**3GPP TSG-RAN WG2 Meeting #109bis-e R2-200xxxx**

**Electronic, 20 April - 30 April 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.306** | **CR** |  | **rev** | **-** | **Current version:** | **16.0.0** |  |
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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:*** | 38306CR for UE capability of supporting UL Tx switching | | | | | | | | | |
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| ***Source to WG:*** |  | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_RF\_FR1 | | | | |  | ***Date:*** | | | 2020-04-28 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-16 |
|  | *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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
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| ***Reason for change:*** | | In RAN#85 meeting, the following objective was added in the revised WID of “RF requirements for NR frequency range 1”:   * *Specify UE requirements to allow switching between case 1 and case 2 as below for two uplink carriers case inter-band EN-DC without SUL, inter-band UL CA and standalone SUL for UE supporting maximum two concurrent transmission*  |  |  | | --- | --- | | *Case 1* | *1 Tx on carrier 1 and 1 Tx on carrier 2* | | *Case 2* | *0 Tx on carrier 1 and 2 Tx on carrier 2* |   In RAN4#93 meeting, it is agreed that UE capability to support Tx switching between two uplink carriers should be per pair of uplink bands per UL band combination.  In RAN4#94e, the follow agreements on the length of UL switching period have been reached.  • Length of UL switching period for defining UE RF requirements and capability reporting:  – For SUL and UL CA  • {35us, 140 us, 210us}  – For EN-DC  • {35us, 140 us} | | | | | | | | |
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| ***Summary of change:*** | | 1. Introduce a new UE capability of Tx switching period.  2. Introduce the UL Tx switching specific band combination.  **Impact analysis**  Impacted 5G architecture options: EN-DC, NGEN-DC, NR SA  Impacted functionality: UL Tx switching in FR1  Inter-operability:  1. If NW implements according to the CR and the UE does not, there are no inter-operatibility problems as in such case UE should operate according to legacy Rel-15 behavior.  2. If the UE implements according to the CR and the network does not, there are inter-operatibility problems as the network does not understand the new UE capability and may not perform UL scheduling properly. | | | | | | | | |
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| ***Consequences if not approved:*** | | The Tx switching between uplink carriers is not supported. | | | | | | | | |
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| ***Clauses affected:*** | | 4.2.7.1, 4.2.7.11 | | | | | | | | |
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|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 38.331 CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

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#### 4.2.7.1 *BandCombinationList* parameters

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- |
| ***bandEUTRA***  Defines supported EUTRA frequency band by NR frequency band number, as specified in TS 36.101 [14]. | Band | Yes | No | No |
| ***bandList***  Each entry of the list should include at least one bandwidth class for UL or DL. | BC | Yes | No | No |
| ***bandNR***  Defines supported NR frequency band by NR frequency band number, as specified in TS 38.101-1 [2] and TS 38.101-2 [3]. | Band | Yes | No | No |
| ***ca-BandwidthClassDL-EUTRA***  Defines for DL, the class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by the UE, as specified in TS 36.101 [14]. When all FeatureSetEUTRA-DownlinkId:s in the corresponding FeatureSetsPerBand are zero, this field is absent. | Band | No | No | No |
| ***ca-BandwidthClassDL-NR***  Defines for DL, the class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by the UE, as specified in TS 38.101-1 [2] and TS 38.101-2 [3]. When all FeatureSetDownlinkId:s in the corresponding FeatureSetsPerBand are zero, this field is absent. | Band | No | No | No |
| ***ca-BandwidthClassUL-EUTRA***  Defines for UL, the class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by the UE, as specified in TS 36.101 [14]. When all FeatureSetEUTRA-UplinkId:s in the corresponding FeatureSetsPerBand are zero, this field is absent. | Band | No | No | No |
| ***ca-BandwidthClassUL-NR***  Defines for UL, the class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by the UE, as specified in TS 38.101-1 [2] and TS 38.101-2 [3]. When all FeatureSetUplinkId:s in the corresponding FeatureSetsPerBand are zero, this field is absent. | Band | No | No | No |
| ***ca-ParametersEUTRA***  Contains the EUTRA part of band combination parameters for a given EN-DC band combination. | BC | No | No | No |
| ***ca-ParametersNR***  Contains the NR band combination parameters for a given EN-DC and/or NR CA band combination. | BC | No | No | No |
| ***ca-ParametersNRDC***  Indicates whether the UE supports NR-DC for the band combination. It contains the NR band combination parameters applicable across MCG and SCG. | BC | No | No | No |
| ***featureSetCombination***  Indicates the feature set that the UE supports on the NR and/or MR-DC band combination by FeatureSetCombinationId. | BC | N/A | No | No |
| ***mrdc-Parameters***  Contains the band combination parameters for a given EN-DC band combination. | BC | No | No | No |
| ***ne-DC-BC***  Indicates whether the UE supports NE-DC for the band combination. | BC | No | No | No |
| ***powerClass***  Indicates power class 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. The UE sets the power class parameter only in band combinations with two FR1 uplink serving cells. | BC | No | No | FR1 only |
| ***SRS-SwitchingTimeNR***  Indicates the interruption time on DL/UL reception within a NR band pair during the RF retuning for switching between a carrier on one band and another (PUSCH-less) carrier on the other band to transmit SRS. *switchingTimeDL/ switchingTimeUL*:n0us represents 0 us, n30us represents 30us, and so on. *switchingTimeDL/ switchingTimeUL* is mandatory present if switching between the NR band pair is supported, otherwise the field is absent. It is signalled per pair of bands per band combination. | FD | No | No | No |
| ***SRS-SwitchingTimeEUTRA***  Indicates the interruption time on DL/UL reception within a EUTRA band pair during the RF retuning for switching between a carrier on one band and another (PUSCH-less) carrier on the other band to transmit SRS. *switchingTimeDL/ switchingTimeUL:* n0 represents 0 OFDM symbols, n0dot5 represents 0.5 OFDM symbols, n1 represents 1 OFDM symbol and so on. *switchingTimeDL/ switchingTimeUL* is mandatory present if switching between the EUTRA band pair is supported, otherwise the field is absent. It is signalled per pair of bands per band combination. | FD | No | No | No |
| ***srs-TxSwitch***  Defines whether UE supports SRS for DL CSI acquisition as defined in clause 6.2.1.2 of TS 38.214 [12]. The capability signalling comprises of the following parameters:  - *supportedSRS-TxPortSwitch* indicates SRS Tx port switching pattern supported by the UE, which is mandatory with capability signaling. The indicated UE antenna switching capability of ′xTyR′ corresponds to a UE, capable of SRS transmission on ′x′ antenna ports over total of ′y′ antennas, where ′y′ corresponds to all or subset of UE receive antennas, where 2T4R is two pairs of antennas. *supportedSRS-TxPortSwitch-r16*, which is optional to report, indicates downgrading configuration of SRS Tx port switching pattern. If the UE indicates the support of downgrading configuration of SRS Tx port switching pattern using *supportedSRS-TxPortSwitch-r16*, the UE shall report the values for this as below, based on what is reported in *supportedSRS-TxPortSwitch*.   |  |  | | --- | --- | | *supportedSRS-TxPortSwitch* | *supportedSRS-TxPortSwitch-r16* | | *t1r2* | *t1r1-t1r2* | | *t1r4* | *t1r1-t1r2-t1r4* | | *t2r4* | *t1r1-t1r2-t2r2-t2r4* | | *t2r2* | *t1r1-t2r2* | | *t4r4* | *t1r1-t2r2-t4r4* | | *t1r4-t2r4* | *t1r1-t1r2-t2r2-t1r4-t2r4* |   - *txSwitchImpactToRx* indicates the entry number of the first-listed band with UL in the band combination that affects this DL, which is mandatory with capability signaling;  - *txSwitchWithAnotherBand* indicates the entry number of the first-listed band with UL in the band combination that switches together with this UL, which is mandatory with capability signaling.  For *txSwitchImpactToRx* and *txSwitchWithAnotherBand*, value 1 means first entry, value 2 means second entry and so on. All DL and UL that switch together indicate the same entry number.  The UE is restricted not to include fallback band combinations for the purpose of indicating different SRS antenna switching capabilities. | BC | FD | No | No |
| ***supportedBandwidthCombinationSet***  Defines the supported bandwidth combination for the band combination set as defined in the TS 38.101-1 [2], TS 38.101-2 [3] and TS 38.101-3 [4]. For NR SA CA, NR-DC, inter-band EN-DC without intra-band EN-DC component and intra-band EN-DC with additional inter-band NR CA component, the field defines the bandwidth combinations for the NR part of the band combination. For intra-band EN-DC without additional inter-band NR and LTE CA component, the field indicates the supported bandwidth combination set applicable to the NR and LTE band combinations. Field encoded as a bit map, where bit N is set to "1" if UE support Bandwidth Combination Set N for this band combination as defined in the TS 38.101-1 [2], TS 38.101-2 [3] and TS 38.101-3 [4]. The leading / leftmost bit (bit 0) corresponds to the Bandwidth Combination Set 0, the next bit corresponds to the Bandwidth Combination Set 1 and so on. It is mandatory if the band combination has more than one NR carrier (at least one SCell in an NR cell group) or is an intra-band EN-DC combination or both. | BC | CY | No | No |
| ***supportedBandwidthCombinationSetIntraENDC***  Defines the supported bandwidth combination for the band combination set as defined in the TS 38.101-3 [4]. For intra-band EN-DC with additional inter-band CA component(s) of LTE and/or NR, the field defines the bandwidth combinations for the intra-band EN-DC component. Field encoded as a bit map, where bit N is set to "1" if UE support Bandwidth Combination Set N for this band combination as defined in the TS 38.101-3 [4]. The leading / leftmost bit (bit 0) corresponds to the Bandwidth Combination Set 0, the next bit corresponds to the Bandwidth Combination Set 1 and so on. It is mandatory if the band combination is an intra-band EN-DC combination with additional inter-band NR/LTE CA component. | BC | CY | No | No |
| ***uplinkTxSwitchingPeriod***  Indicates the interruption time on uplink transmission within a band pair during the uplink Tx switching between a carrier on one band and another carrer on the other band. For uplink CA and SUL, the value range of uplinkTxSwitchingPeriod is {n35us, n140us, n210us}. For EN-DC, the the value range of uplinkTxSwitchingPeriod is {n35us, n140us}. n35us represents 35 us, n140us represents 140us, and so on, as specified in TS 38.101-1 [2] and TS 38.101-3 [4]. uplinkTxSwitchingPeriod is mandatory present if switching between the band pair is supported for uplink CA or SUL or EN-DC, otherwise the field is absent. It is signalled per pair of bands per band combination. | FD | No | No | FR1 only |

------------------------------ [Next Change] ------------------------------

4.2.7.11 Other PHY parameters

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- |
| ***appliedFreqBandListFilter***  Mirrors the *FreqBandList* that the NW provided in the capability enquiry, if any. The UE filtered the band combinations in the *supportedBandCombinationList* in accordance with this *appliedFreqBandListFilter*. | UE | No | No | No |
| ***downlinkSetEUTRA***  Indicates the features that the UE supports on the DL carriers corresponding to one EUTRA band entry in a band combination by FeatureSetEUTRA-DownlinkId. The FeatureSetEUTRA-DownlinkId = 0 means that the UE does not support a EUTRA DL carrier in this band of a band combination. | Band | N/A | No | No |
| ***downlinkSetNR***  Indicates the features that the UE supports on the DL carriers corresponding to one NR band entry in a band combination by FeatureSetDownlinkId. The FeatureSetDownlinkId = 0 means that the UE does not support a DL carrier in this band of a band combination. A fallback per band feature set resulting from the reported DL feature set that has fallback per CC feature set is not signalled but the UE shall support it. | Band | N/A | No | No |
| ***featureSetCombinations***  Pools of feature sets that the UE supports on the NR or MR-DC band combinations. | UE | N/A | No | No |
| ***featureSets***  Pools of downlink and uplink features sets as well as a pool of FeatureSetCombination elements. A FeatureSetCombination refers to the IDs of the feature set(s) that the UE supports in that FeatureSetCombination. The BandCombination entries in the BandCombinationList then indicate the ID of the FeatureSetCombination that the UE supports for that band combination. | UE | N/A | No | No |
| ***naics-Capability-List***  Indicates that UE in MR-DC supports NAICS as defined in TS 36.331 [17]. | UE | No | No | No |
| ***receivedFilters***  Contains all filters requested with UE-CapabilityRequestFilterNR from version 15.6.0 onwards. | UE | No | No | No |
| ***supportedBandCombinationList***  Defines the supported NR and/or MR-DC band combinations by the UE. For each band combination the UE identifies the associated feature set combination by featureSetCombinations index referring to featureSetCombination. A fallback band combination resulting from the reported CA and MR-DC band combination is not signalled but the UE shall support it. For intra-band non-contiguous CA band combinations, the UE only includes one band combination, and exclude the others for which the presence of uplink CA bandwidth class in the band combination entry is different. One band combination entry can also indicate support of any other possible permutations in the presence of uplink CA bandwidth class where a paired downlink CA bandwidth class is the same or where the number of UL CCs is smaller than the one of paired DL CCs expressed by the CA bandwidth class, as specified in TS 36.306 [15]. For these band combinations not included in the capability, the supported feature set is the same as the ones for the band combination included in the UE capability. | UE | Yes | No | No |
| ***supportedBandCombinationListNEDC-Only***  Defines the supported NE-DC only type of band combinations by the UE. | UE | No | No | No |
| ***supportedBandComibinationList-UplinkTxSwitch***  Defines the NR uplink CA/SUL band combinations and/or EN-DC band combinations supporting uplink Tx switching by the UE. | UE | No | No | No |
| ***supportedBandListNR***  Includes the supported NR bands as defined in TS 38.101-1 [2] and TS 38.101-2 [3]. | UE | Yes | No | No |
| ***uplinkSetEUTRA***  Indicates the features that the UE supports on the UL carriers corresponding to one EUTRA band entry in a band combination by FeatureSetEUTRA-UplinkId. The FeatureSetUplinkId = 0 means that the UE does not support a UL carrier in this band of a band combination. | Band | N/A | No | No |
| ***uplinkSetNR***  Indicates the features that the UE supports on the UL carriers corresponding to one NR band entry in a band combination by FeatureSetUplinkId. The FeatureSetUplinkId = 0 means that the UE does not support a UL carrier in this band of a band combination. A fallback per band feature set resulting from the reported UL feature set that has fallback per CC feature set is not signalled but the UE shall support it. | Band | N/A | No | No |

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