**3GPP TSG-RAN WG2 Meeting #110-e R2-200xxxx**

**1 June – 12 June 2020**

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| *CR-Form-v11.2.1* |
| **CHANGE REQUEST** |
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|  | **38.331** | **CR** | **1683** | **rev** | **1** | **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:***  |  UE Capability Enhancement for FR1(TDD/FDD) / FR2 CA and DC |
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| ***Source to WG:*** |  Qualcomm Incorporated |
| ***Source to TSG:*** |  R2 |
|  |  |
| ***Work item code:*** | NR\_newRAT-Core |  | ***Date:*** | 2020-06-01 |
|  |  |  |  |  |
| ***Category:*** | **A** |  | ***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 canbe 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)* |
|  |  |
| ***Reason for change:*** | **Current Signaling Limitation:** If UL CA on FDD TDD is supported by the UE then, currently there is no way for the network to distinguish between:* FDD(PCell) + TDD(SCell) and
* TDD(PCell) + FDD(SCell).

From a 3GPP perspective, network shall consider both combinations to be supported.The distinction between the two configurations is necessary as each configuration requires a separate interoperability testing. UE Capability is motivated to ensure that the network is aware of which feature(s) the UE has been tested as part of the interoperability tests.LTE had already introduced a per-UE capability ***tdd-FDD-CA-PCellDuplex*** in Rel. 12 to provide the same capability as shown above.  |
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| ***Summary of change:*** | The proposal adds 9 new per UE capability flavors to indicate which one is supported on the SpCell.CarrierAggregationVariant capability was added for (NG)EN-DC, NR SA, NR-DC and NE-DC with these variants: fr1fdd-FR1TDD-CA-SpCellOnFR1FDD fr1fdd-FR1TDD-CA-SpCellOnFR1TDD fr1fdd-FR2TDD-CA-SpCellOnFR1FDD fr1fdd-FR2TDD-CA-SpCellOnFR2TDD fr1tdd-FR2TDD-CA-SpCellOnFR1TDD fr1tdd-FR2TDD-CA-SpCellOnFR2TDD fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR1FDD fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR1TDD fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR2TDD**Impact Analysis:**Impacted 5G architecture options: (NG)EN-DC, NR SA, NE-DC, NR-DCImpacted functionality:Duplex mode of operation in CA.Interoperability issue:* if the network is implemented according to the CR and the UE is not,

network may assume that the UE support PCell/PSCell on any of the bands which has a FeatureSetUplink in the band combination.* if the UE is implemented according to the CR and the network is not,

The network may misconfigure the UE with PCell/PSCell on a band on which UE has not indicated support. |
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| ***Consequences if not approved:*** | UE may be deployed with a capability that has not been interoperability tested, resulting in undefined performance.  |
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| ***Clauses affected:*** | 6.3.3  |
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|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS/TR 38.306 CR 0346  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |

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| Start of changes |

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| Change 1 |

#### – *CarrierAggregationVariant*

The IE *CarrierAggregationVariant* informs the network about supported “placement” of the SpCell in an NR cell group.

*CarrierAggregationVariant* information element

-- ASN1START

-- TAG-CARRIERAGGREGATIONVARIANT-START

CarrierAggregationVariant ::= SEQUENCE {

 fr1fdd-FR1TDD-CA-SpCellOnFR1FDD ENUMERATED {supported} OPTIONAL,

 fr1fdd-FR1TDD-CA-SpCellOnFR1TDD ENUMERATED {supported} OPTIONAL,

 fr1fdd-FR2TDD-CA-SpCellOnFR1FDD ENUMERATED {supported} OPTIONAL,

 fr1fdd-FR2TDD-CA-SpCellOnFR2TDD ENUMERATED {supported} OPTIONAL,

 fr1tdd-FR2TDD-CA-SpCellOnFR1TDD ENUMERATED {supported} OPTIONAL,

 fr1tdd-FR2TDD-CA-SpCellOnFR2TDD ENUMERATED {supported} OPTIONAL,

 fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR1FDD ENUMERATED {supported} OPTIONAL,

 fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR1TDD ENUMERATED {supported} OPTIONAL,

 fr1fdd-FR1TDD-FR2TDD-CA-SpCellOnFR2TDD ENUMERATED {supported} OPTIONAL

}

-- TAG-CARRIERAGGREGATIONVARIANT-STOP

-- ASN1STOP

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| Change 2 |

– *Phy-Parameters*

The IE *Phy-Parameters* is used to convey the physical layer capabilities.

***Phy-Parameters* information element**

-- ASN1START

-- TAG-PHY-PARAMETERS-START

Phy-Parameters ::= SEQUENCE {

 phy-ParametersCommon Phy-ParametersCommon OPTIONAL,

 phy-ParametersXDD-Diff Phy-ParametersXDD-Diff OPTIONAL,

 phy-ParametersFRX-Diff Phy-ParametersFRX-Diff OPTIONAL,

 phy-ParametersFR1 Phy-ParametersFR1 OPTIONAL,

 phy-ParametersFR2 Phy-ParametersFR2 OPTIONAL

}

Phy-ParametersCommon ::= SEQUENCE {

 csi-RS-CFRA-ForHO ENUMERATED {supported} OPTIONAL,

 dynamicPRB-BundlingDL ENUMERATED {supported} OPTIONAL,

 sp-CSI-ReportPUCCH ENUMERATED {supported} OPTIONAL,

 sp-CSI-ReportPUSCH ENUMERATED {supported} OPTIONAL,

 nzp-CSI-RS-IntefMgmt ENUMERATED {supported} OPTIONAL,

 type2-SP-CSI-Feedback-LongPUCCH ENUMERATED {supported} OPTIONAL,

 precoderGranularityCORESET ENUMERATED {supported} OPTIONAL,

 dynamicHARQ-ACK-Codebook ENUMERATED {supported} OPTIONAL,

 semiStaticHARQ-ACK-Codebook ENUMERATED {supported} OPTIONAL,

 spatialBundlingHARQ-ACK ENUMERATED {supported} OPTIONAL,

 dynamicBetaOffsetInd-HARQ-ACK-CSI ENUMERATED {supported} OPTIONAL,

 pucch-Repetition-F1-3-4 ENUMERATED {supported} OPTIONAL,

 ra-Type0-PUSCH ENUMERATED {supported} OPTIONAL,

 dynamicSwitchRA-Type0-1-PDSCH ENUMERATED {supported} OPTIONAL,

 dynamicSwitchRA-Type0-1-PUSCH ENUMERATED {supported} OPTIONAL,

 pdsch-MappingTypeA ENUMERATED {supported} OPTIONAL,

 pdsch-MappingTypeB ENUMERATED {supported} OPTIONAL,

 interleavingVRB-ToPRB-PDSCH ENUMERATED {supported} OPTIONAL,

 interSlotFreqHopping-PUSCH ENUMERATED {supported} OPTIONAL,

 type1-PUSCH-RepetitionMultiSlots ENUMERATED {supported} OPTIONAL,

 type2-PUSCH-RepetitionMultiSlots ENUMERATED {supported} OPTIONAL,

 pusch-RepetitionMultiSlots ENUMERATED {supported} OPTIONAL,

 pdsch-RepetitionMultiSlots ENUMERATED {supported} OPTIONAL,

 downlinkSPS ENUMERATED {supported} OPTIONAL,

 configuredUL-GrantType1 ENUMERATED {supported} OPTIONAL,

 configuredUL-GrantType2 ENUMERATED {supported} OPTIONAL,

 pre-EmptIndication-DL ENUMERATED {supported} OPTIONAL,

 cbg-TransIndication-DL ENUMERATED {supported} OPTIONAL,

 cbg-TransIndication-UL ENUMERATED {supported} OPTIONAL,

 cbg-FlushIndication-DL ENUMERATED {supported} OPTIONAL,

 dynamicHARQ-ACK-CodeB-CBG-Retx-DL ENUMERATED {supported} OPTIONAL,

 rateMatchingResrcSetSemi-Static ENUMERATED {supported} OPTIONAL,

 rateMatchingResrcSetDynamic ENUMERATED {supported} OPTIONAL,

 bwp-SwitchingDelay ENUMERATED {type1, type2} OPTIONAL,

 ...,

 [[

 dummy ENUMERATED {supported} OPTIONAL

 ]],

 [[

 maxNumberSearchSpaces ENUMERATED {n10} OPTIONAL,

 rateMatchingCtrlResrcSetDynamic ENUMERATED {supported} OPTIONAL,

 maxLayersMIMO-Indication ENUMERATED {supported} OPTIONAL

 ]],

 [[

 spCellPlacement CarrierAggregationVariant OPTIONAL

 ]]

}

Phy-ParametersXDD-Diff ::= SEQUENCE {

 dynamicSFI ENUMERATED {supported} OPTIONAL,

 twoPUCCH-F0-2-ConsecSymbols ENUMERATED {supported} OPTIONAL,

 twoDifferentTPC-Loop-PUSCH ENUMERATED {supported} OPTIONAL,

 twoDifferentTPC-Loop-PUCCH ENUMERATED {supported} OPTIONAL,

 ...,

 [[

 dl-SchedulingOffset-PDSCH-TypeA ENUMERATED {supported} OPTIONAL,

 dl-SchedulingOffset-PDSCH-TypeB ENUMERATED {supported} OPTIONAL,

 ul-SchedulingOffset ENUMERATED {supported} OPTIONAL

 ]]

}

Phy-ParametersFRX-Diff ::= SEQUENCE {

 dynamicSFI ENUMERATED {supported} OPTIONAL,

 dummy1 BIT STRING (SIZE (2)) OPTIONAL,

 twoFL-DMRS BIT STRING (SIZE (2)) OPTIONAL,

 dummy2 BIT STRING (SIZE (2)) OPTIONAL,

 dummy3 BIT STRING (SIZE (2)) OPTIONAL,

 supportedDMRS-TypeDL ENUMERATED {type1, type1And2} OPTIONAL,

 supportedDMRS-TypeUL ENUMERATED {type1, type1And2} OPTIONAL,

 semiOpenLoopCSI ENUMERATED {supported} OPTIONAL,

 csi-ReportWithoutPMI ENUMERATED {supported} OPTIONAL,

 csi-ReportWithoutCQI ENUMERATED {supported} OPTIONAL,

 onePortsPTRS BIT STRING (SIZE (2)) OPTIONAL,

 twoPUCCH-F0-2-ConsecSymbols ENUMERATED {supported} OPTIONAL,

 pucch-F2-WithFH ENUMERATED {supported} OPTIONAL,

 pucch-F3-WithFH ENUMERATED {supported} OPTIONAL,

 pucch-F4-WithFH ENUMERATED {supported} OPTIONAL,

 pucch-F0-2WithoutFH ENUMERATED {notSupported} OPTIONAL,

 pucch-F1-3-4WithoutFH ENUMERATED {notSupported} OPTIONAL,

 mux-SR-HARQ-ACK-CSI-PUCCH-MultiPerSlot ENUMERATED {supported} OPTIONAL,

 uci-CodeBlockSegmentation ENUMERATED {supported} OPTIONAL,

 onePUCCH-LongAndShortFormat ENUMERATED {supported} OPTIONAL,

 twoPUCCH-AnyOthersInSlot ENUMERATED {supported} OPTIONAL,

 intraSlotFreqHopping-PUSCH ENUMERATED {supported} OPTIONAL,

 pusch-LBRM ENUMERATED {supported} OPTIONAL,

 pdcch-BlindDetectionCA INTEGER (4..16) OPTIONAL,

 tpc-PUSCH-RNTI ENUMERATED {supported} OPTIONAL,

 tpc-PUCCH-RNTI ENUMERATED {supported} OPTIONAL,

 tpc-SRS-RNTI ENUMERATED {supported} OPTIONAL,

 absoluteTPC-Command ENUMERATED {supported} OPTIONAL,

 twoDifferentTPC-Loop-PUSCH ENUMERATED {supported} OPTIONAL,

 twoDifferentTPC-Loop-PUCCH ENUMERATED {supported} OPTIONAL,

 pusch-HalfPi-BPSK ENUMERATED {supported} OPTIONAL,

 pucch-F3-4-HalfPi-BPSK ENUMERATED {supported} OPTIONAL,

 almostContiguousCP-OFDM-UL ENUMERATED {supported} OPTIONAL,

 sp-CSI-RS ENUMERATED {supported} OPTIONAL,

 sp-CSI-IM ENUMERATED {supported} OPTIONAL,

 tdd-MultiDL-UL-SwitchPerSlot ENUMERATED {supported} OPTIONAL,

 multipleCORESET ENUMERATED {supported} OPTIONAL,

 ...,

 [[

 csi-RS-IM-ReceptionForFeedback CSI-RS-IM-ReceptionForFeedback OPTIONAL,

 csi-RS-ProcFrameworkForSRS CSI-RS-ProcFrameworkForSRS OPTIONAL,

 csi-ReportFramework CSI-ReportFramework OPTIONAL,

 mux-SR-HARQ-ACK-CSI-PUCCH-OncePerSlot SEQUENCE {

 sameSymbol ENUMERATED {supported} OPTIONAL,

 diffSymbol ENUMERATED {supported} OPTIONAL

 } OPTIONAL,

 mux-SR-HARQ-ACK-PUCCH ENUMERATED {supported} OPTIONAL,

 mux-MultipleGroupCtrlCH-Overlap ENUMERATED {supported} OPTIONAL,

 dl-SchedulingOffset-PDSCH-TypeA ENUMERATED {supported} OPTIONAL,

 dl-SchedulingOffset-PDSCH-TypeB ENUMERATED {supported} OPTIONAL,

 ul-SchedulingOffset ENUMERATED {supported} OPTIONAL,

 dl-64QAM-MCS-TableAlt ENUMERATED {supported} OPTIONAL,

 ul-64QAM-MCS-TableAlt ENUMERATED {supported} OPTIONAL,

 cqi-TableAlt ENUMERATED {supported} OPTIONAL,

 oneFL-DMRS-TwoAdditionalDMRS-UL ENUMERATED {supported} OPTIONAL,

 twoFL-DMRS-TwoAdditionalDMRS-UL ENUMERATED {supported} OPTIONAL,

 oneFL-DMRS-ThreeAdditionalDMRS-UL ENUMERATED {supported} OPTIONAL

 ]],

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 pdcch-BlindDetectionNRDC SEQUENCE {

 pdcch-BlindDetectionMCG-UE INTEGER (1..15),

 pdcch-BlindDetectionSCG-UE INTEGER (1..15)

 } OPTIONAL,

 mux-HARQ-ACK-PUSCH-DiffSymbol ENUMERATED {supported} OPTIONAL

 ]]

}

Phy-ParametersFR1 ::= SEQUENCE {

 pdcch-MonitoringSingleOccasion ENUMERATED {supported} OPTIONAL,

 scs-60kHz ENUMERATED {supported} OPTIONAL,

 pdsch-256QAM-FR1 ENUMERATED {supported} OPTIONAL,

 pdsch-RE-MappingFR1-PerSymbol ENUMERATED {n10, n20} OPTIONAL,

 ...,

 [[

 pdsch-RE-MappingFR1-PerSlot ENUMERATED {n16, n32, n48, n64, n80, n96, n112, n128,

 n144, n160, n176, n192, n208, n224, n240, n256} OPTIONAL

 ]]

}

Phy-ParametersFR2 ::= SEQUENCE {

 dummy ENUMERATED {supported} OPTIONAL,

 pdsch-RE-MappingFR2-PerSymbol ENUMERATED {n6, n20} OPTIONAL,

 ...,

 [[

 pCell-FR2 ENUMERATED {supported} OPTIONAL,

 pdsch-RE-MappingFR2-PerSlot ENUMERATED {n16, n32, n48, n64, n80, n96, n112, n128,

 n144, n160, n176, n192, n208, n224, n240, n256} OPTIONAL

 ]]

}

-- TAG-PHY-PARAMETERS-STOP

-- ASN1STOP

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| ***Phy-ParametersFRX-Diff field description*** |
| ***csi-RS-IM-ReceptionForFeedback/ csi-RS-ProcFrameworkForSRS/ csi-ReportFramework***These fields are optionally present in *fr1-fr2-Add-UE-NR-Capabilities* in *UE-NR-Capability*. For a band combination comprised of FR1 and FR2 bands, these parameters, if present, limit the corresponding parameters in *MIMO-ParametersPerBand*. |

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| Change 3 |

– *Phy-ParametersMRDC*

The IE *Phy-ParametersMRDC* is used to convey physical layer capabilities for MR-DC.

***Phy-ParametersMRDC* information element**

-- ASN1START

-- TAG-PHY-PARAMETERSMRDC-START

Phy-ParametersMRDC ::= SEQUENCE {

 naics-Capability-List SEQUENCE (SIZE (1..maxNrofNAICS-Entries)) OF NAICS-Capability-Entry OPTIONAL,

 ... ,

 [[

 spCellPlacement CarrierAggregationVariant OPTIONAL

 ]]

}

NAICS-Capability-Entry ::= SEQUENCE {

 numberOfNAICS-CapableCC INTEGER(1..5),

 numberOfAggregatedPRB ENUMERATED {n50, n75, n100, n125, n150, n175, n200, n225,

 n250, n275, n300, n350, n400, n450, n500, spare},

 ...

}

-- TAG-PHY-PARAMETERSMRDC-STOP

-- ASN1STOP

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| ***PHY-ParametersMRDC* field descriptions** |
| ***naics-Capability-List***Indicates that UE in MR-DC supports NAICS as defined in TS 36.331 [10]. |

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| End of changes |