters for GNSS Integrity | Indicates whether the target device supports the IEs *ORBIT-IntegrityParameters* and *SSR-IntegrityOrbitBounds*. |  | *orbit-IntegritySup-r17* | *GNSS-SSR-OrbitCorrectionsSupport-r15* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-8 | Code bias bound for GNSS Integrity | Indicates whether the target device supports the IE *SSR-IntegrityCodeBiasBounds*. |  | *ssr-IntegrityCodeBiasBoundsSup-r17* | *GNSS-SSR-CodeBiasSupport-r15* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-9 | Phase bias bound for GNSS Integrity | Indicates whether the target device supported the IE *SSR-IntegrityPhaseBiasBounds.* |  | *ssr-IntegrityPhaseBiasBoundsSup-r17* | *GNSS-SSR-PhaseBiasSupport-r16* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-10 | STEC parameters for GNSS Integrity | Indicates whether the target device supported the IE *STEC-IntegrityParameters* and *STEC-IntegrityErrorBounds* |  | *stec-IntegritySup-r17* | *GNSS-SSR-STEC-CorrectionSupport-r16* | N/A | N/A |  | Optional with capability signalling | |
|  | 35-11 | Gridded correction parameters for GNSS Integrity | Indicates whether the target device supports the IEs *SSR-GriddedCorrectionIntegrityParameters* and *TropoDelayIntegrityErrorBounds*. |  | *griddedCorrectionIntegritySup-r17* | *GNSS-SSR-GriddedCorrectionSupport-r16* | N/A | N/A |  | Optional with capability signalling |

### 6.2.12 NR\_RedCap

Table 6.2.12-1: Layer-2 and Layer-3 feature list for NR\_RedCap

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 36. NR\_redcap-Core | 36-1 | Support 16 DRBs | Defines whether the RedCap UE supports 16 DRBs as specified in TS 38.331 [2]. |  | *supportOf16DRB-RedCap-r17* | *RedCapParameters-r17* | No | No |  | Optional with capability signalling |
| 36-2 | Support 18 bit length of PDCP sequence number | Defines whether the RedCap UE supports 18 bit length of PDCP sequence number as specified in TS 38.331 [2]. |  | *longSN-RedCap-r17* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 36-3 | Support AM DRB with 18 bit length of RLC sequence number | Defines whether the RedCap UE supports AM DRB with 18 bit length of RLC sequence number as specified in TS 38.331 [2]. |  | *am-WithLongSN-RedCap-r17* | *RLC-Parameters* | No | No |  | Optional with capability signalling |
| 36-4 | Support of RRM relaxation in RRC\_CONNECTED | Defines whether the RedCap UE supports Rel-17 relaxed RRM measurements in RRC\_CONNECTED as specified in TS 38.331 [2]. |  | *rrm-RelaxationRRC-ConnectedRedCap-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 36-5 | Support of extended DRX in RRC\_INACTIVE | Defines whether a UE (RedCap or Non-RedCap) supports the extended DRX in RRC\_INACTIVE with values of 256, 512 and 1024 radio frames as specified in TS 38.331 [2]. The UE may indicate support for extended DRX in RRC\_INACTIVE only if it supports extended DRX in RRC\_IDLE. |  | *extendedDRX-CycleInactive-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |

### 6.2.13 NR\_ENDC\_SON\_MDT\_enh

Table 6.2.13-1: Layer-2 and Layer-3 feature list for NR\_ENDC\_SON\_MDT\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331 [2]** | **Parent IE in TS 38.331 [2]** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 37. NR\_ENDC\_SON\_MDT\_enh-Core | 37-1 | RLF for CHO | Indicates whether the UE supports RLF-Report for conditional handover. |  | *rlfReportCHO-r17* | *SON-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-2 | RLF for DAPS HO | Indicates whether the UE supports RLF-Report for DAPS handover. |  | *rlfReportDAPS-r17* | *SON-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-3 | Report for SHR | Indicates whether the UE supports the storage and delivery of Successful Handover Report upon request from the network as specified in TS 38.331 [2]. |  | *success-HO-Report-r17* | *SON-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-4 | RA report for 2-step RA | Indicates whether the UE supports the storage and delivery of 2-step RACH related information upon request from the network as specified in TS 38.331 [2]. | 20-1 | *twoStepRACH-Report-r17* | *SON-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-5 | SpCell ID indication | It is optional for UE to support the delivery of the *SpCellID-r17* in the RA-Report, if the RA procedure is performed in a SCell of the MCG/SCG. | 20-1 | *N/A* | *N/A* | No | No |  | Optional without capability signalling |
| 37-6 | PSCell MHI storage | t is optional for UE to support the storage of PSCell mobility history information and the reporting in UEInformationResponse message as specified in TS 38.331 [2]. | 20-12 | *pscell-MHI-Report-r17* | *SON-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-7 | SCG Failure Report for MRO | It is optional for UE to support the delivery of the SCG failure related parameters for MRO in SCGFailureInformation message to the network. |  | *N/A* | *N/A* | No | No |  | Optional without capability signalling |
| 37-8 | On demand SI report | Indicates whether the UE supports delivery of on-Demand SI information upon request from the network as specified in TS 38.331 [2]. | 20-1 | *onDemandSI-Report-r17* | *SON-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-9 | Signaling Based Logged MDT Override Protection | Indicates whether the UE supports the override protection of the signalling based logged measurements configured in NR. | 20-6 | *sigBasedLogMDT-OverrideProtect-r17* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-10 | Multiple CEF report | Indicates whether the UE supports the storage and delivery of multiple CEF reports upon request from the network as specified in TS 38.331 [2]. |  | *multipleCEF-Report-r17* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-11 | Excess packet delay | Indicates whether the UE supports the UL PDCP excess packet delay measurement per DRB as specified in TS 38.314. A UE that supports the UL PDCP excess packet delay measurement shall also support the measurement configuration and reporting as specified in TS 38.331 [2]. |  | *excessPacketDelay-r17* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |
| 37-12 | Logged Measurements Suspension due to IDC Interference | It is mandatory to support Logged Measurements Suspension due to IDC Interference if both logged MDT and IDC are supported. | 20-6 and 24-7 | *n/a* | *n/a* | n/a | n/a |  | Conditional mandatory without capability signalling |
|  | 37-13 | Early measurement log | Indicates whether the UE supports the storage of Early Measurement Logging in logged measurements and the reporting upon request from the network as specified in TS 38.331 [2]. |  | *earlyMeasLog-r17* | *UE-BasedPerfMeas-Parameters-r16* | No | No |  | Optional with capability signalling |

### 6.2.14 NR\_QoE

Table 6.2.14-1: Layer-2 and Layer-3 feature list for NR\_QoE

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 38. NR\_QoE-Core | 38-1a | NR QoE measurement collection for streaming | Indicates whether the UE supports NR QoE Measurement Collection for streaming services. |  | *qoe-Streaming-MeasReport-r17* | *AppLayerMeasParameters-r17* | No | No |  | Optional with capability signalling |
|  | 38-1b | NR QoE measurement collection for MTSI | Indicates whether the UE supports NR QoE Measurement Collection for MTSI services. |  | *qoe-MTSI-MeasReport-r17* | *AppLayerMeasParameters-r17* | No | No |  | Optional with capability signalling |
|  | 38-1c | NR QoE measurement collection for VR | Indicates whether the UE supports NR QoE Measurement Collection for VR services. |  | *qoe-VR-MeasReport-r17* | *AppLayerMeasParameters-r17* | No | No |  | Optional with capability signalling |
|  | 38-2a | RAN visible QoE measurement collection for streaming | Indicates whether the UE supports RAN visible QoE Measurement Collection for streaming services. | 38-1a | *ran-VisibleQoE-Streaming-MeasReport-r17* | *AppLayerMeasParameters-r17* | No | No |  | Optional with capability signalling |
|  | 38-2b | RAN visible QoE measurement collection for VR | Indicates whether the UE supports RAN visible QoE Measurement Collection for VR services. | 38-1c | *ran-VisibleQoE-VR-MeasReport-r17* | *AppLayerMeasParameters-r17* | No | No |  | Optional with capability signalling |
|  | 38-3 | Segmentation of MeasurementReportAppLayer message in UL | Indicates whether the UE supports RRC segmentation of the MeasurementReportAppLayer message in UL. |  | *ul-MeasurementReportAppLayer-Seg-r17* | *AppLayerMeasParameters-r17* | No | No |  | Optional with capability signalling |
|  | 38-4 | AS layer memory size for QoE paused measurement reports | It is mandatory to support the minimum AS layer memory size of 64KB for QoE paused measurement reports for UEs which support *qoe-Streaming-MeasReport-r17, qoe-MTSI-MeasReport-r17* or *qoe-VR-MeasReport-r17*. |  | *n/a* | *n/a* | n/a | n/a |  | Conditionally mandatory without capability signalling |

### 6.2.15 NR\_SL\_enh

Table 6.2.15-1: Layer-2 and Layer-3 feature list for NR\_SL\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 39. NR\_SL\_enh-Core | 39-1 | Sidelink DRX on PC5 interface | Indicates whether UE supports sidelink DRX for unicast, groupcast and broadcast. |  | *drx-OnSidelink-r17* | *MAC-ParametersSidelinkCommon-r16* | No | No |  | Optional with capability signalling |
| 39-2 | Uu DRX for sidelink | Indicates whether UE supports sidelink related Uu-DRX mechanisms for PDCCH monitoring. | 15-2 | *enhancedUuDRX-forSidelink-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signaling |

### 6.2.16 NR\_RAN\_PRN\_enh

Table 6.2.16-1: Layer-2 and Layer-3 feature list for NR\_RAN\_PRN\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 40. NG\_RAN\_PRN\_enh-Core | 40-1 | IMS emergency service over SNPN | it is mandatory to support IMS emergency call over SNPN for UEs that are SNPN capable and IMS voice capable over SNPNs |  | *n/a* | *n/a* | n/a | n/a | *Include it in existing IMS emergency call* | Conditional mandatory without capability signalling |
| 40-2 | VoiceOverNR in SNPN | Indicates whether the UE supports IMS voice over NR. It is mandated to the UE if the UE is capable of IMS voice over NR (including SNPN if the UE is SNPN capable). Otherwise, the UE does not include this field. If this field is included and the UE is capable of E-UTRA with EPC, the UE shall support IMS voice over E-UTRA via EPC. |  | *voiceOverNR* | *IMS-ParametersFRX-Diff* | No | Yes | *Update to the field description of existing VoiceOverNR* | Optional with capability signalling |

### 6.2.17 NR\_ext\_to\_71GHz

Table 6.2.17-1: Layer-2 and Layer-3 feature list for NR\_ext\_to\_71GHz

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 41. NR\_ext\_to\_71GHz-Core | 41-1 | UE assistance information for power saving – Maximum aggregated bandwidth preference | Indicates whether the UE supports providing its preference of a cell group on the maximum aggregated bandwidth for power saving in RRC\_CONNECTED, as specified in TS 38.331 [2]. |  | *maxBW-Preference-r17* | *PowSav-ParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-2 | UE assistance information for power saving – Maximum number of MIMO layers preference | Indicates whether the UE supports providing its preference of a cell group on the maximum number of MIMO layers for power saving in RRC\_CONNECTED, as specified in TS 38.331 [2]. |  | *maxMIMO-LayerPreference-r17* | *PowSav-ParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-3 | Direct NR MCG SCell activation | 1) Indicates whether the UE supports direct NR MCG SCell activation, as specified in TS 38.321 [10], upon SCell addition, upon reconfiguration with sync of the MCG, as specified in TS 38.331 [2].  2) Indicates whether the UE supports direct NR MCG SCell activation, as specified in TS 38.321 [10], upon reception of an RRCResume message, as specified in TS 38.331 [2]. |  | *1) directMCG-SCellActivation-r17*  *2) directMCG-SCellActivationResume-r17* | *MAC-ParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-4 | Direct NR SCG SCell activation | 1) Indicates whether the UE supports direct NR SCG SCell activation, as specified in TS 38.321 [10], upon SCell addition and upon reconfiguration with sync of the SCG, both performed via an RRCReconfiguration message received via SRB3 or contained in an RRC(Connection)Reconfiguration message received via SRB1, as specified in TS 38.331 [2] and TS 36.331 [12].  2) Indicates whether the UE supports direct NR SCG SCell activation, as specified in TS 38.321 [10]:  - upon reception of an RRCReconfiguration included in an RRCConnectionResume message, as specified in TS 38.331 [2] and TS 36.331 [12], if the UE indicates support of en-dc and of *resumeWithSCG-Config-r16* as specified in TS 36.331 [12],  - upon reception of an RRCReconfiguration included in an RRCResume message, as specified in TS 38.331 [2], if the UE indicates support of nr-dc and of *resumeWithSCG-Config-r16* as specified in TS 38.331 [2]. | 1) Support of EN-DC or NGEN-DC as specified in TS 36.331 [12], or Support of *nr-dc* as specified in TS 38.331 [2].  2) Support of EN-DC or NGEN-DC, and *resumeWithSCG-Config-r16* as specified in TS 36.331 [12], or Support of *nr-dc* and *18-3* | *1)directSCG-SCellActivation-r17*  *2) directSCG-SCellActivationResume-r17* | *MAC-ParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-5 | HO to EUTRA connected to 5GC in FR2-2 | Indicates whether the UE supports HO to EUTRA connected to 5GC. It is mandated if the UE supports EUTRA connected to 5GC |  | *handoverLTE-5GC-r17* | *MeasAndMobParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-6 | HO between FR1 and FR2-2 | Indicates whether the UE supports HO between FR1 and FR2-2. This field only applies to NR SA/NR-DC/NE-DC (e.g. PCell handover) and PSCell change when (NG)EN-DC/NR-DC is configured. UEs supporting this shall indicate support of handoverInterF for both FR1 and FR2-2. |  | *handoverFR1-FR2-2-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional capability with signalling |
| 41-7 | HO between FR2-1 and FR2-2 | Indicates whether the UE supports HO between FR2-1 and FR2-2. This field only applies to NR SA/NR-DC/NE-DC (e.g. PCell handover) and PSCell change when (NG)EN-DC/NR-DC is configured. UEs supporting this shall indicate support of handoverInterF for both FR2-1 and FR2-2. |  | *handoverFR2-1-FR2-2-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional capability with signalling |
| 41-8 | Inter-frequency HO for FR2-2 | Indicates whether the UE supports inter-frequency HO. It indicates the support for inter-frequency HO from the corresponding duplex mode and from frequency range indicated to be supported as described in Annex B. This field only applies to NR SA/NR-DC/NE-DC (e.g. PCell handover). For PSCell change when (NG)EN-DC/NR-DC is configured, this feature is mandatory supported. |  | *handoverInterF-r17* | *MeasAndMobParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-9 | HO to EUTRA connected to EPC in FR2-2 | Indicates whether the UE supports HO to EUTRA connected to EPC. It is mandated if the UE supports EUTRA connected to EPC. |  | *handoverLTE-EPC-r17* | *MeasAndMobParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-10 | RRM during IDLE/INACTIVE – Support of NR SSB measurement and reporting upon network request in FR2-2 | Indicates whether the UE supports configuration of NR SSB measurements in RRC\_IDLE/RRC\_INACTIVE and reporting of the corresponding results upon network request as specified in TS 38.331 [2]. If this parameter is indicated for FR1 and FR2 differently, each indication corresponds to the frequency range of measured target cell. |  | *idleInactiveNR-MeasReport-r17* | *MeasAndMobParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-11 | IMS voice for FR2-2 | Indicates whether the UE supports IMS voice over NR. It is mandated to the UE if the UE is capable of IMS voice over NR (including SNPN if the UE is SNPN capable). Otherwise, the UE does not include this field. If this field is included and the UE is capable of E-UTRA with EPC, the UE shall support IMS voice over E-UTRA via EPC. |  | *voiceOverNR-r17* | *IMS-ParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-12 | DRX adaptation for FR2-2 | Indicates whether the UE supports DRX adaptation comprised of the following functional components:  - Configured ps-Offset for the detection of DCI format 2\_6 with CRC scrambling by ps-RNTI and reported MinTimeGap before the start of drx-onDurationTimer of Long DRX  - Indication of UE whether or not to start drx-onDurationTimer for the next Long DRX cycle by detection of DCI format 2\_6  - Configured UE wakeup or not when DCI format 2\_6 is not detected at all monitoring occasions outside Active Time  - Configured periodic CSI report apart from L1-RSRP (ps-TransmitOtherPeriodicCSI) when impacted by DCI format 2\_6 that drx-onDurationTimer does not start for the next Long DRX cycle  - Configured periodic L1-RSRP report (ps-TransmitPeriodicL1-RSRP) when impacted by DCI format 2\_6 that drx-onDurationTimer does not start for the next Long DRX cycle  The capability signalling includes the minimum time gap between the end of the slot of last DCI format 2\_6 monitoring occasion and the beginning of the slot where the UE would start the drx-onDurationTimer of Long DRX for each SCS. The value sl1 indicates 1 slot. The value sl2 indicates 2 slots, and so on. Support of this feature is reported for licensed and unlicensed bands, respectively. When this field is reported, either of sharedSpectrumChAccess-r16 or non-SharedSpectrumChAccess-r16 shall be reported, at least. |  | *drx-Adaptation-r17* | *MAC-ParametersFR2-2-r17* | No | Yes  (Incl FR2-2 DIFF) |  | Optional capability with signalling |
| 41-13 | Extended values for drx-HARQ-RTT-TimerDL/UL | It is mandatory for UEs which support FR2-2 bands with SCS 480kHz and/or 960kHz |  | *n/a* | n/a | n/a | n/a |  | Conditionally mandatory without capability signalling |

### 6.2.18 NR\_UDC

Table 6.2.18-1: Layer-2 and Layer-3 feature list for NR\_UDC

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Field name in TS 38.331 [2]** | **Parent IE in TS 38.331 [2]** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Note** | **Mandatory/Optional** |
| 2. NR\_UDC-Core | 42-1 | UDC | Indicates whether the UE supports the uplink data compression. |  | *udc-r17* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 42-2 | UDC | Indicates whether the UE supports uplink data compression with the SIP static dictionary. | 42-1 | *standardDictionary-r17* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 42-3 | UDC | Indicates whether the UE supports UL data compression with operator defined dictionary. | 42-1 | *operatorDictionary-r17* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 42-4 | UDC | Indicates the version of the operator defined dictionary that the UE supports. | 42-1 | *versionofDictionary-r17* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 42-5 | UDC | Indicates the associated PLMN ID of the operator defined dictionary that the UE supports which has no relationship with UE’s HPLMN ID. | 42-1 | *associatedPLMN-ID-r17* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 42-6 | UDC | Indicates whether the UE supports continuation of uplink data compression protocol operation where the UE does not reset the buffer upon PDCP re-establishment. | 42-1 | *continueUDC-r17* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |
| 42-7 | UDC | Indicates which compression buffer size the UE supports. | 42-1 | *supportOfBufferSize-r17* | *PDCP-Parameters* | No | No |  | Optional with capability signalling |

### 6.2.19 TEI17 and Others

Table 6.2.19-1: Layer-2 and Layer-3 feature list for TEI17 and Others

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 43. TEI17/Others | 43-1 | Minimization of service interruption | It is optional for UE to support minimization of service interruption including reporting to NAS of disaster roaming information for available PLMNs and Access Barring check for Access Identity 3, as specified in TS 38.331 [2]. |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 43-2 | Use the same i\_s to determine PO in RRC\_INACTIVE state as in RRC\_IDLE state | Indicates whether the UE supports to use the same i\_s to determine PO in RRC\_INACTIVE state as in RRC\_IDLE state. |  | *inactiveStatePO-Determination-r17* | *UE-NR-Capability-v1700* | No | No |  | Optional with capability signalling |
| 43-3 | Cell reselection priority handling for NR HSDN | It is optional for UE to support HSDN cell reselection priority handling in RRC\_IDLE/RRC\_INACTIVE as specified in TS 38.304 [19] and TS 38.331 [2]. |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 43-4 | Acquisition of SI messages with explicit SI window positions | It is mandatory to support acquisition of SI messages with explicit SI window positions for UEs which support the SIB types in schedulingInfoList2 as specified in TS 38.331 [2]. |  | *n/a* | *n/a* | n/a | n/a |  | Conditional mandatory without capability signalling |
| 43-5 | CHO with target SCG for NR-DC | Indicates whether the UE supports conditional handover with NR SCG configuration for NR-DC. | 17-3 and at least one NR-DC band combination | *condHandoverWithSCG-NRDC-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 43-6 | CHO with target SCG for EN-DC | Indicates whether the UE supports conditional handover with NR SCG configuration for EN-DC. | *cho-r16* in TS 36.306 [14] and at least one EN-DC band combination. | *condHandoverWithSCG-ENDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No |  | Optional with capability signalling |
| 43-7 | CHO with target SCG for NE-DC | Indicates whether the UE supports conditional handover with E-UTRA SCG configuration for NE-DC. | 17-3 and at least one NE-DC band combination. | *condHandoverWithSCG-NEDC-r17* | *MeasAndMobParametersMRDC-Common-v1700* | No | No |  | Optional with capability signalling |
| 43-8 | Flexible gNB ID length for NR-DC | Indicates whether the UE supports acquisition and reporting of gNB ID length from a neighbouring intra-frequency or inter-frequency NR cell by reading the SI of the neighbouring cell and reporting the acquired gNB ID length to the network as specified in TS 38.331 [2] when (NG)EN-DC and NE-DC are not configured or, when consistent DRX is configured in NR-DC. The consistent DRX configuration implies that MN and SN have the same DRX cycle and on-duration configured by MN completely contains on-duration configured by SN. It is mandated if UE supports NR CGI reporting (NG)EN-DC and NE-DC are not configured or, when consistent DRX is configured in NR-DC. |  | *gNB-ID-Length-Reporting-r17* | *MeasAndMobParametersCommon* | No | No |  | Conditional mandatory with capability signalling |
| 43-9 | Flexible gNB ID length for (NG)EN-DC | Indicates whether the UE supports acquisition and reporting of gNB ID length from a neighbouring intra-frequency or inter-frequency NR cell by reading the SI of the neighbouring cell and reporting the acquired gNB ID length to the network as specified in TS 38.331 [2] when the (NG)EN-DC is configured. It is mandated if UE supports NR CGI reporting when (NG)EN-DC is configured. |  | *gNB-ID-Length-Reporting-ENDC-r17* | *MeasAndMobParametersCommon* | No | No |  | Conditional mandatory with capability signalling |
| 43-10 | Flexible gNB ID length for NE-DC | Indicates whether the UE supports acquisition and reporting of gNB ID length from a neighbouring intra-frequency or inter-frequency NR cell by reading the SI of the neighbouring cell and reporting the acquired gNB ID length to the network as specified in TS 38.331 [2] when the NE-DC is configured. It is mandated if UE supports NR CGI reporting when NE-DC is configured. |  | *gNB-ID-Length-Reporting-NEDC-r17* | *MeasAndMobParametersCommon* | No | No |  | Conditional mandatory with capability signalling |
| 43-11 | Flexible gNB ID length | Indicates whether the UE supports acquisition and reporting of gNB ID length from a neighbouring intra-frequency or inter-frequency NR cell by reading the SI of the neighbouring cell and reporting the acquired gNB ID length to the network as specified in TS 38.331 [2] when the NR-DC is configured wherein MN and SN have different DRX cycles, or on-duration configured by MN does not contain on-duration configured by SN if the DRX cycles are the same. It is mandated if UE supports NR CGI reporting when NR-DC is configured. |  | *gNB-ID-Length-Reporting-NRDC-r17* | *MeasAndMobParametersCommon* | No | No |  | Conditional mandatory with capability signalling |
| 43-12 | Flexible gNB ID length | Indicates whether the UE supports acquisition of NPN-relevant gNB ID length from a neighbouring intra-frequency or inter-frequency NR NPN cell by reading the SI of the neighbouring cell and reporting the acquired gNB ID length to the network as specified in TS 38.331 [2]. It is mandated if UE supports NPN CGI reporting. |  | *gNB-ID-Length-Reporting-NPN-r17* | *MeasAndMobParametersCommon* | No | No |  | Conditional mandatory with capability signalling |
| 43-13 | CG Time Domain Allocation extension | Indicates whether UE supports the *timeDomainAllocation-v1700* configured in rrc-ConfiguredUplinkGrant to indicate more than 16 entries in PUSCH TDRA table. | This field is only applicable if the UE supports both *pusch-RepetitionTypeB-r16* and either *configuredUL-GrantType1* or *configuredUL-GrantType1-v1650.* | *cg-TimeDomainAllocationExtension-r17* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |
| 43-14 | n77 Canada | This field is only applicable for UEs that indicate support for band n77. If present, the UE supports the restriction to 3450 - 3650 MHz and 3650 - 3980 ranges of band n77 in Canada as specified in Note 12 of Table 5.2-1 in TS 38.101. If absent, the UE supports only restriction to the 3450 - 3650 MHz range of band n77 in Canada. A UE that indicates this field shall also support NS value 57 as specified in TS 38.101-1. A UE supporting NS value 57 shall indicate this field. |  | *extendedBand-n77-2-r17* | *RF-Parameters* | No | No |  | Optional with capability signalling |
| 43-15 | DRX HARQ　RTT　UL timer with bundling | Indicates whether the UE supports starting the *drx-HARQ-RTT-TimerUL* after the end of the last transmission within a bundle as specified in TS 38.321 [10]. |  | *lastTransmissionUL-r17* | *MAC-ParametersCommon* | No | No |  | Optional with capability signalling |
| 43-16 | Idle/Inactive measurement for voice fallback | It is optional for UE to support the idle/inactive measurement for EPS fallback in RRC\_IDLE/RRC\_INACTIVE as specified in TS 38.331 [2]. |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 43-17 | Selection of acceptable E-UTRA cell upon HO failure during EPS fallback for emergency call | It is optional for UE to support selecting an acceptable E-UTRA cell supporting emergency call if no suitable E-UTRA cell is available upon handover failure during EPS fallback when the UE has an ongoing emergency call as specified in TS 38.331 [2]. |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 43-18 | E-UTRA cell selection upon HO failure during EPS services fallback | It is optional for UE to support selecting a suitable E-UTRA cell, and support selecting an acceptable E-UTRA cell supporting emergency call if no suitable E-UTRA cell is available upon handover failure when the UE is performing emergency services fallback as specified in TS 38.331 [2]. |  | *n/a* | *n/a* | n/a | n/a |  | Optional without capability signalling |
| 43-19 | Higher granularity for per-FR gap capability | This field indicates whether the UE supports two independent measurement gap configurations for FR1 and FR2 as specified in clause 9.1.2 of TS 38.133 while the number of configured serving cells is less than or equal to the indicated number.  UE indicating support of this feature shall not indicate support of *independentGapConfig*. |  | *independentGapConfig-maxCC-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
|  | 43-20 | Support of the value ‘n3’ for repetitionFactor-r17 | Indicates the support of the value “n3” for *repetitionFactor-r17*. | The UE indicating support of this feature shall also indicate support of *srs-increasedRepetition-r17*. | *srs-AdditionalRepetition-r17* | *Phy-ParametersCommon* | No | No |  | Optional with capability signalling |

## 6.3 RF and RRM Features

### 6.3.0 General

Tables 6.3.1-1 to 6.3.13-1 provide the list of RF and RRM features, as shown in [18], and the corresponding UE capability field name, as specified in TS 38.331 [2].

### 6.3.1 NR\_pos\_enh

Table 6.3.1-1: RF and RRM Feature List for NR\_pos\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] or TS 37.355 [9] | Parent IE in TS 38.331 [2] or TS 37.355 [9] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | 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) | *independentGapConfigPRS-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 14  NR\_pos\_enh | 14-2 | PRS measurement for reduced sample in RRC\_inactive state | Capability of supporting reduced number of samples (M=1, 2) for PRS measurement in RRC\_inactive state | 27-17 | *supportedDL-PRS-ProcessingSamples-RRC-Inactive-r17* | *LPP*  *PRS-ProcessingCapabilityPerBand-r16* | No | No |  | Optional with capability signalling |
| 14. NR\_pos\_enh | 14-3 | PRS measurement without MG | Capability for the threshold used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG. | 27-3-2 | *prs-MeasurementWithoutMG-r17* | *RRC*  *BandNR*  *LPP*  *PRS-ProcessingCapabilityPerBand-r16* | No | No | The candidate threshold values: CP length, 1/4 symbol, 1/2 symbol, half of slot | Optional with capability signalling |
| 14. NR\_pos\_enh | 14-4 | Parallel PRS measurements in RRC\_INACTIVE state | Capability for the support of performing RRM measurement and PRS measurement in parallel |  | *parallelPRS-MeasRRC-Inactive-r17* | *BandNR* | No | Yes | Measurement period for UE suporting this capability scales with Kcarrier\_PRS=1 | Optional with capability signalling |

### 6.3.2 NR\_ext\_to\_71GHz

Table 6.3.2-1: RF and RRM Feature List for NR\_ext\_to\_71GHz

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 15. NR\_ext\_to\_71GHz | 15-1 | 64QAM for PUSCH for FR2-2 | 1) Support of 64QAM modulation for FR2-2 PUSCH |  | *modulation64-QAM-PUSCH-FR2-2-r17* | *FR2-2-AccessParamsPerBand-r17* | N/A | Applicable to FR2-2 only |  | Optional with capability signalling |
| 15. NR\_ext\_to\_71GHz | 15-3 | UE support of CBW for 480kHz SCS | Support of {800, 1600} CBW for 480kHz SCS | Support of 480kHz SCS | *channelBWs-DL-SCS-480kHz-FR2-2-r17,*  *channelBWs-UL-SCS-480kHz-FR2-2-r17* | *BandNR* | N/A | Applicable to FR2-2 only | 400 MHz is a mandatory CBW if the UE supports 480 kHz SCS | Optional with capability signalling |
| 15. NR\_ext\_to\_71GHz | 15-4 | UE support of CBW for 960kHz SCS | Support of {800, 1600, 2000} CBW for 960kHz SCS | Support of 960kHz SCS | *channelBWs-DL-SCS-960kHz-FR2-2-r17,*  *channelBWs-UL-SCS-960kHz-FR2-2-r17* | *BandNR* | N/A | Applicable to FR2-2 only | 400 MHz is a mandatory CBW if the UE supports 960 kHz SCS | Optional with capability signalling |

### 6.3.3 NR\_RF\_FR1\_enh

Table 6.3.3-1: RF and RRM Feature List for NR\_RF\_FR1\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 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 |  | *ULTxSwitchingBandPair-v1700* | *supportedBandPairListNR-v1700* | No need | Applicable only to FR1 | 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 |  | *ULTxSwitchingBandPair-v1700* | *supportedBandPairListNR-v1700* | No need | Applicable only to FR1 | 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 |  | *ULTxSwitchingBandPair-v1700* | *supportedBandPairListNR-v1700* | No need | Applicable only to FR1 | 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 | *uplinkTxSwitching-DL-Interruption-r16* | *ULTxSwitchingBandPair-r16* | No need | Applicable only to FR1 | 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 | *uplinkTxSwitching-PUSCH-TransCoherence-r16* | *BandCombination-UplinkTxSwitch-r16* | No need | Applicable only to FR1 | 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 | *uplinkTxSwitchingBandParametersList-v1700* | *BandCombination-UplinkTxSwitch-v1700* | No need | Applicable only to FR1 | Detailed information can refer to the LS to RAN2 in R4-2120039. | Optional with capability signalling |
| 16. NR\_RF\_FR1\_enh | 16-8 | UE power class per band per band combination | Per band per band combination power class |  | *ue-PowerClassPerBandPerBC-r17* | *FeatureSetUplink-v1710* | No | FR1 only |  | Optional with capability signalling |

### 6.3.4 NR\_RF\_FR2\_req\_enh2

Table 6.3.4-1: RF and RRM Feature List for NR\_RF\_FR2\_req\_enh2

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 17. UL gap for Tx power management | 17-1 | Support of UL gap in FR2 for Tx power management | Capability of performing BPS sensing for Tx power management by the use of uplink gap patterns.(UL MGP #0, #1, #2, #3 as specified in TS 38.133) The UE indicating this capability shall meet the corresponding enhanced UE requirements defined in Section TBD.  If UE reports this capability, UE is mandated to report 17-2 |  | *ul-GapFR2-r17* | *BandNR* | No | FR2 only |  | Optional with capability signalling |
| 17. UL gap pattern for Tx power management | 17-2 | Support of UL gap patterns for Tx power management | Capability of supporting UL gap patterns (UL MGP #0, #1, #2, #3 as specified in TS 38.133) needed for performing BPS sensing for Tx power management. The UE indicating this capability shall meet the corresponding enhanced UE requirements defined in Section TBD.  UE is mandated to support at least one of UL MGP #1 and #3 when it indicate support of UL gap for Tx power management (FG 17-1). All other gap patterns except for the one or two selected mandatory gap pattern(s) are optional. | 17-1 | *ul-GapFR2-Pattern-r17* | *UE-NR-Capability-v1700* | 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. |  | *beamManagementType-CBM-r17* | *CA-ParametersNR-v1700*  *CA-ParametersNRDC-v1700* | 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.  The capability is only applicable to band combinations with two bands.  UE is not allowed to report CBM or both in Rel-17. | Optional with capability signalling |
| 17. 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 in one band. |  | *extendedDC-LocationReport-r17* | *FeatureSetUplink-v1720* | No | No |  | Optional with capability signalling |
| 17. New CA BW clases | 17-6 | Support of new CA BW Classes | RAN4 has introduced new CA BW Classes R2~R12, and [‘R, S, T, U’] for REL17 |  | *CA-BandwidthClassNR* | *BandParameters* | No | FR2 only |  | Optional with capability signalling |
| 17. UL transmission in FR2 bands within an UL gap when the UL gap is activated | 17-8 | Support of UL transmission in FR2 bands within an UL gap when the UL gap is activated in inter-band UL CA | UE indicates the constituent band(s) for which UL transmission is supported within an UL gap when the UL gap is activated in inter-band UL CA. | 17-1 | *tx-Support-UL-GapFR2-r17* | *FeatureSetUplink-v1710* | No | FR2 only |  | Optional with capability signalling |

### 6.3.5 NR\_HST\_FR1\_enh

Table 6.3.5-1: RF and RRM Feature List for NR\_HST\_FR1\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 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 | *measurementEnhancementCA-r17* | *HighSpeedParameters-v1700* | NO | FR1 only |  | 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 | *measurementEnhancementInterFreq-r17* | *HighSpeedParameters-v1700* | NO | FR1 only |  | 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 |  | n/a | n/a | NO | FR1 only |  | 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 | *demodulationEnhancementCA-r17* | *CA-ParametersNR-v1700* | No | FR1 only |  | Optional with capability signalling |

### 6.3.6 NR\_MG\_enh

Table 6.3.6-1: RF and RRM Feature List for NR\_MG\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 19. Network controlled small gap (NCSG) | 19-1a | Reporting of Network controlled small gap (NCSG) for NR | Reporting of the NCSG and measurement gap requirement information for SSB based measurement |  | *nr-NeedForGapNCSG-Reporting-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 19-1b | Reporting of Network controlled small gap (NCSG) for EUTRA | Reporting of the NCSG and measurement gap requirement information for E-UTRA target bands |  | *eutra-NeedForGapNCSG-Reporting-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 19-1-1 | per FR Network controlled small gap | Support of per-FR NCSG | 19-1a | *ncsg-MeasGapPerFR-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 19-1-2 | Network controlled small gap (NCSG) supported patterns | Supported NCSG patterns | 19-1a or 19-1b | *ncsg-MeasGapPatterns-r17* | *MeasAndMobParametersCommon* | No | No | NCSG patterns #0, #1 are conditional mandatory if the UE is NCSG capable  NCSG patterns #13, #14 are conditional mandatory if UE supports ~~19-1 and~~ 19-1-1 | Optional with capability signalling |
| 19-1-3 | Network controlled small gap (NCSG) supported NR-only patterns | Supported NR-only NCSG patterns | 19-1a | *ncsg-MeasGapNR-Patterns-r17* | *MeasAndMobParametersCommon* | No | No | NCSG patterns #2 and #3 are conditional mandatory if the UE is NCSG capable  NCSG patterns #17 and #18 are conditional mandatory if the UE is NCSG capable and supports a FR2 band | Optional with capability signalling |
| 19-1-4 | Network controlled small gap (NCSG) performing measurement based on flag *deriveSSB-IndexFromCellInter* | Support performing measurement with NCSG based on flagderiveSSB-IndexFromCell-inter and meeting the following requirements:  -       Scheduling restriction in FR2 serving cell during NCSG ML is on SSB symbol level | 19-1a | *ncsg-SymbolLevelScheduleRestrictionInter-r17* | *MeasAndMobParametersCommon* | No | FR2 only |  | Optional with capability signalling |
| 19. Concurrent measurement gap | 19-2 | Concurrent measurement gaps | Support of more than 1 per-UE measurement gap configurations  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. |  | *concurrentMeasGap-r17 CHOICE*  *{*  *concurrentPerUE-OnlyMeasGap-r17,*  *concurrentPerUE-PerFRCombMeasGap-r17*  *}* | *MeasAndMobParametersCommon* | No | No | This is the baseline capability is to indicate UE support multiple concurrent gaps. | Optional with capability signalling |
| 19. Concurrent measurement gap | 19-2-1 | Concurrent measurement gaps for E-UTRAN measurement objectives | Capability of supporting configurations of E-UTRAN measurement objectives associated with more than 1 concurrent measurement gaps | 19-2 | *concurrentMeasGapEUTRA-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 19. Pre-configured gap | 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 |  | *preconfiguredNW-ControlledMeasGap-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |
| 19. Pre-configured gap | 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 |  | *preconfiguredUE-AutonomousMeasGap-r17* | *MeasAndMobParametersCommon* | No | No |  | Optional with capability signalling |

### 6.3.7 NR\_SAR\_PC2\_interB\_SUL\_2BUL

Table 6.3.7-1: RF and RRM Feature List for NR\_SAR\_PC2\_interB\_SUL\_2BUL

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 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. |  | *maxUplinkDutyCycle-interBandCA-PC2-r17* | *CA-ParametersNR-v1700* | 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. |  | *maxUplinkDutyCycle-SULcombination-PC2-r17* | *CA-ParametersNR-v1700* | N/A | FR1 only |  | Optional with capability signalling |

### 6.3.8 NR\_PC2\_UE\_FDD

Table 6.3.8-1: RF and RRM Feature List for NR\_PC2\_UE\_FDD

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
|  |  |  |  |  |  |  |  |  |  |  |

### 6.3.9 NR\_HST\_FR2

Table 6.3.9-1: RF and RRM Feature List for NR\_HST\_FR2

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 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 |  | *ue-PowerClass-v1700* | *BandNR* | NO | FR2 only | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signalling |
| 22. NR\_HST\_FR2 | 22-2 | Support of one shot large UL timing adjustment | 1) Support of one shot large UL timing adjustment | 22-1 Support of FR2 HST operation | *ue-OneShotUL-TimingAdj-r17* | *BandNR* | NO | FR2 only |  | Optional with capability signaling |

### 6.3.10 NR\_UE\_pow\_sav\_enh

Table 6.3.10-1: RF and RRM Feature List for NR\_UE\_pow\_sav\_enh

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 23. NR\_UE\_pow\_sav\_enh | 23-1 | Support of RLM relaxation | For the UE capable of SSB-based RLM, and/or CSI-RS based RLM, the feature indicates the support of corresponding RLM relaxation measurement. | 1-3 SS block based RLM and/or  1-7 CSI-RS based RLM and/or | *rlm-Relaxation-r17* | *BandNR* | NO | Yes | The feature group can be supported by UE if any prerequisite feature group is supported by UE. | Optional with capability signalling |
| 23. NR\_UE\_pow\_sav\_enh | 23-2 | Support of BFD relaxation | For the UE capable of SSB-based BFD, and/or CSI-RS based BFD, the feature indicates the support of corresponding BFD relaxation measurement. | 2-31 Beam failure recovery | *bfd-Relaxation-r17* | *BandNR* | NO | Yes |  | Optional with capability signalling |

### 6.3.11 NR\_demod\_enh2-Perf

Table 6.3.11-1: RF and RRM Feature List for NR\_demod\_enh2-Perf

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 24. NR\_demod\_enh2-Perf | 24-1 | CRS-IM (Interference Mitigation) in DSS scenario | Support of neighboring LTE cell CRS-IM in DSS scenario with NR 15 kHz SCS  Note: In the DSS scenario, serving and neighboring cells are both operating with dynamic spectrum sharing (DSS) of NR and LTE. | 5-28 (Rate-matching around LTE CRS) | *crs-IM-DSS-15kHzSCS-r17* | *FeatureSetDownlinkPerCC-v1700*  *supportedCRS-InterfMitigation-r17*  *CRS-InterfMitigation-r17* | No | Applicable only to FR1 | Note: UE can support the feature on the CC(s) in a band only if the UE indicates support of rateMatchingLTE-CRS on that band. | Optional with capability signaling |
| 24. NR\_demod\_enh2-Perf | 24-2 | CRS-IM in non-DSS and 15 kHz NR SCS scenario, without the assistance of network signaling on LTE channel bandwidth | Support of neighboring LTE cell CRS-IM in non-DSS and 15 kHz NR SCS scenario, without the assistance of network signaling on LTE channel bandwidth  Note: In the non-DSS scenario, serving cell is operating in NR, and neighboring cells are operating in LTE. |  | *crs-IM-nonDSS-15kHzSCS-r17* | *FeatureSetDownlinkPerCC-v1700*  *supportedCRS-InterfMitigation-r17*  *CRS-InterfMitigation-r17* | No | Applicable only to FR1 |  | Optional with capability signaling |
| 24. NR\_demod\_enh2-Perf | 24-3 | CRS-IM in non-DSS and 15 kHz NR SCS scenario, with the assistance of network signaling on LTE channel bandwidth | Support of neighboring LTE cell CRS-IM in non-DSS and 15 kHz NR SCS scenario, with the assistance of network signaling on LTE channel bandwidth |  | *crs-IM-nonDSS-NWA-15kHzSCS-r17* | *FeatureSetDownlinkPerCC-v1700*  *supportedCRS-InterfMitigation-r17*  *CRS-InterfMitigation-r17* | No | Applicable only to FR1 |  | Optional with capability signaling |
| 24. NR\_demod\_enh2-Perf | 24-4 | CRS-IM in non-DSS and 30 kHz NR SCS scenario, without the assistance of network signaling on LTE channel bandwidth | Support of neighboring LTE cell CRS-IM in non-DSS and 30 kHz NR SCS scenario, without the assistance of network signaling on LTE channel bandwidth |  | *crs-IM-nonDSS-30kHzSCS-r17* | *FeatureSetDownlinkPerCC-v1700*  *supportedCRS-InterfMitigation-r17*  *CRS-InterfMitigation-r17* | No | Applicable only to FR1 |  | Optional with capability signaling |
| 24. NR\_demod\_enh2-Perf | 24-5 | CRS-IM in non-DSS and 30 kHz NR SCS scenario, with the assistance of network signaling on LTE channel bandwidth | Support of neighboring LTE cell CRS-IM in non-DSS and 30 kHz NR SCS scenario, with the assistance of network signaling on LTE channel bandwidth |  | *crs-IM-nonDSS-NWA-30kHzSCS-r17* | *FeatureSetDownlinkPerCC-v1700*  *supportedCRS-InterfMitigation-r17*  *CRS-InterfMitigation-r17* | No | Applicable only to FR1 |  | Optional with capability signaling |
| 24. NR\_demod\_enh2-Perf | 24-6 | MMSE-IRC receiver for scenarios with inter-cell and intra-cell inter-user interference | Support of MMSE-IRC processing for scenarios with inter-cell and intra-cell inter-user interference |  | n/a | n/a | No | FR1 only |  | Optional without capability signalling for Rel-15 and Rel-16  Mandatory without capability signalling from Rel-17 |

### 6.3.12 NR\_NTN\_Solutions

Table 6.3.12-1: RF and RRM Feature List for NR\_NTN\_Solutions

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 25. NR\_NTN\_solutions | 25-1 | Parallel measurements on multiple SMTC-s for a single frequency carrier | Support of measurements on target cells belonging to 4 SMTC-s on a single frequency carrier |  | *parallelSMTC-r17* | *MeasAndMobParametersCommon* | FDD only | FR1 only | UE is mandatory to support 2 and can optionally support 4 if the feature is supported | Optional with capability signaling |
| 25. NR\_NTN\_solutions | 25-2 | Parallel measurements on cells belonging to a different NGSO satellite than a serving satellite without scheduling restrictions on normal operations with the serving cell | Support of measurements on cells belonging to different satellite as the serving cell in parallel with normal operation (i.e. data/control transmission and/or reception, and L1 measurements) of serving cell without scheduling restrictions. The feature is applicable only when the serving satellite is NGSO. If the serving cell belongs to GSO satellite, the scheduling restriction is not applied on the premise that a mixed type of satellites on the same frequency layer is not supported in this release (Rel-17). |  | *parallelMeasurementWithoutRestriction-r17* | *BandNR* | FDD only | FR1 only | For UEs not able to perform measurements in parallel with normal operation of serving cell scheduling restrictions shall apply. | Optional with capability signaling |
| 25. NR\_NTN\_solutions | 25-3 | Parallel measurements with multiple measurement gaps | Support of 2 measurement gaps |  | *parallelMeasurementGap-r17* | *MeasAndMobParametersCommon* | FDD only | FR1 only | UE is mandatory to support 1 measurement gaps | Optional with capability signaling |
| 25. NR\_NTN\_solutions | 25-4 | Enhanced RRM requirements for measurements in IDLE and INACTIVE modes | If UE does not support the capability, legacy TN non-HST measurement requirements for both LEO and GEO. |  | n/a | n/a | FDD only | FR1 only |  | Optional without capability signaling |
| 25. NR\_NTN\_solutions | 25-5 | Parallel measurements on multiple NGSO satellites within a SMTC | Support of simultaneously measurements on target cells belonging to different NGSO satellites within a SMTC |  | *maxNumber-NGSO-SatellitesWithinOneSMTC-r17* | *BandNR* | FDD only | FR1 only | Candidate values for the number of NGSO satellites are 1,2,3, or 4 |  |
| 25. NR\_NTN\_solutions | 25-6 | Relaxed cell reselection on GEO | Support of relaxed cell reselection on GEO |  | n/a | n/a | FDD only | FR1 only | Only applicable for GEO | Optional without capability signaling |
| 25. NR\_NTN\_solutions | 25-7 | The number of target LEO satellites the UE can monitor per carrier including serving satellite | On serving carrier, it indicates the number of target LEO satellites the UE can monitor per carrier including serving satellite  On non-serving carrier, it indicates the number of target LEO satellites the UE can monitor per carrier. |  | *maxNumber-LEO-SatellitesPerCarrier-r17* | *BandNR* | FDD only | FR1 only | Candidate values for the number of NGSO satellites are 2,3, or 4.  The value shall be larger than or equal to the reported value on FG 25-5. | Optional with capability signaling |

### 6.3.13 Higher Power Limit CA\_DC

Table 6.3.13-1: RF and RRM Feature List for Higher Power Limit CA\_DC

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 26. Increased MOP for CA and DC | 26-1 | Higher Power Limit CA\_DC | Support of increase in maximum output power above the power class indication |  | *higherPowerLimit-r17* | *CA-ParametersNR-v1720* | N/A | FR1 only |  | Optional with capability signaling |

Annex A (informative):  
URLLC capabilities

The Release 15 features listed in Table A-1 are some of the features for UEs supporting services requiring ultra reliability and/or low latency, as defined in TS 38.300 [16]. It should be noted that the list is not exhaustive and not all features need to be supported at the same time for UEs supporting services requiring ultra reliability and/or low latency.

Table A-1: Rel-15 UE capabilities relevant for UEs supporting ultra-reliable and/or low latency services

| **Feature Category** | **3GPP capabilities** |
| --- | --- |
| Repetitions | *pusch-RepetitionMultiSlots* |
|  | *pdsch-RepetitionMultiSlots* |
|  | *type1-PUSCH-RepetitionMultiSlots* |
|  | *type2-PUSCH-RepetitionMultiSlots* |
| Mini-slot | *pdsch-MappingTypeA* |
|  | *pdsch-MappingTypeB* |
|  | *pdsch-ProcessingType1-DifferentTB-PerSlot* |
|  | *pusch-ProcessingType1-DifferentTB-PerSlot* |
| PDCCH processing | *pdcch-MonitoringAnyOccasionsWithSpanGap* |
|  | *pdcch-MonitoringAnyOccasions* |
|  | *pdcch-MonitoringSingleOccasion* |
| UL configured grant | *configuredUL-GrantType1* |
|  | *configuredUL-GrantType2* |
| DL SPS | *downlinkSPS* |
| HARQ-ACK | *mux-HARQ-ACK-PUSCH-DiffSymbol* |
| Reduced processing time | *pdsch-ProcessingType2* |
|  | *pusch-ProcessingType2* |
| Ultra-reliable CQI/MCS | *cqi-TableAlt* |
|  | *dl-64QAM-MCS-TableAlt* |
|  | *ul-64QAM-MCS-TableAlt* |
|  | *dl-MCS-TableAlt-DynamicIndication* |
|  | *ul-MCS-TableAlt-DynamicIndication* |
| PDCP duplication | *pdcp-DuplicationSplitSRB* |
|  | *pdcp-DuplicationSRB* |
|  | *pdcp-DuplicationMCG-OrSCG-DRB* |
|  | *pdcp-DuplicationSplitDRB* |

Annex B (informative):  
Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2019-04 | RAN2 #105bis | R2-1904720 |  |  |  | Endorsed skeleton TR | 0.0.1 |
| 2019-05 | RAN2 #106 | R2-1905904 |  |  |  | TR update as the outcome of email discussion [105bis#11] before RAN2 #106 | 0.0.2 |
| 2019-05 | RAN2 #106 | R2-1908347 |  |  |  | TR update reflecting the latest L2/L3 feature list and capturing the handling of the TR after completion of Rel-15. | 0.0.3 |
| 2019-05 | RAN2 #106 | R2-1908456 |  |  |  | TR 38.822 v0.1.0 as endorsed at RAN2 #106 | 0.1.0 |
| 2019-05 | RAN2 #106 | R2-1908511 |  |  |  | TR update reflecting the latest RAN1/RAN4 feature lists | 0.1.1 |
| 2019-05 | RAN2 #106 | R2-1908512 |  |  |  | TR 38.822 v0.2.0 as agreed by RAN2 in email discussion [106#15] after RAN2 #106 | 0.2.0 |
| 2019-06 | RAN#84 | RP-191034 |  |  |  | Presentation to TSG-RAN for approval (no change in contents compared to v0.2.0) | 1.0.0 |
| 2019-06 | RAN#84 | RP-191445 |  |  |  | Presentation to TSG-RAN for approval reflecting updates during RAN #84 | 1.1.0 |
| 2019-06 | RAN#84 |  |  |  |  | TR put under change control and updated to Rel-15 | 15.0.0 |
| 2019-07 |  |  |  |  |  | MCC: changed the document type from TS to TR | 15.0.1 |
| 2021-06 | RP-92 | RP-211480 | 0004 | 4 | B | UE Feature list for NR Rel-16 [Rel16FeatureList] | 16.0.0 |
| 2021-09 | RP-93 | RP-212623 | 0005 | - | F | Introduction of informative annex on list of Rel-15 features relevant to URLLC | 16.1.0 |
| 2021-12 | RP-94 | RP-213344 | 0006 | 2 | F | Updates based on RAN1 NR positioning features list | 16.2.0 |
|  | RP-94 | RP-213344 | 0007 | 1 | F | Add the missing capabilities for SON and MDT | 16.2.0 |
| 2022-03 | RP-95 | RP-220835 | 0009 | 1 | F | Miscellaneous updates on TR38.822 | 16.3.0 |
| 2022-12 | RP-98 | RP-223407 | 0011 | 1 | F | Miscellaneous updates for TR 38.822 | 16.4.0 |
| 2023-03 | RP-99 | RP-230695 | 0012 | 1 | B | UE Feature List for Rel-17 | 17.0.0 |