**3GPP TSG-RAN WG2 Meeting #117 electronic R2-22**

**Electronic Meeting, Feb 21– Mar 3, 2022**

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| --- |
| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **36.331** | **CR** | **draft** | **rev** | **-** | **Current version:** | **16.7.0** |  |
|  |
| *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:***  | Solution for random access issue on multiCarrier in NB-IoT |
|  |  |
| ***Source to WG:*** | CMCC |
| ***Source to TSG:*** | RAN2 |
|  |  |
| ***Work item code:*** | NB\_IOTenh4\_LTE\_eMTC6-Core |  | ***Date:*** | 2022-02-21 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | In real NB-IoT network, single-carrier cells are deployed to meet coverage requirements for most scenarios, and multi-carriers cells are deployed for concurrent service scenarios to meet capacity expansion requirements. The anchor carriers are deployed with inter frequency to reduce interference among cells, and it’s generally that the non-anchor carriers in one cell are deployed on the same frequency as the anchor carrier in the neighbour cells. The downlink narrowband reference-signal EPRE (Energy Per Resource Element) of the non-anchor carriers is generally lower relative to the downlink narrowband reference-signal EPRE of the anchor carrier to reduce the interference between the non-anchor carrier and the neighbour cells using the same frequency. Due to lower EPRE of non-anchor carrier than EPRE of anchor carrier, coverage of non-anchor carrier is shrunken than the anchor carrier. Non-anchor carrier suffered more UL interference from the same frequency neighborhood cell with uplink service terminals. This may degrade uplink performance. According to the actual coverage, there is the overlapping area that the UE’s CE levels is different between on the anchor carrier and non-anchor carriers, and CE level on the non-anchor carriers is usually worse than the CE level for the anchor carrier. The UE may fail to access to the non-anchor carrier or try more times to access to the non-anchor carrier with the nprach resource based on the anchor carrier’s CE level.  |
|  |  |
| ***Summary of change:*** | * add the RSRP Threshold for each non-anchor carrier in *SystemInformationBlockType22-NB* in 6.7.3.1
* add UE Capability *nonAnchorThresh-NPRACH-r16* in *UE-Capability-NB*
1. **Impact analysis**
2. Impacted functionality:
3. Random Access for multi-carriers
4. Inter-operability:

If the network implements the change but not the UE, there is no inter-operability issue.If the UE implements the change but not the network, there is no inter-operability issue.  |
|  |  |
| ***Consequences if not approved:*** | RSRP Threshold list for each non-anchor carrier for random access to determine UE’s CE level on non-anchor carrier may not be supported. |
|  |  |
| ***Clauses affected:*** | 6.7.3.1, 6.7.3.6 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **Y** | **X** |  Other core specifications  | TS/TR ... 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:*** |  |

*Start of Change*

6.7.3 NB-IoT information elements

6.7.3.1 NB-IoT System information blocks

/\*partially omitted\*/

#### – *SystemInformationBlockType22-NB*

The IE *SystemInformationBlockType22-NB* contains radio resource configuration for paging and random access procedure on non-anchor carriers.

*SystemInformationBlockType22-NB* information element

-- ASN1START

SystemInformationBlockType22-NB-r14 ::= SEQUENCE {

 dl-ConfigList-r14 DL-ConfigCommonList-NB-r14 OPTIONAL, -- Need OR

 ul-ConfigList-r14 UL-ConfigCommonList-NB-r14 OPTIONAL, -- Need OR

 pagingWeightAnchor-r14 PagingWeight-NB-r14 OPTIONAL, -- Cond pcch-config

 nprach-ProbabilityAnchorList-r14 NPRACH-ProbabilityAnchorList-NB-r14 OPTIONAL, -- Cond nprach-config

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 ...,

 [[ mixedOperationModeConfig-r15 SEQUENCE {

 dl-ConfigListMixed-r15 DL-ConfigCommonList-NB-r14 OPTIONAL, -- Cond dl-ConfigList

 ul-ConfigListMixed-r15 UL-ConfigCommonList-NB-r14 OPTIONAL, -- Cond ul-ConfigList

 pagingDistribution-r15 ENUMERATED {true} OPTIONAL, -- Need OR

 nprach-Distribution-r15 ENUMERATED {true} OPTIONAL -- Need OR

 } OPTIONAL, -- Need OR

 ul-ConfigList-r15 UL-ConfigCommonListTDD-NB-r15 OPTIONAL -- Cond TDD

 ]]

}

DL-ConfigCommonList-NB-r14 ::= SEQUENCE (SIZE (1.. maxNonAnchorCarriers-NB-r14)) OF

 DL-ConfigCommon-NB-r14

UL-ConfigCommonList-NB-r14 ::= SEQUENCE (SIZE (1.. maxNonAnchorCarriers-NB-r14)) OF

 UL-ConfigCommon-NB-r14

UL-ConfigCommonListTDD-NB-r15 ::= SEQUENCE (SIZE (1.. maxNonAnchorCarriers-NB-r14)) OF

 UL-ConfigCommonTDD-NB-r15

DL-ConfigCommon-NB-r14 ::= SEQUENCE {

 dl-CarrierConfig-r14 DL-CarrierConfigCommon-NB-r14,

 pcch-Config-r14 PCCH-Config-NB-r14 OPTIONAL, -- Need OR

 ...,

 [[ wus-Config-r15 WUS-ConfigPerCarrier-NB-r15 OPTIONAL -- Cond WUS

 ]],

 [[ gwus-Config-r16 WUS-ConfigPerCarrier-NB-r15 OPTIONAL -- Cond GWUS

 ]]

}

PCCH-Config-NB-r14 ::= SEQUENCE {

 npdcch-NumRepetitionPaging-r14 ENUMERATED {

 r1, r2, r4, r8, r16, r32, r64, r128,

 r256, r512, r1024, r2048,

 spare4, spare3, spare2, spare1} OPTIONAL, -- Need OP

 pagingWeight-r14 PagingWeight-NB-r14 DEFAULT w1,

 ...

}

PagingWeight-NB-r14 ::= ENUMERATED {w1, w2, w3, w4, w5, w6, w7, w8,

 w9, w10, w11, w12, w13, w14, w15, w16}

UL-ConfigCommon-NB-r14 ::= SEQUENCE {

 ul-CarrierFreq-r14 CarrierFreq-NB-r13,

 nprach-ParametersList-r14 NPRACH-ParametersList-NB-r14 OPTIONAL, -- Need OR

 ...,

 [[ nprach-ParametersListEDT-r15 NPRACH-ParametersList-NB-r14 OPTIONAL -- Cond EDT

 ]]

 [[ rsrp-ThresholdsPrach-NonAnchorInfoList-v16xy RSRP-ThresholdsNPRACH-InfoList-NB-r13 OPTIONAL, -- Need OR

 ]]

}

UL-ConfigCommonTDD-NB-r15 ::= SEQUENCE {

 tdd-UL-DL-AlignmentOffset-r15 TDD-UL-DL-AlignmentOffset-NB-r15,

 nprach-ParametersListTDD-r15 NPRACH-ParametersListTDD-NB-r15 OPTIONAL, -- Need OR

 ...

}

NPRACH-ProbabilityAnchorList-NB-r14 ::= SEQUENCE (SIZE (1.. maxNPRACH-Resources-NB-r13)) OF

 NPRACH-ProbabilityAnchor-NB-r14

NPRACH-ProbabilityAnchor-NB-r14 ::= SEQUENCE {

 nprach-ProbabilityAnchor-r14 ENUMERATED {

 zero, oneSixteenth, oneFifteenth, oneFourteenth,

 oneThirteenth, oneTwelfth, oneEleventh, oneTenth,

 oneNinth, oneEighth, oneSeventh, oneSixth,

 oneFifth, oneFourth, oneThird, oneHalf}

 OPTIONAL -- Need OP

}

-- ASN1STOP

| *SystemInformationBlockType22-NB* field descriptions |
| --- |
| ***dl-CarrierConfig***For FDD: Provides the configuration of the DL non-anchor carrier.For TDD: Provides the configuration of the non-anchor carrier. |
| ***dl-ConfigList, dl-ConfigListMixed***For FDD: List of DL non-anchor carriers and associated configuration that can be used for paging and/or random access. E-UTRAN configures DL non-anchor carriers operating in mixed operation mode only in *dl-ConfigListMixed* and only a UE that supports mixed operation mode uses the carriers in *dl-ConfigListMixed*. A given carrier is either signalled in the *dl-ConfigList* or in *dl-ConfigListMixed*.If *dl-ConfigListMixed* is present and at least one of the carriers in *dl-ConfigListMixed* is configured for paging:- If *pagingDistribution* is present, the UE supporting mixed operation mode creates a combined list of DL carriers for paging by appending *dl-ConfigListMixed* to the *dl-ConfigList* while maintaining the order among *dl-ConfigList* and *dl-ConfigListMixed*; the total number of signalled DL non-anchor carriers cannot be more than *maxNonAnchorCarriers-NB-r14*.- If *pagingDistribution* is absent, the UE supporting mixed operation mode uses the list of DL carriers for paging provided in *dl-ConfigListMixed* and considers *pagingWeightAncho*r being set to w0, i.e. the anchor carrier is not used*.*Otherwise, the *pagingDistribution* field is not applicable and the UE shall ignore the value.For TDD: List of non-anchor carriers and associated configuration that can be used for paging and/or random access. |
| ***gwus-Config***For FDD: Carrier specific GWUS Configuration.If both *gwus-Config* and *wus-Config* are present for the carrier, E-UTRAN configures the same value for both fields. |
| ***mixedOperationModeConfig***For FDD: Provides the configuration of DL and UL non-anchor carriers that can be used for paging and random access by a UE that supports mixed operation mode.For TDD: This parameter is absent. |
| ***npdcch-NumRepetitionPaging***Maximum number of repetitions for NPDCCH common search space (CSS) for paging, see TS 36.213 [23], clause 16.6.If the field is absent, the value *of npdcch-NumRepetitionPaging* configured in *SystemInformationBlockType2-NB* in IE *pcch-Config* applies. |
| ***nprach-Distribution***Indicates which UL carriers a UE supporting mixed operation mode uses for random access as defined in description of *ul-ConfigList, ul-ConfigListMixed*.  |
| ***nprach-ParametersList, nprach-ParametersList-EDT***Configure NPRACH parameters for each NPRACH resource on one non-anchor UL carrier. Up to three NPRACH resources can be configured on one non-anchor UL carrier. Each NPRACH resource is associated with a different number of NPRACH repetitions.NPRACH resources in *nprach-ParametersListEDT* are used to initiateEDT. Each NPRACH resource is associated with a maximum TBS signalled in the corresponding entry of *edt-TBS-InfoList* in *SystemInformationBlockType2-NB*.E-UTRAN includes the same number of entries, and listed in the same order, as in *nprach-ParametersList* in *SystemInformationBlockType2-NB*. |
| ***nprach-ParametersListTDD***For TDD: Configure NPRACH parameters for each NPRACH resource on one non-anchor UL carrier. Up to three NPRACH resources can be configured on one non-anchor UL carrier. Each NPRACH resource is associated with a different number of NPRACH repetitions.E-UTRAN includes the same number of entries in *nprach-ParametersListTDD*, and listed in the same order, as in *nprach-ParametersListTDD* in *SystemInformationBlockType2-NB*.. |
| ***nprach-ProbabilityAnchor***Configure the selection probability for the anchor carrier NPRACH resource, see TS 36.321 [6]. Value zero corresponds to a probability of 0, oneSixteenth corresponds to the probability of 1/16, oneFifteenth corresponds to the probability of 1/15, and so on.If the field is absent, the selection probability of the anchor carrier NPRACH resource is 1.All non-anchor carriers NPRACH resources have equal probability between them.If there is no NPRACH resource defined on the anchor carrier for one repetition level in *nprach-ParametersList-EDT*, (respectively *nprach-ParametersListFmt2*, *nprach-ParametersListFmt2-EDT*), the UE shall use the value 'zero' and ignore the signalled value of *nprach-ProbabilityAnchor* for this repetition level for the NPRACH resources defined by *nprach-ParametersList-EDT* (respectively *nprach-ParametersListFmt2*, *nprach-ParametersListFmt2-EDT*). |
| ***nprach-ProbabilityAnchorList***Configures the selection probability for each NPRACH resource on the anchor carrier.E-UTRAN includes the same number of entries, and listed in the same order, as in *nprach-ParametersList* in *SystemInformationBlockType2-NB.* |
| ***pagingDistribution***Indicates which DL carriers a UE supporting mixed operation mode monitors for paging as defined in description of *dl-ConfigList, dl-ConfigListMixed*. |
| ***pagingWeight***Weight of the non-anchor paging carrier for uneven paging load distribution across the carriers. Value w1 corresponds to a relative weight of 1, w2 corresponds to a relative weight of 2, and so on.The paging load for a carrier 'i' is equal to w(i)/W where i is equal to 0 for the anchor carrier and equal to the index of the carrier in the *dl-ConfigList* / *dl-ConfigListMixed* for a non-anchor carrier, W is the sum of the weights of all paging carriers.To avoid correlation between paging carrier and paging occasion, the weights should be assigned such that: nB \* W <= 16384. |
| ***pagingWeightAnchor***Weight of the anchor carrier for uneven paging load distribution across the carriers. Value w1 corresponds to a relative weight of 1, w2 corresponds to a relative weight of 2, and so on.If the field is absent, the (default) value of w0 is applied, i.e. the anchor carrier is not used for paging. |
| ***pcch-Config***Configure the PCCH parameters for the non-anchor DL carrier. |
| ***rsrp-ThresholdsPrach-NonAnchorInfoList***The criterion for UEs to select a NPRACH resource on the non-Anchor carriers. Up to 2 RSRP threshold values can be signalled. The first element corresponds to RSRP threshold 1, the second element corresponds to RSRP threshold 2. See TS 36.321 [6]. If absent, there is only one NPRACH resource. The number of RSRP threshold for the non-anchor carrier is the same as the number of RSRP threshold defined by rsrp-ThresholdsPrachInfoList-r13 in SIB2.A UE that supports *powerClassNB-14dBm-r14* shall correct the RSRP threshold values before applying them as follows:RSRP threshold = Signalled RSRP threshold - min{0, (14-min(23, P-Max))} where P-Max*:*is the value of *p-Max* field in *SystemInformationBlockType1-NB.* |
| ***tdd-UL-DL-AlignmentOffset***Indicates the offset between the UL carrier frequency center with respect to DL carrier frequency center for the non-anchor carrier. |
| ***ul-CarrierFreq***For FDD: UL carrier frequency of the non-anchor carrier as defined in TS 36.101 [42], clause 5.7.3F.For TDD: This field is absent and the uplink carrier frequency is same as the downlink frequency. |
| ***ul-ConfigList, ul-ConfigListMixed***For FDD: List of UL non-anchor carriers and associated configuration that can be used for random access. E-UTRAN configures UL non-anchor carriers operating in mixed operation mode only in *ul-ConfigListMixed* and only a UE that supports mixed operation mode uses the carriers in *ul-ConfigListMixed*. A given carrier is either signalled in the *ul-ConfigList* or in *ul-ConfigListMixed*.If *ul-ConfigListMixed* is present and at least one of the carriers in *ul-ConfigListMixed* is configured for random access:- If *nprach-Distribution* is present, the UE supporting mixed operation mode creates a combined list of UL carriers for random access by appending *ul-ConfigListMixed* to the *ul-ConfigList* while maintaining the order among both *ul-ConfigList* and *ul-ConfigListMixed*; the total number of signalled UL non-anchor carriers cannot be more than *maxNonAnchorCarriers-NB-r14*.- If *nprach-Distribution* is absent, the UE supporting mixed operation mode uses the list of UL carriers for random access provided in *ul-ConfigListMixed* and considers *nprach-ProbabiliyAnchor* being set to zero for each NPRACH resource, i.e. the anchor carrier is not used for random access*.*Otherwise, the *nprach-Distribution* field is not applicable and the UE shall ignore the value.For TDD: E-UTRAN configures *ul-ConfigList-r15* and includes the same number of entries as in *dl-ConfigList*. The UL carrier frequency of the non-anchor carrier is same as the DL carrier frequency. |
| ***wus-Config***For FDD: Carrier specific WUS Configuration. |

| Conditional presence | Explanation |
| --- | --- |
| *dl-ConfigList* | This field is optionally present, Need OR, if the field *dl-ConfigList* is present. Otherwise the field is not present. |
| *EDT* | The field is optionally present, Need OR, if *edt-Parameters* in *SystemInformationBlockType2-NB* is present; otherwise the field is not present and the UE shall delete any existing value for this field. |
| *GWUS* | This field is optionally present, Need OR, if g*wus-Config-r16* is present in *SystemInformationBlockType2-NB*. Otherwise the field is not present. |
| *pcch-config* | This field is optionally present, Need OP, if the field *dl-ConfigList* is present and at least one of the carriers in *dl-ConfigList* is configured for paging. Otherwise the field is not present and only the anchor carrier is used for paging. |
| *nprach-config* | This field is mandatory present, if the field *ul-ConfigList* is present and at least one of the carriers in *ul-ConfigList* is configured for random access. Otherwise the field is not present and only the anchor carrier is used for random access. |
| *TDD* | This field is optionally present, Need OR, for TDD. Otherwise the field is not present. |
| *ul-ConfigList* | This field is optionally present, Need OR, if the field *ul-ConfigList* is present. Otherwise the field is not present. |
| *WUS* | This field is mandatory present, if the field *wus-Config* is present in *SystemInformationBlockType2-NB*. Otherwise the field is not present, Need OR. |

*Next Change*

6.7.3.6 NB-IoT Other information elements

/\*partially omitted\*/

#### – *UE-Capability-NB*

The IE *UE-Capability-NB* is used to convey the NB-IoT UE Radio Access Capability Parameters, see TS 36.306 [5]. The IE *UE-Capability-NB* is transferred in NB-IoT only.

*UE-Capability-NB* information element

-- ASN1START

UE-Capability-NB-r13 ::= SEQUENCE {

 accessStratumRelease-r13 AccessStratumRelease-NB-r13,

 ue-Category-NB-r13 ENUMERATED {nb1} OPTIONAL,

 multipleDRB-r13 ENUMERATED {supported} OPTIONAL,

 pdcp-Parameters-r13 PDCP-Parameters-NB-r13 OPTIONAL,

 phyLayerParameters-r13 PhyLayerParameters-NB-r13,

 rf-Parameters-r13 RF-Parameters-NB-r13,

 dummy SEQUENCE {} OPTIONAL

}

UE-Capability-NB-Ext-r14-IEs ::= SEQUENCE {

 ue-Category-NB-r14 ENUMERATED {nb2} OPTIONAL,

 mac-Parameters-r14 MAC-Parameters-NB-r14 OPTIONAL,

 phyLayerParameters-v1430 PhyLayerParameters-NB-v1430 OPTIONAL,

 rf-Parameters-v1430 RF-Parameters-NB-v1430,

 nonCriticalExtension UE-Capability-NB-v1440-IEs OPTIONAL

}

UE-Capability-NB-v1440-IEs ::= SEQUENCE {

 phyLayerParameters-v1440 PhyLayerParameters-NB-v1440 OPTIONAL,

 nonCriticalExtension UE-Capability-NB-v14x0-IEs OPTIONAL

}

UE-Capability-NB-v14x0-IEs ::= SEQUENCE {

-- Following field is only to be used for late REL-14 extensions

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension UE-Capability-NB-v1530-IEs OPTIONAL

}

UE-Capability-NB-v1530-IEs ::= SEQUENCE {

 earlyData-UP-r15 ENUMERATED {supported} OPTIONAL,

 rlc-Parameters-r15 RLC-Parameters-NB-r15,

 mac-Parameters-v1530 MAC-Parameters-NB-v1530,

 phyLayerParameters-v1530 PhyLayerParameters-NB-v1530 OPTIONAL,

 tdd-UE-Capability-r15 TDD-UE-Capability-NB-r15 OPTIONAL,

 nonCriticalExtension UE-Capability-NB-v15x0-IEs OPTIONAL

}

UE-Capability-NB-v15x0-IEs ::= SEQUENCE {

-- Following field is only to be used for late REL-15 extensions

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension UE-Capability-NB-v1610-IEs OPTIONAL

}

UE-Capability-NB-v1610-IEs ::= SEQUENCE {

 earlySecurityReactivation-r16 ENUMERATED {supported} OPTIONAL,

 earlyData-UP-5GC-r16 ENUMERATED {supported} OPTIONAL,

 pur-Parameters-r16 PUR-Parameters-NB-r16 OPTIONAL,

 mac-Parameters-v1610 MAC-Parameters-NB-v1610,

 phyLayerParameters-v1610 PhyLayerParameters-NB-v1610 OPTIONAL,

 son-Parameters-r16 SON-Parameters-NB-r16 OPTIONAL,

 meas-Parameters-r16 Meas-Parameters-NB-r16,

 tdd-UE-Capability-v1610 TDD-UE-Capability-NB-v1610 OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

TDD-UE-Capability-NB-r15 ::= SEQUENCE {

 ue-Category-NB-r15 ENUMERATED {nb2} OPTIONAL,

 phyLayerParametersRel13-r15 PhyLayerParameters-NB-r13 OPTIONAL,

 phyLayerParametersRel14-r15 PhyLayerParameters-NB-v1430 OPTIONAL,

 phyLayerParameters-v1530 PhyLayerParameters-NB-v1530 OPTIONAL,

 ...

}

TDD-UE-Capability-NB-v1610 ::= SEQUENCE {

 slotSymbolResourceResvDL-r16 ENUMERATED {supported} OPTIONAL,

 slotSymbolResourceResvUL-r16 ENUMERATED {supported} OPTIONAL,

 subframeResourceResvDL-r16 ENUMERATED {supported} OPTIONAL,

 subframeResourceResvUL-r16 ENUMERATED {supported} OPTIONAL

}

AccessStratumRelease-NB-r13 ::= ENUMERATED {rel13, rel14, rel15, rel16, spare4, spare3, spare2, spare1, ...}

PDCP-Parameters-NB-r13 ::= SEQUENCE {

 supportedROHC-Profiles-r13 SEQUENCE {

 profile0x0002 BOOLEAN,

 profile0x0003 BOOLEAN,

 profile0x0004 BOOLEAN,

 profile0x0006 BOOLEAN,

 profile0x0102 BOOLEAN,

 profile0x0103 BOOLEAN,

 profile0x0104 BOOLEAN

 },

 maxNumberROHC-ContextSessions-r13 ENUMERATED {cs2, cs4, cs8, cs12} DEFAULT cs2,

 ...

}

RLC-Parameters-NB-r15 ::= SEQUENCE {

 rlc-UM-r15 ENUMERATED {supported} OPTIONAL

}

MAC-Parameters-NB-r14 ::= SEQUENCE {

 dataInactMon-r14 ENUMERATED {supported} OPTIONAL,

 rai-Support-r14 ENUMERATED {supported} OPTIONAL

}

MAC-Parameters-NB-v1530 ::= SEQUENCE {

 sr-SPS-BSR-r15 ENUMERATED {supported} OPTIONAL

}

MAC-Parameters-NB-v1610 ::= SEQUENCE {

 rai-SupportEnh-r16 ENUMERATED {supported} OPTIONAL

}

Meas-Parameters-NB-r16 ::= SEQUENCE {

 dl-ChannelQualityReporting-r16 ENUMERATED {supported} OPTIONAL

}

PhyLayerParameters-NB-r13 ::= SEQUENCE {

 multiTone-r13 ENUMERATED {supported} OPTIONAL,

 multiCarrier-r13 ENUMERATED {supported} OPTIONAL

 }

PhyLayerParameters-NB-v1430 ::= SEQUENCE {

 multiCarrier-NPRACH-r14 ENUMERATED {supported} OPTIONAL,

 twoHARQ-Processes-r14 ENUMERATED {supported} OPTIONAL

}

PhyLayerParameters-NB-v1440 ::= SEQUENCE {

 interferenceRandomisation-r14 ENUMERATED {supported} OPTIONAL

}

PhyLayerParameters-NB-v1530 ::= SEQUENCE {

 mixedOperationMode-r15 ENUMERATED {supported} OPTIONAL,

 sr-WithHARQ-ACK-r15 ENUMERATED {supported} OPTIONAL,

 sr-WithoutHARQ-ACK-r15 ENUMERATED {supported} OPTIONAL,

 nprach-Format2-r15 ENUMERATED {supported} OPTIONAL,

 additionalTransmissionSIB1-r15 ENUMERATED {supported} OPTIONAL,

 npusch-3dot75kHz-SCS-TDD-r15 ENUMERATED {supported} OPTIONAL

}

PhyLayerParameters-NB-v1610 ::= SEQUENCE {

 npdsch-MultiTB-r16 ENUMERATED {supported} OPTIONAL,

 npdsch-MultiTB-Interleaving-r16 ENUMERATED {supported} OPTIONAL,

 npusch-MultiTB-r16 ENUMERATED {supported} OPTIONAL,

 npusch-MultiTB-Interleaving-r16 ENUMERATED {supported} OPTIONAL,

 multiTB-HARQ-AckBundling-r16 ENUMERATED {supported} OPTIONAL,

 slotSymbolResourceResvDL-r16 ENUMERATED {supported} OPTIONAL,

 slotSymbolResourceResvUL-r16 ENUMERATED {supported} OPTIONAL,

 subframeResourceResvDL-r16 ENUMERATED {supported} OPTIONAL,

 subframeResourceResvUL-r16 ENUMERATED {supported} OPTIONAL

}

PhyLayerParameters-NB-v16xy ::= SEQUENCE {

 nonAnchorThresh-NPRACH-r16 ENUMERATED {supported} OPTIONAL

}

PUR-Parameters-NB-r16 ::= SEQUENCE {

 pur-CP-EPC-r16 ENUMERATED {supported} OPTIONAL,

 pur-CP-5GC-r16 ENUMERATED {supported} OPTIONAL,

 pur-UP-EPC-r16 ENUMERATED {supported} OPTIONAL,

 pur-UP-5GC-r16 ENUMERATED {supported} OPTIONAL,

 pur-NRSRP-Validation-r16 ENUMERATED {supported} OPTIONAL,

 pur-CP-L1Ack-r16 ENUMERATED {supported} OPTIONAL

}

RF-Parameters-NB-r13 ::= SEQUENCE {

 supportedBandList-r13 SupportedBandList-NB-r13,

 multiNS-Pmax-r13 ENUMERATED {supported} OPTIONAL

}

RF-Parameters-NB-v1430 ::= SEQUENCE {

 powerClassNB-14dBm-r14 ENUMERATED {supported} OPTIONAL

}

SupportedBandList-NB-r13 ::= SEQUENCE (SIZE (1..maxBands)) OF SupportedBand-NB-r13

SupportedBand-NB-r13 ::= SEQUENCE {

 band-r13 FreqBandIndicator-NB-r13,

 powerClassNB-20dBm-r13 ENUMERATED {supported} OPTIONAL

}

SON-Parameters-NB-r16 ::= SEQUENCE {

 anr-Report-r16 ENUMERATED {supported} OPTIONAL,

 rach-Report-r16 ENUMERATED {supported} OPTIONAL

}

-- ASN1STOP

| *UE-Capability-NB* field descriptions | *FDD/TDD appl* | *FDD/TDD diff* |
| --- | --- | --- |
| ***accessStratumRelease***Set to rel16 in this version of the specification. | FDD/TDD | No |
| ***additionalTransmissionSIB1***Indicates whether the UE supports additional SIB1 transmission as specified in TS 36.213 [23]. | FDD | - |
| ***anr-Report***Indicates whether the UE supports ANR measurements in RRC\_IDLE. | FDD/TDD | No |
| ***dataInactMon***Indicates whether the UE supports the data inactivity monitoring as specified in TS 36.321 [6]. | FDD/TDD | No |
| ***dl-ChannelQualityReporting-r16***Indicates whether the UE supports DL channel quality reporting in connected mode as specified in TS 36.321 [6]. | FDD | - |
| ***dummy***This field is not used in the specification. It shall not be sent by the UE. | NA | NA |
| ***earlyData-UP, earlyData-UP-5GC***Indicates whether the UE supports EDT for User plane CIoT EPS/5GS optimisations, as defined in TS 24.301 [35] and 24.501 [95] respectively. | FDD | - |
| ***earlySecurityReactivation***Indicates whether the UE supports early security reactivation when resuming a suspended RRC connection. | FDD/TDD | No |
| ***interferenceRandomisation***For FDD: Indicates whether the UE supports interference randomisation in connected mode as defined in TS.36.211 [21]. | FDD | - |
| ***maxNumberROHC-ContextSessions***Set to the maximum number of concurrently active ROHC contexts supported by the UE, excluding context sessions that leave all headers uncompressed. cs2 corresponds with 2 (context sessions), cs4 corresponds with 4 and so on. The network ignores this field if the UE supports none of the ROHC profiles in *supportedROHC-Profiles*. | FDD/TDD | No |
| ***mixedOperationMode***Defines whether the UE supports multi-carrier operation with mixed operation mode, standalone or inband/guardband, between the anchor carrier and the non-anchor carrier for unicast, paging, and random access as specified in TS 36.300 [9]. | FDD | - |
| ***multiCarrier***Defines whether the UE supports multi -carrier operation. | FDD/TDD | Yes |
| ***multicarrier-NPRACH***Defines whether the UE supports NPRACH on non-anchor carrier as specified in TS 36.321 [6]. | FDD/TDD | Yes |
| ***multipleDRB***Defines whether the UE supports multiple DRBs. | FDD/TDD | No |
| ***multiNS-Pmax***Defines whether the UE supports the mechanisms defined for NB-IoT cells broadcasting *NS-PmaxList-NB*. | FDD/TDD | No |
| ***multiTB-HARQ-AckBundling***Indicates whether the UE supports HARQ ACK bundling for interleaved transmission for DL.If *multiTB-HARQ-AckBundling* is included, the UE shall also indicate support for *npdsch-MultiTB-Interleaving*. | FDD | - |
| ***multiTone***Defines whether the UE supports UL multi-tone transmissions on NPUSCH. | FDD/TDD | Yes |
| ***nonAnchorThresh-NPRACH-r16***Indicates whether the UE supports RSRP Threshold list for each non-anchor carrier for random access to determine UE’s CE level on non-anchor carrier and to exclude the non-anchor carriers with larger CEL than the anchor carrier when building the list of NPRACH resources, as specified in TS 36.321[6]. | FDD/TDD | Yes |
| ***npdsch-MultiTB***Indicates whether the UE supports multiple TBs scheduling in RRC\_CONNECTED for DL.If *npdsch-MultiTB* is included, the UE shall also indicate support for *twoHARQ-Processes*. | FDD | - |
| ***npdsch-MultiTB-Interleaving***Indicates whether the UE supports interleaved transmission when multiple TBs is scheduled in RRC\_CONNECTED for DL. | FDD | - |
| ***nprach-Format2***Defines whether the UE supports NPRACH resources using preamble format 2. | FDD | - |
| ***npusch-3dot75kHz-SCS-TDD***Indicates whether the UE supports NPUSCH with 3.75kHz SCS for TDD. | TDD | - |
| ***npusch-MultiTB***Indicates whether the UE supports multiple TBs scheduling in RRC\_CONNECTED for UL.If *npusch-MultiTB* is included, the UE shall also indicate support for *twoHARQ-Processes*. | FDD | - |
| ***npusch-MultiTB-Interleaving***Indicates whether the UE supports interleaved transmission when multiple TBs is scheduled in RRC\_CONNECTED for UL. | FDD | - |
| ***powerClassNB-14dBm***Defines whether the UE supports power class 14dBm in all the bands supported by the UE as specified in TS 36.101 [42].If *powerClassNB-20dBm* is included, the UE shall not include the field *powerClassNB-14dBm*. | FDD/TDD | No |
| ***powerClassNB-20dBm***Defines whether the UE supports power class 20dBm in NB-IoT for the band, as specified in TS 36.101 [42]. If neither *powerClassNB-14dBm* nor *powerClassNB-20dBm* is included, UE supports power class 23 dBm in the NB-IoT band. | FDD/TDD | No |
| ***pur-CP-EPC*, *pur-CP-5GC***Indicates whether the UE supports transmission using PUR for Control plane CIoT EPS/5GS optimisations, as defined in TS 24.301 [35] and TS 24.501 [95] respectively. | FDD | - |
| ***pur-CP-L1Ack***Indicates whether UE supports L1 acknowledgement in response to CP transmission using PUR.If *pur-CP-L1Ack* is included, the UE shall also indicate support for *pur-CP-EPC* or *pur-CP-5GC*. | FDD | - |
| ***pur-NRSRP-Validation***Indicates whether UE supports serving cell NRSRP for TA validation for transmission using PUR.If *pur-NRSRP-Validation* is included, the UE shall also indicate support for *pur-CP-EPC*, *pur-CP-5GC*, *pur-UP-EPC* or *pur-CP-5GC*. | FDD | - |
| ***pur-UP-EPC*, *pur-UP-5GC***Indicates whether the UE supports transmission using PUR for User plane CIoT EPS/5GS optimisations, as defined in TS 24.301 [35] and TS 24.501 [95] repectively. | FDD | - |
| ***rach-Report***Indicates whether the UE supports delivery of *rach-Report*. | FDD/TDD | No |
| ***rai-Support***Defines whether the UE supports release assistance indication (RAI) as specified in TS 36.321 [6]. | FDD/TDD | No |
| ***rai-SupportEnh***Indicates whether the UE supports AS Release Assistance Indication via the DCQR and AS RAI MAC CE when connected to EPC as specified in TS 36.321 [6]. | FDD/TDD | No |
| ***rlc-UM***Defines whether the UE supports RLC UM as specified in TS 36.322 [7]. | FDD/TDD | No |
| ***slotSymbolResourceResvDL***Indicates whether the UE supports slot/symbol-level time-domain DL resource reservation, e.g. for NB-IoT coexistence with NR.If *slotSymbolResourceResvDL* is included, the UE shall also indicate support for *subframeResourceResvDL*. | FDD/TDD | Yes |
| ***slotSymbolResourceResvUL***Indicates whether the UE supports slot/symbol-level time-domain UL resource reservation, e.g. for NB-IoT coexistence with NR.If *slotSymbolResourceResvUL* is included, the UE shall also indicate support for *subframeResourceResvUL*. | FDD/TDD | Yes |
| ***supportedBandList***Includes the supported NB-IoT bands as defined in TS 36.101 [42]. | FDD/TDD | No |
| ***sr-SPS-BSR*** Defines whether the UE supports SR using SPS BSR as specified in TS 36.321 [6]. | FDD | - |
| ***sr-withHARQ-ACK*** Defines whether the UE supports physical layer SR with HARQ ACK as specified in TS 36.213 [23]. | FDD | - |
| ***sr-withoutHARQ-ACK*** Defines whether the UE supports physical layer SR without HARQ ACK as specified in TS 36.211 [21] and TS 36.213 [23]. | FDD | - |
| ***subframeResourceResvDL***Indicates whether the UE supports subframe-level time-domain DL resource reservation, e.g. for NB-IoT coexistence with NR. | FDD/TDD | Yes |
| ***subframeResourceResvUL***Indicates whether the UE supports subframe-level time-domain UL resource reservation, e.g. for NB-IoT coexistence with NR. | FDD/TDD | Yes |
| ***supportedROHC-Profiles***List of supported ROHC profiles as defined in TS 36.323 [8]. | FDD/TDD | No |
| ***twoHARQ-Processes***Defines whether the UE supports two HARQ processes operation in DL and UL as specified in TS 36.212 [22] and TS 36.213 [23]. | FDD/TDD | Yes |
| ***ue-Category-NB***UE category as defined in TS 36.306 [5]. Value nb1 corresponds to UE category NB1, value nb2 corresponds to UE category NB2.A UE shall always include the field *ue-Category-NB-r13* in this version of the specification. | FDD/TDD | Yes |

NOTE 1: The IE *UE-Capability-NB* does not include AS security capability information, since these are the same as the security capabilities that are signalled by NAS. Consequently AS need not provide "man-in-the-middle" protection for the security capabilities.

NOTE 2: The column 'FDD/TDD appl' indicates the applicability to the xDD mode: 'FDD' means applicable to FDD only, 'TDD' means applicable to TDD only and 'FDD/TDD' means applicable to FDD and TDD.

NOTE 3: The column 'FDD/TDD diff' indicates if the UE is allowed to signal a different value for FDD and TDD when the capability applies to both FDD and TDD modes. '-' is used when the capability applies to one mode only, 'No' is used for dual mode capabilities where a common value is signalled for both modes, and 'Yes' is used for dual mode capabilities where a separate value is signalled for each mode. Common capabilities and FDD capabilities are reported in the fields of *UE-Capability-NB* except field *tdd-UE-Capability.* TDD capabilities are reported in *tdd-UE-Capability*.

*End of Change*