**3GPP TSG-RAN WG2 Meeting #117 electronic R2-220**

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

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **36.331** | **CR** | **4777** | **rev** | **-(to be 1)** | **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:*** | Introduction of carrier specific NRSRP thresholds for NPRACH resource selection | | | | | | | | | | | |
|  |  | | | | | | | | | | | |
| ***Source to WG:*** | CMCC | | | | | | | | | | | |
| ***Source to TSG:*** | RAN2 | | | | | | | | | | | |
|  |  | | | | | | | | | | | |
| ***Work item code:*** | NB\_IOTenh-Core, TEI16 | | | | | |  | ***Date:*** | | | 2022-03-10 | |
|  |  | | | | |  | |  | | |  | |
| ***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 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)* | | |
|  |  | | | | | | | | | | | |
| ***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  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.  Implementation of this CR from Rel-14 will not cause interoperability issues. | | | | | | | | | |
|  | | |  | | | | | | | | | |
| ***Consequences if not approved:*** | | | | In some cases the UE may use more repetitions during random access or even fail random access on a non-anchor carrier with the NPRACH resource based on the anchor carrier’s CE level thresholds. | | | | | | | | |
|  | | |  | | | | | | | | | |
| ***Clauses affected:*** | | | 6.7.3.1, Annex G | | | | | | | | | |
|  | | |  | | | | | | | | | |
|  | | | **Y** | **N** |  | | | |  | | | |
| ***Other specs*** | | | **X** |  | Other core specifications | | | | TS 36.321 CR 1535  TS 36.306 CR 1844 | | | |
| ***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-ThresholdsPrachInfoList-r16 RSRP-ThresholdsNPRACH-InfoList-NB-r13 OPTIONAL -- Need OP

]]

}

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-ThresholdsPrachInfoList***  The criterion for UE to select an NPRACH resource on the non-Anchor carrier. The threshold values are related to the anchor carrier NRSRP measurement. See TS 36.321 [6]. E-UTRAN includes the same number of entries, and listed in the same order, as in *rsrp-ThresholdsPrachInfoList* in *SystemInformationBlockType2-NB*.  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*

Annex G (normative): List of CRs Containing Early Implementable Features and Corrections

This annex lists the Change Requests (CRs) whose changes may be implemented by a UE of an earlier release than which the CR was approved in (i.e. CRs that contain on their coversheets the sentence "Implementation of this CR from Rel-N will not cause interoperability issues").

**Table G-1: List of CRs Containing Early Implementable Features and Corrections**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **TDoc Number (RP-xxxxxx): CR Title** | **CR Number(s)** | **CR Revision Number(s)** | **Earliest Implementable Release** | **Additional Information** |
| RP-181233: Successful acknowledgement of RRCConnectionRelease for BL and CE UE | 3324 | 1 | Release 13 | *RRCConnectionRelease* message, for which the poll bit is not set, can be considered succesfully acknowledged when UE has sent HARQ ACK feedback. |
| RP-182674: CR for T312 on LTE HetNet mobility | 3506 | 5 | Release 12 | Remove T312 in leaving condition for event trigger. |
| RP-182671: Corrections on paging monitoring and SI acquisition in RRC\_CONNECTED for BL UEs and UEs in CE | 3647 | 2 | Release 13 |  |
| RP-190548: Update description of ack-NACK-NumRepetitions | 3899 | 2 | Release 13 |  |
| RP-190548: Corrections of NB-IoT Access Barring | 3900 | 2 | Release 13 |  |
| RP-191382: SI update notification and access barring in NB-IoT | 4020 | 2 | Release 13 |  |
| RP-192195 : Correction on handling of SCell(s) during Make Before Break handover | 3986 | 3 | Release 14 |  |
| RP-192940: Stop using redirectedCarrierOffsetDedicated after reselection to another frequency | 4144 | 1 | Release 14 |  |
| RP-200338: Corrections to T312 and Discovery Signals measurement | 4198 | 1 | Release 12 |  |
| RP-200367: Correction on H1 and H2 events | 4103 | 2 | Release 15 |  |
| RP-201166: Allowing PDCP version change without handover | 4262 | 2 | Release 15 |  |
| RP-201166: upperLayerIndication enhancements | 4266 | 3 | Release 15 |  |
| RP-201192: Relaxed serving cell measurement for UEs using WUS | 4344 | - | Release 15 |  |
| RP-202780: Corrections to the field descriptions for TDD/FDD capability differentiation, and to nMaxResource value range | 4389 | 5 | Release 12 | The CR corrects multiple UE capability field descriptions introduced in various releases, the changes are early implementable back to the release in which the corresponding capability was introduced. |
| RP-202789: Correction on uac-AC1-SelectAssistInfo | 4488 | 2 | Release 15 |  |
| RP-211481: Clarification on the initiation of RNA update | 4651 | 1 | Release 15 |  |
| RP-212596: Distinguishing support of extended band n77 | 4723 | 2 | Release 15 |  |
| RP-22xxxx: Introduction of carrier specific NRSRP thresholds for NPRACH resource selection | 4777 | - | Release 14 |  |
| NOTE 1: In case a CR has mirror CR(s), the mirror CR(s) are not listed.  NOTE 2: The Additional Information column briefly describes the content of a CR in cases where the CR title may not be descriptive enough. If the CR title is descriptive enough, then the Additional Information column may be left blank. | | | | |

*End of Change*