**3GPP TSG-RAN WG2 Meeting #117 electronic R2-2203853**

**Online, February 21 – March 3, 2022**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.306** | **CR** | **0683** | **rev** | **2** | **Current version:** | **16.7.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Introduction of RRM enhancements for Rel-17 NR FR1 HST | | | | | | | | | |
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| ***Source to WG:*** | CMCC, Ericsson, Huawei, Nokia, Qualcomm | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_HST\_FR1\_enh | | | | |  | ***Date:*** | | | 2022-02-21 |
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| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
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| ***Reason for change:*** | | R17 HST capabilities are captured in RAN4 feature list in R4-2202400.  As per the Rel-17 work item RRM enhancements for Rel-17 NR FR1 HST the network should be able to enable/disable RRM measurement enhancements for FR1 high-speed train scenarios. RAN4 has agreed the following:  *Rev 0 (Add features according to RAN4 LSin R4-2120286 at RAN2#116bis-e)*  For CA enhancement:   * the network needs to be able to inform UE whether to apply the enhanced RRM requirements for CA specified in TS38.133 * a per-UE capability is needed which indicates whether the UE is capable of supporting the enhanced RRM requirements for CA in Rel-17   For inter-frequency measurement enhancement:   * for idle mode, network signalling should be added to inform the UE whether the enhanced inter-frequency HST measurement requirements are applied per each inter-frequency carrier * a per-UE capability is needed which indicates whether the UE is capable of supporting the enhanced RRM requirements for inter-frequency measurement for connected mode * the support of HST idle mode inter-frequency measurement enhancements is an optional UE feature without capability signalling.   *Rev 1 (Add features according to RAN4 LSin R4-2202591 and R4-2202984 at RAN2#117-e)*  For demodulation enhancement:   * introduce a new UE capability For the enhanced demodulation requirements for CA in HST SFN. | | | | | | | | |
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| ***Summary of change:*** | | *Rev 0 (Add features according to RAN4 LSin R4-2120286 at RAN2#116bis-e)*  For CA enhancement:   * a per-UE capability indication has been added that indicates whether the UE is capable of supporting the enhanced RRM requirements for CA. This capability indication has been named *measurementEnhancementCA* and has been added to High speed parameters.   For inter-frequency measurement enhancement:   * a per-UE capability indication has been added that indicates whether the UE is capable of supporting the enhanced RRM requirements for inter-frequency measurements. This capability indication has been named *measurementEnhancementInter-Freq* and has been added to High speed parameters. * high speed inter-frequency measurements in RRC\_IDLE / RRC\_INACTIVE has been added as an optional feature without capability signalling   *Rev 1 (Add features according to RAN4 LSin R4-2202591 and R4-2202984 at RAN2#117-e)*  For demodulation enhancement:   * For the enhanced demodulation requirements for CA in HST, introduce a new UE capability for HST SFN CA. | | | | | | | | |
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| ***Consequences if not approved:*** | | RRM enhancements for Rel-17 NR FR1 HST is not supported in 38.306. | | | | | | | | |
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| ***Clauses affected:*** | | 4.2.7.4, 4.2.19, 5.6 | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 38.331 CR 2898 | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
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| ***Other comments:*** | | This CR can be early implemented by Rel-16 UEs. | | | | | | | | |
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| ***This CR's revision history:*** | |  | | | | | | | | |

*FIRST CHANGE*

#### 4.2.7.4 CA-ParametersNR

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
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| ***beamManagementType-r16***  Indicates 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).  In this release of the specification, the UE shall only report value of '*ibm*'. | BC | Yes | TDD only | FR2 only |
| ***blindDetectFactor-r16***  Defines the value of factor R for blind detection as specified in Clause 10.1 [11].  The UE that indicates support of this feature shall support *multiDCI-MultiTRP-r16.* | BC | No | N/A | N/A |
| ***codebookComboParametersAdditionPerBC-r16***  Indicates the list of supported CSI-RS resources across all bands in a band combination by referring to *codebookVariantsList* for the mixed codebook types. For mixed codebook types, UE reports support active CSI-RS resources and ports for up to 4 mixed codebook combinations in any slot. The following parameters are included in *codebookVariantsList* for each code book type:  - *maxNumberTxPortsPerResource* indicates the maximum number of Tx ports in a resource across all bands within a band combination;  - *maxNumberResourcesPerBand* indicates the maximum number of resources across all CCs within a band combination, simultaneously;  - *totalNumberTxPortsPerBand* indicates the total number of Tx ports across all CCs within a band combination, simultaneously.  For each band in a band combination, supported values for these three parameters are determined in conjunction with *codebookComboParametersAddition-r16* reported in *MIMO-ParametersPerBand*. | BC | No | N/A | N/A |
| ***codebookParametersAdditionPerBC-r16***  Indicates the list of supported CSI-RS resources across all bands in a band combination by referring to *codebookVariantsList* for the additional codebook types. The following parameters are included in *codebookVariantsList* for each code book type:  - *maxNumberTxPortsPerResource* indicates the maximum number of Tx ports in a resource across all bands within a band combination;  - *maxNumberResourcesPerBand* indicates the maximum number of resources across all CCs within a band combination, simultaneously;  - *totalNumberTxPortsPerBand* indicates the total number of Tx ports across all CCs within a band combination, simultaneously.  For each band in a band combination, supported values for these three parameters are determined in conjunction with *codebookParametersAddition-r16* reported in *MIMO-ParametersPerBand*. | BC | No | N/A | N/A |
| ***crossCarrierA-CSI-trigDiffSCS-r16***  Indicates the UE support of handling cross-carrier A-CSI trigger with different SCS. Value *higherA-CSI-SCS* indicates the UE support of PDCCH cell of lower SCS and A-CSI RS cell of higher SCS and value *lowerA-CSI-SCS* indicates the UE support of PDCCH cell of higher SCS and A-CSI RS cell of lower SCS, and value *both* indicates the support of both variations. A UE supporting this feature shall also indicate support of CSI-RS and CSI-IM reception for CSI feedback using *csi-RS-IM-ReceptionForFeedback* | BC | No | N/A | N/A |
| ***crossCarrierSchedulingDefaultQCL-r16***  Indicates whether the UE can be configured with *enabledDefaultBeamForCCS* for default QCL assumption for cross-carrier scheduling for same/different numerologies. A UE supporting this feature shall either indicate support of *crossCarrierScheduling-SameSCS* or *crossCarrierSchedulingDL-DiffSCS-r16*.  Value *diff-only* indicates UE supports this feature only for different SCS combination(s).  Value *both* indicates UE supports this feature for same SCS and for different SCS combination(s). | BC | No | N/A | N/A |
| ***crossCarrierSchedulingDL-DiffSCS-r16***  Indicates the UE supports 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.  Value *low-to-hig*h indicates UE supports scheduling CC of lower SCS to scheduled CC of higher SCS;  Value *high-to-low* indicates UE supports scheduling CC of higher SCS to scheduled CC of lower SCS;  Value *both* indicates UE supports both scheduling CC of lower SCS to scheduled CC of higher SCS and scheduling CC of higher SCS to scheduled CC of lower SCS.  NOTE 1: Following components are applicable to cross carrier scheduling from lower SCS to higher SCS when the UE reports this feature:  - 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 2: Following components are applicable to cross carrier scheduling from higher SCS to lower SCS when the UE reports this feature:  - 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) | BC | No | N/A | N/A |
| ***crossCarrierSchedulingUL-DiffSCS-r16***  Indicates the UE supports 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.  Value *low-to-high* indicates UE supports scheduling CC of lower SCS to scheduled CC of higher SCS;  Value *high-to-low* indicates UE supports scheduling CC of higher SCS to scheduled CC of lower SCS;  Value *both* indicates UE supports both scheduling CC of lower SCS to scheduled CC of higher SCS and scheduling CC of higher SCS to scheduled CC of lower SCS.  NOTE 1: Following components are applicable to cross carrier scheduling from lower SCS to higher SCS when the UE reports this feature:  - 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 2: Following components are applicable to cross carrier scheduling from higher SCS to lower SCS when the UE reports this feature:  - 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) | BC | No | N/A | N/A |
| ***csi-RS-IM-ReceptionForFeedbackPerBandComb***  Indicates support of CSI-RS and CSI-IM reception for CSI feedback. This capability signalling comprises the following parameters:  - *maxNumberSimultaneousNZP-CSI-RS-ActBWP-AllCC* indicates the maximum number of simultaneous CSI-RS resources (irrespective of the associated codebook type) in active BWPs across all CCs, and across MCG and SCG in case of NR-DC. The network applies this limit in addition to the limits signalled in *MIMO-ParametersPerBand-> maxNumberSimultaneousNZP-CSI-RS-PerCC* and in *Phy-ParametersFRX-Diff-> maxNumberSimultaneousNZP-CSI-RS-PerCC*;  - *totalNumberPortsSimultaneousNZP-CSI-RS-ActBWP-AllCC* indicates the total number of CSI-RS ports in simultaneous CSI-RS resources (irrespective of the associated codebook type) in active BWPs across all CCs, and across MCG and SCG in case of NR-DC. The network applies this limit in addition to the limits signalled in *MIMO-ParametersPerBand-> totalNumberPortsSimultaneousNZP-CSI-RS-PerCC* and in *Phy-ParametersFRX-Diff-> totalNumberPortsSimultaneousNZP-CSI-RS-PerCC*.  The UE is mandated to report *csi-RS-IM-ReceptionForFeedbackPerBandComb*. | BC | Yes | N/A | N/A |
| ***defaultQCL-CrossCarrierA-CSI-Trig-r16***  Indicates whether the UE can be configured with *enabledDefaultBeamForCCS* for default QCL assumption for cross-carrier A-CSI-RS triggering for same/different numerologies as specified in TS 38.213 11].  Value *diffOnly* indicates the UE supports this feature for different SCS combination(s).  Value *both* indicates the UE supports this feature for same SCS and for different SCS combination(s) (low-to-high, high-to-low or both) reported for *crossCarrierA-CSI-trigDiffSCS-r16.* | BC | No | N/A | N/A |
| ***demodulationEnhancementCA-r17***  Indicates whether the UE supports the enhanced demodulation processing for carrier aggregation for HST-SFN joint transmission scheme with velocity up to 500km/h as specified in TS 38.101-4 [18]. | BC | No | No | FR1 only |
| ***diffNumerologyAcrossPUCCH-Group***  Indicates whether different numerology across two NR PUCCH groups for data and control channel at a given time in NR CA and (NG)EN-DC/NE-DC is supported by the UE. | BC | No | N/A | N/A |
| ***diffNumerologyAcrossPUCCH-Group-CarrierTypes-r16***  Indicates whether different numerology across two NR PUCCH groups for data and control channel at a given time in NR CA for UE supporting two PUCCH groups with 3 or more bands with at least two carrier types. UE indicating support of this feature shall indicate support of *twoPUCCH-Grp-ConfigurationsList-r16.* | BC | No | N/A | N/A |
| ***diffNumerologyWithinPUCCH-GroupLargerSCS***  Indicates whether UE supports different numerology across carriers within a PUCCH group and a same numerology between DL and UL per carrier for data/control channel at a given time in NR CA, (NG)EN-DC/NE-DC and NR-DC.  In case of NR CA and (NG)EN-DC/NE-DC with one NR PUCCH group and in case of NR CA with two NR PUCCH groups, it also indicates whether the UE supports different numerologies across NR carriers within the same NR PUCCH group up to two different numerologies within the same NR PUCCH group, wherein NR PUCCH is sent on the carrier with larger SCS for data and control channel at a given time.  In case of (NG)EN-DC/NE-DC with two NR PUCCH groups, it indicates whether the UE supports 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 and control channel at a given time.  In case of NR-DC, it indicates whether the UE supports different numerologies across NR carriers within the same NR PUCCH group in MCG (in FR1) 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). | BC | No | N/A | N/A |
| ***diffNumerologyWithinPUCCH-GroupLargerSCS-CarrierTypes-r16***  Indicates whether UE supports different numerology across carriers up to 2 different numerologies within the same PUCCH group wherein PUCCH is sent on the carrier with larger SCS for data/control channel at a given time in NR CA for UE supporting two PUCCH groups with 3 or more bands with at least two carrier types. UE indicating support of this feature shall indicate support of *twoPUCCH-Grp-ConfigurationsList-r16.*  NOTE: PUCCH is sent on a carrier with SCS not smaller than SCS of any DL carriers corresponding to the PUCCH group. | BC | No | N/A | N/A |
| ***diffNumerologyWithinPUCCH-GroupSmallerSCS***  Indicates whether UE supports different numerology across carriers within a PUCCH group and a same numerology between DL and UL per carrier for data/control channel at a given time in NR CA, (NG)EN-DC/NE-DC and NR-DC.  In case of NR CA and (NG)EN-DC/NE-DC with one NR PUCCH group and in case of NR CA with two NR PUCCH groups, it also indicates whether the UE supports different numerologies across NR carriers within the same NR PUCCH group up to two different numerologies within the same NR PUCCH group, wherein NR PUCCH is sent on the carrier with smaller SCS for data and control channel at a given time.  In case of (NG)EN-DC/NE-DC with two NR PUCCH groups, it indicates whether the UE supports 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 and control channel at a given time.  In case of NR-DC, it indicates whether the UE supports different numerologies across NR carriers within the same NR PUCCH group in MCG (in FR1) 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). | BC | No | N/A | N/A |
| ***diffNumerologyWithinPUCCH-GroupSmallerSCS-CarrierTypes-r16***  Indicates whether UE supports different numerology across carriers up to 2 different numerologies within the same PUCCH group wherein PUCCH is sent on the carrier with smaller SCS for data/control channel at a given time in NR CA for UE supporting two PUCCH groups with 3 or more bands with at least two carrier types. UE indicating support of this feature shall indicate support of *twoPUCCH-Grp-ConfigurationsList-r16.*  NOTE: NR PUCCH is sent on a carrier with SCS not larger than SCS of any DL carriers corresponding to the NR PUCCH group. | BC | No | N/A | N/A |
| ***dualPA-Architecture***  For band combinations with single-band with UL CA, this field indicates the support of dual PA. If absent in such band combinations, the UE supports single PA for all the ULs. For other band combinations, this field is not applicable. | BC | No | N/A | N/A |
| ***half-DuplexTDD-CA-SameSCS-r16***  Indicates whether the UE supports directional collision handling between reference and other cell(s) for half-duplex operation in TDD CA with same SCS. The UE can include this field for band combinations including only intra-band TDD CA or if *simultaneousRxTxInterBandCA* is not present for band combinations involving mix of intra-band TDD CA and inter-band TDD CA. | BC | No | TDD only | N/A |
| ***interCA-NonAlignedFrame-r16***  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 smaller than or equal to the lowest subcarrier spacing of the subcarrier spacings given in scs-SpecificCarrierList for each of the non-aligned SCells. | BC | No | N/A | N/A |
| ***interCA-NonAlignedFrame-B-r16***  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.  A UE indicating support of interCA-NonAlignedFrame-B-r16 shall also indicate support of interCA-NonAlignedFrame-r16. | BC | No | N/A | N/A |
| ***interFreqDAPS-r16***  Indicates whether the UE supports inter-frequency handover, e.g. support of simultaneous DL reception of PDCCH and PDSCH from source and target cell. A UE indicating this capability shall also support synchronous DAPS handover, and single UL transmission for inter-frequency DAPS handover. The capability signalling comprises of the following parameters:  - *interFreqAsyncDAPS-r16* indicates whether the UE supports asynchronous DAPS handover.  - *interFreqDiffSCS-DAPS-r16* indicates whether the UE supports different SCSs in source PCell and inter-frequency target PCell in DAPS handover. The UE only includes this field if different SCSs can be supported in both UL and DL. If absent, the UE does not support either UL or DL SCS being different in DAPS handover.  - *interFreqMultiUL-TransmissionDAPS-r16* indicates whether the UE supports simultaneous UL transmission in source PCell and target PCell during a DAPS handover. The UE can include this field only if any of *semiStaticPowerSharingDAPS-Mode1-r16*, *semiStaticPowerSharingDAPS-Mode2-r16* or *dynamicPowersharingDAPS-r16* are included. Otherwise, the UE does not include this field.  - *interFreqSemiStaticPowerSharingDAPS-Mode1-r16* indicates whether the UE supports semi-static UL power sharing mode 1 during DAPS handover between source and target cells of same FR.  - *interFreqSemiStaticPowerSharingDAPS-Mode2-r16* indicates whether the UE supports semi-static UL power sharing mode 2 during DAPS handover between source and target cells of same FR. It is only applicable to DAPS Handover in synchronous scenarios. The UE only includes this field if *semiStaticPowerSharingDAPS-Mode1-r16* is included. Otherwise, the UE does not include this field.  - *interFreqDynamicPowersharingDAPS-r16* indicates the value of T offset (short or long) that the UE supports for dynamic UL power sharing during DAPS handover between source and target cells of same FR. The UE only include this field if *semiStaticPowerSharingDAPS-Mode1-r16* is included. Otherwise, the UE does not include this field.  - *interFreqUL-TransCancellationDAPS-r16* indicates support of cancelling UL transmission to the source PCell for inter-frequency DAPS handover. | BC | No | N/A | N/A |
| ***intraBandFreqSeparationUL-AggBW-GapBW-r16***  Indicates the UL frequency separation class between lower edge of lowest CC and upper edge of highest CC of Intra-band UL non-contiguous CA, i.e. including both the aggregated bandwidth and the gap bandwidth. 3 frequency separation classes are introduced and the values are as follow:  - class I: Non-contiguous CA separation class ≤ 100MHz  - class II: 100MHz < Non-contiguous CA separation class≤ 200MHz  - class III: 200MHz < Non-contiguous CA separation class <600MHz | BC | No | N/A | FR1 only |
| ***jointSearchSpaceSwitchAcrossCells-r16***  Indicates whether the UE supports being configured with a group of cells and switching search space set group jointly over these cells. If the UE supports this feature, the UE needs to report *searchSpaceSwitchWithDCI-r16* or *searchSpaceSwitchWithoutDCI-r16*. | BC | No | N/A | N/A |
| ***maxUpTo3Diff-NumerologiesConfigSinglePUCCH-grp-r16***  Indicates the UE support of up to 3 different numerologies in the same PUCCH group where UE is not configured with two NR PUCCH groups by indicating one or multiple NR carrier types {FR1 licensed TDD (*fr1-NonSharedTDD-r16*), FR1 unlicensed TDD (*fr1-SharedTDD-r16*), FR1 licensed FDD (*fr1-NonSharedFDD-r16*), FR2(*fr2-r16*)} that can transmit the PUCCH for NR part of (NG)EN-DC, NE-DC and NR-CA.  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. | BC | No | N/A | N/A |
| ***maxUpTo4Diff-NumerologiesConfigSinglePUCCH-grp-r16***  Indicates the UE support of up to 4 different numerologies in the same PUCCH group where UE is not configured with two NR PUCCH groups by indicating one or multiple the NR carrier types {FR1 licensed TDD (*fr1-NonSharedTDD-r16*), FR1 unlicensed TDD (*fr1-SharedTDD-r16*), FR1 licensed FDD (*fr1-NonSharedFDD-r16*), FR2(*fr2-r16*)} that can transmit the PUCCH for NR part of (NG)EN-DC, NE-DC and NR-CA.  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. | BC | No | N/A | N/A |
| ***msgA-SUL-r16***  Indicates whether the UE supports MSGA transmission in a band combination including SUL. A UE supporting this feature shall also indicate support of *twoStepRACH-r16*. | BC | No | N/A | N/A |
| ***parallelTxMsgA-SRS-PUCCH-PUSCH-r16***  Indicates whether the UE supports parallel transmission of MsgA and SRS/ PUCCH/ PUSCH across CCs in an inter-band CA band combination. A UE supporting this feature shall also indicate support of *parallelTxPRACH-SRS-PUCCH-PUSCH*. | BC | No | N/A | N/A |
| ***parallelTxSRS-PUCCH-PUSCH***  Indicates whether the UE supports parallel transmission of SRS and PUCCH/ PUSCH across CCs in an inter-band CA band combination. | BC | No | N/A | N/A |
| ***parallelTxPRACH-SRS-PUCCH-PUSCH***  Indicates whether the UE supports parallel transmission of PRACH and SRS/PUCCH/PUSCH across CCs in an inter-band CA band combination. | BC | No | N/A | N/A |
| ***pdcch-BlindDetectionCA-Mixed-r16***  This field indicates mixed operation of two variants of the number of blind detections in case of CA. UE indicating support of this feature shall also indicate support of *pdcch-MonitoringMixed-r16*. | BC | No | N/A | N/A |
| ***pdcch-BlindDetectionCA-Mixed-NonAlignedSpan-r16***  This field indicates mixed operation of two variants of the number of blind detections in case of CA when the UE supports aligned span and non-aligned span. In the case of non-aligned span, when the configured number of CCs 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. UE indicating support of this feature shall also indicate support of *pdcch-MonitoringMixed-r16*. 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. | BC | No | N/A | N/A |
| ***pdcch-BlindDetectionMCG-UE-r16, pdcch-BlindDetectionSCG-UE-r16***  This field indicates the number of blind detections supported for MCG and SCG, respectively.  If a UE supports *pdcch-MonitoringCA-r16* or *pdcch-MonitoringCA-NonAlighedSpan-r16*, then the capability defined by *pdcch-MonitoringCA-r16* or *pdcch-MonitoringCA-NonAlighedSpan-r16* is applied to the feature. | BC | No | N/A | N/A |
| ***pdcch-BlindDetectionMCG-UE-Mixed-r16, pdcch-BlindDetectionSCG-UE-Mixed-r16***  This field indicates mixed operation of two variants of the number of blind detections supported for MCG and SCG, respectively.  If a UE supports *pdcch-BlindDetectionCA-Mixed-r16*or *pdcch-BlindDetectionCA-Mixed-NonAlignedSpan-r16*, then the capability defined by *pdcch-BlindDetectionCA-Mixed-r16*or *pdcch-BlindDetectionCA-Mixed-NonAlignedSpan-r16* is applied to the feature. | BC | No | N/A | N/A |
| ***pdcch-MonitoringCA-r16***  Indicates the number of CCs for monitoring a maximum number of blind detections and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells. This field also indicates supported span arrangement for CA. A UE that supports this feature shall also support *pdcch-Monitoring-r16*. UE indicating support of this feature shall also indicate support of *pdcch-Monitoring-r16.* | BC | No | N/A | N/A |
| ***pdcch-MonitoringCA-NonAlignedSpan-r16***  Indicates the number of CCs for monitoring a maximum number of blind detections and non-overlapped CCEs per span when configured with DL CA with Rel-16 PDCCH monitoring capability on all the serving cells in the case UE supports aligned span and non-aligned span. In the case of non-aligned span, when the configured number of CCs with Rel-16 PDCCH monitoring is larger than the UE reported value and PDCCH monitoring occasion(s) should be configured only on same symbol(s) every slot. UE indicating support of this feature shall also indicate support of *pdcch-Monitoring-r16*. | BC | No | N/A | N/A |
| ***scellDormancyWithinActiveTime-r16***  Indicates whether the UE supports SCell dormancy indication received on SPCell with DCI format 0\_1/1\_1 sent within the active time as defined in clause 10.3 of TS 38.213 [11]. If the UE indicates the support of this, the UE supports one dormant BWP and at least one non-dormant BWP per carrier. To support more than one non-dormant BWP in a carrier, the UE indicates support of *upto4* in *bwp-SameNumerology* or *upto4* in *bwp-DiffNumerology*. One dormant BWP and one non-dormant BWP are UE specific BWPs even for UEs not supporting *bwp-SameNumerology.* | BC | No | N/A | N/A |
| ***scellDormancyOutsideActiveTime-r16***  Indicates whether the UE supports SCell dormancy indication received on SPCell using DCI format 2\_6 sent outside the active time as defined in clause 10.3 of TS 38.213 [11]. A UE supporting this feature shall also indicate support of power saving DRX adaptation using *drx-Adaptation-r16* and shall also support one dormant BWP and at least one non-dormant BWP per carrier. To support more than one non-dormant BWP in a carrier, the UE indicates support of *upto4* in *bwp-SameNumerology* or *upto4* in *bwp-DiffNumerology*. One dormant BWP and one non-dormant BWP are UE specific BWPs even for UEs not supporting *bwp-SameNumerology.* | BC | No | N/A | N/A |
| ***simultaneousCSI-ReportsAllCC***  Indicates whether the UE supports CSI report framework and the number of CSI report(s) which the UE can simultaneously process across all CCs, and across MCG and SCG in case of NR-DC. The CSI report comprises periodic, semi-persistent and aperiodic CSI and any latency classes and codebook types. The CSI report in *simultaneousCSI-ReportsAllCC* includes the beam report and CSI report. This parameter may further limit *simultaneousCSI-ReportsPerCC* in *MIMO-ParametersPerBand* and *Phy-ParametersFRX-Diff* for each band in a given band combination. | BC | Yes | N/A | N/A |
| ***simul-SRS-Trans-BC-r16***  Indicates the number of SRS resources for positioning on a symbol for a given band combination. The UE can include this field only if the UE supports *srs-PosResources-r16*. Otherwise, the UE does not include this field;  NOTE 1: For single-band band combinations, it defines the capability for intra-band CA, and for band combinations with at least two bands, it defines the capability for inter-band carrier aggregation.  NOTE 2: if the UE does not indicate this capability for a band combination, the UE does not support the feature in this band combination. | BC | No | N/A | N/A |
| ***simul-SRS-MIMO-Trans-BC-r16***  Indicates the number of SRS resources for positioning and SRS resource for MIMO on a symbol for a given BC. The UE can include this field only if the UE supports *srs-PosResources-r16*. Otherwise, the UE does not include this field.  NOTE 1: 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 2: For single-band band combinations, it defines the capability for intra-band carrier aggregation, and for band combinations with at least two bands, it defines the capability for inter-band carrier aggregation.  NOTE 3: if the UE does not indicate this capability for a band combination, the UE does not support the feature in this band combination. | BC | No | N/A | N/A |
| ***simulTX-SRS-AntSwitchingInterBandUL-CA-r16***  Indicates whether the UE support simultaneous transmission of SRS on different CCs for inter-band UL CA. The UE indicating support of this feature shall include at least one of the following capabilities:  - *supportSRS-xTyR-xLessThanY-r16* indicates 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.  - *supportSRS-xTyR-xEqualToY-r16* indicates 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.  - *supportSRS-AntennaSwitching-r16* Indicates whether the UE support simultaneous transmission of SRS for antenna switching on different CCs in overlapped symbol(s) for inter-band UL CA.  NOTE: For simultaneously antenna switching and antenna switching SRS in inter-band CAs with bands whose UL are switched together according to the reported *supportSRS-AntennaSwitching-r16*, the UE expects the same configuration of xTyR across the different CCs and the SRS resources overlapped in time domain from UE perspective are from the same UE antenna ports. | BC | No | N/A | N/A |
| ***simultaneousRxTxInterBandCA***  Indicates whether the UE supports simultaneous transmission and reception in TDD-TDD and TDD-FDD inter-band NR CA. If this field is included in *ca-ParametersNR-ForDC*, it indicates the UE supports simultaneous transmission and reception between any UL/DL band pair within a cell group and across MCG and SCG in TDD-TDD and TDD-FDD inter-band NR-DC. It is mandatory for certain TDD-FDD and TDD-TDD band combinations defined in TS 38.101-1 [2], TS 38.101-2 [3] and TS 38.101-3 [4]. | BC | CY | N/A | N/A |
| ***simultaneousRxTxInterBandCAPerBandPair***  Indicates whether the UE supports simultaneous transmission and reception in TDD-TDD and TDD-FDD inter-band NR CA for each band pair in the band combination.  Encoded as a bitmap with size L \* (L – 1) / 2, and bit N (leftmost bit is indexed as bit 0) is set to "1" if the UE supports simultaneous transmission and reception for band pair (x, y), where L is the number of band entries in the band combination, x and y are the indices of the band entry in the band combination (the first band entry is indexed as 0), x < y, and N = x\*(2\*L – x – 1)/2 + y – x – 1.  If this field is included in *ca-ParametersNR-ForDC*, each bit of this field indicates whether the UE supports simultaneous transmission and reception between each band pair, within a cell group and across MCG and SCG in TDD-TDD and TDD-FDD inter-band NR-DC.  The UE does not include this field if the UE supports simultaneous transmission and reception for all band pairs in the band combination (in which case *simultaneousRxTxInterBandCA* is included) or does not support for any band pair in the band combination. The UE shall consistently set the bits which correspond to the same band pair. | BC | No | N/A | N/A |
| ***simultaneousRxTxSUL***  Indicates whether the UE supports simultaneous reception and transmission for a NR band combination including SUL. Mandatory/Optional support depends on band combination and captured in TS 38.101-1 [2]. | BC | CY | N/A | N/A |
| ***simultaneousRxTxSULPerBandPair***  Indicates whether the UE supports simultaneous reception and transmission for a NR band combination including SUL for each band pair in the band combination.  Encoded in the same manner as *simultaneousRxTxInterBandCAPerBandPair*.  The UE does not include this field if the UE supports simultaneous transmission and reception for all band pairs in the band combination (in which case *simultaneousRxTxSUL* is included) or does not support for any band pair in the band combination. The UE shall consistently set the bits which correspond to the same band pair. | BC | No | N/A | N/A |
| ***simultaneousSRS-AssocCSI-RS-AllCC***  Indicates support of CSI-RS processing framework for SRS and the number of SRS resources that the UE can process simultaneously across all CCs, and across MCG and SCG in case of NR-DC, including periodic, aperiodic and semi-persistent SRS. This parameter may further limit *simultaneousSRS-AssocCSI-RS-PerCC* in *MIMO-ParametersPerBand* and *Phy-ParametersFRX-Diff* for each band in a given band combination. | BC | No | N/A | N/A |
| ***supportedCSI-RS-ResourceListAlt-r16***  Indicates the list of supported CSI-RS resources across all bands in a band combination by referring to *codebookVariantsList*. The following parameters are included in *codebookVariantsList* for each code book type:  - *maxNumberTxPortsPerResource* indicates the maximum number of Tx ports in a resource across all bands within a band combination;  - *maxNumberResourcesPerBand* indicates the maximum number of resources across all CCs within a band combination, simultaneously;  - *totalNumberTxPortsPerBand* indicates the total number of Tx ports across all CCs within a band combination, simultaneously.  For each band in a band combination, supported values for these three parameters are determined in conjunction with *supportedCSI-RS-ResourceListAlt* reported in *MIMO-ParametersPerBand*. | BC | No | N/A | N/A |
| ***supportedNumberTAG***  Defines the number of timing advance groups supported by the UE. It is applied to NR CA, NR-DC, (NG)EN-DC/NE-DC and DAPS handover. For (NG)EN-DC/NE-DC, it indicates number of TAGs only for NR CG. The number of TAGs for the LTE MCG is signalled by existing LTE TAG capability signalling. For NR CA/NR-DC band combination, if the band combination comprised of more than one band entry (i.e., inter-band or intra-band non-contiguous band combination), it indicates that different timing advances on different band entries are supported. If absent, the UE supports only one TAG for the NR part. It is mandatory for the UE to support more than one TAG for NR-DC and it is mandatory for the UE to support 2 TAGs for inter-frequency DAPS. For the mixed inter-band and intra-band NR CA/NR-DC band combination, if the network configures more non-contiguous UL serving cells than the number of supported TAG, the UE only supports the configuration where all UL CCs of the same frequency band are configured with the same Timing Advance Group ID. | BC | CY | N/A | N/A |
| ***twoPUCCH-Grp-ConfigurationsList-r16***  Indicates one or multiple of supported configuration(s) of {primary PUCCH group config, secondary PUCCH group config} for the band combination where for each of the supported configuration the carrier type(s) (FR1-NonSharedTDD, FR1-SharedTDD, FR1-NonSharedFDD, FR2) that can be mapped to a PUCCH group and also the carrier types that can be configured with PUCCH transmission for primary PUCCH group and secondary PUCCH group for NR-CA band combination with 3 or more bands. The capability signalling of each primary or secondary PUCCH group configuration comprises of the following parameters:  - *pucch-GroupMapping-r16* indicates the PUCCH group(s) that a carrier type can be mapped to.  - pucch-TX-r16 indicates the PUCCH group(s) that a carrier type can be configured for PUCCH transmission  NOTE 1: For a band combination with SUL, the SUL band is counted as one of the bands.  NOTE 2: For a band combination with SDL, the SDL band is counted as one of the bands. SDL is indicated as 'FR1-NonSharedFDD' carrier type. Per UE capabilities that are TDD only are not applicable to SDL.  NOTE 3: 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 4: 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 5: If UE indicating this field does not support *diffNumerologyAcrossPUCCH-Group-CarrierTypes-r16*, the UE can only be configured with the same SCS across NR PUCCH groups. | BC | No | N/A | N/A |
| ***uplinkTxDC-TwoCarrierReport-r16***  Indicates whether the UE supports the uplink Tx Direct Current subcarrier location(s) reporting when configured with uplink CA with two carriers.  It is applicable only for (NG)EN-DC/NE-DC and NR CA where the NR has intra-band uplink CA with two uplink carriers. | BC | No | N/A | N/A |

*NEXT CHANGE*

### 4.2.19 High speed parameters

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- |
| ***measurementEnhancement-r16***  Indicates whether the UE supports the enhanced intra-NR and inter-RAT E-UTRAN RRM requirements to support high speed up to 500 km/h as specified in TS 38.133 [5]. This field applies to MN configured measurement enhancement when MR-DC is not configured and SN configured measurement enhancement when (NG)EN-DC is configured. | UE | No | No | FR1 only |
| ***measurementEnhancementCA-r17***  Indicates whether the UE supports the enhanced RRM requirements for carrier aggregation to support high speed up to 500 km/h as specified in TS 38.133 [5]. | UE | No | No | FR1 only |
| ***measurementEnhancementInterFreq-r17***  Indicates whether the UE supports the enhanced RRM requirements for inter-frequency measurements in connected mode to support high speed up to 500 km/h as specified in TS 38.133 [5]. | UE | No | No | FR1 only |
| ***demodulationEnhancement-r16***  Indicates whether the UE supports the enhanced demodulation processing for HST-SFN joint transmission scheme with velocity up to 500km/h as specified in TS 38.101-4 [18]. This field applies to MN configured demodulation enhancement when MR-DC is not configured and SN configured demodulation enhancement when (NG)EN-DC is configured. | UE | No | No | FR1 only |
| ***intraNR-MeasurementEnhancement-r16***  Indicates whether the UE supports the enhanced intra-NR RRM requirements to support high speed up to 500 km/h as specified in TS 38.133 [5]. This field applies to MN configured measurement enhancement when MR-DC is not configured and SN configured measurement enhancement when (NG)EN-DC is configured.  The UE can include this field only if the UE does not indicate the support of *measurementEnhancement-r16* and *interRAT-MeasurementEnhancement-r16*. Otherwise, the UE does not include this field. | UE | No | No | FR1 only |
| ***interRAT-MeasurementEnhancement-r16***  Indicates whether the UE supports the enhanced inter-RAT E-UTRAN RRM requirements to support high speed up to 500 km/h as specified in TS 38.133 [5]. This field applies to MN configured measurement enhancement.  The UE can include this field only if the UE does not indicate the support of *measurementEnhancement-r16* and *intraNR-MeasurementEnhancement-r16*. Otherwise, the UE does not include this field. | UE | No | No | FR1 only |
|  |  |  |  |  |

*NEXT CHANGE*

# 5 Optional features without UE radio access capability parameters

**/\*Partially omitted\*/**

## 5.6 RRM measurement features

| Definitions for feature |
| --- |
| **High speed inter-frequency IDLE/INACTIVE measurements**  It is optional for UE to support high speed inter-frequency measurements in RRC\_IDLE/RRC\_INACTIVE as specified in TS 38.133 [5]. |
| **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 [21]. |

*CHANGE END*