**3GPP TSG-RAN2#120 Meeting *DRAFT\_R2-2213055***

**Toulouse, France, 14th – 18th November, 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  | **38.331** | **CR** | **3771** | **rev** | - | **Current version:** | **17.2.0** |  |
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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:***  | Correction for RACH partitioning with both 2-step and 4-step RA configurations |
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| ***Source to WG:*** | Huawei, HiSilicon, Intel, Apple, Mediatek, LGE, Qualcomm, CATT |
| ***Source to TSG:*** | RAN2 |
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| ***Work item code:*** | NR\_redcap-Core, NR\_SmallData\_INACTIVE-Core, NR\_cov\_enh-Core, NR\_Slice-Core |  | ***Date:*** | 2022-12 |
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| ***Category:*** | **F** |  | ***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 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | 1. In the current specifications, it is possible that the 2-step RACH configuration for a specific feature combination and 4-step RACH configuration for the same feature combination are provided in different *AdditionalRACH-Config(s)*. When this is the case, it is unclear which parameters the UE should use for 4-step RACH when falling back from 2-step RA to 4-step RA, i.e. the parameters from the same *AdditionalRACH-Config* or the parameters for the same feature combination configured in the different *AdditionalRACH-Config*.
2. Parameter *ra-ContentionResolutionTimer* in *RACH-ConfigCommonTwoStepRA* is Need S, but there is no clarification of the UE behaviour upon this field’s absence in the field description.
3. The behaviour upon absence of *msgA-PreamblePowerRampingStep*, *msgA-ZeroCorrelationZoneConfig* and *preambleTransMax* from *RACH-ConfigGenericTwoStepRA* does not consider the case where these parameters are configured in *AdditionalRACH-Config*.
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| ***Summary of change:*** | 1. It is clarified that the 4-step RACH configuration and the 2-step RACH configurations of one feature combination should be always provided in the same *AdditionalRACH-Config*.
2. The UE behaviour upon absence is clarified for *ra-ContentionResolutionTimer* in *RACH-ConfigCommonTwoStepRA*.
3. The UE behaviour upon absence is clarified for *msgA-PreamblePowerRampingStep*, *msgA-ZeroCorrelationZoneConfig* and *preambleTransMax* from *RACH-ConfigGenericTwoStepRA* for the case where these parameters are missing in *RACH-ConfigGenericTwoStepRA* provided in *AdditionalRACH-Config*.
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| ***Consequences if not approved:*** | 1. It is unclear which parameters the UE should use for RACH attempt when the UE falls back from 2-step RA to 4-step RA.
2. It is unclear which parameter values the UE should use upon absence of some parameters which may lead to misalignement between the UE and the network.

**Impact analysis****Impacted 5G architecture options:**All 5G architectures**Impacted functionality:**Random access**Inter-operability:**For change 1:* If the UE is implemented according to the CR while the network is not, the UE may deem the configuration as erroneous and discard it.
* If the network is implemented according to the CR while the UE is not, there is no inter-operability issue.

For change 2, 3:* If the UE is implemented according to the CR while the network is not, the UE and the network may assume different parameter values for RACH attempts which may lead to RACH performance degradation or failure.
* If the network is implemented according to the CR while the UE is not, the UE and the network may assume different parameter values for RACH attempts which may lead to RACH performance degradation or failure.
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| ***Clauses affected:*** | 6.3.2 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***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's revision history:*** |  |

*START OF CHANGE**S*

6.3.2 Radio resource control information elements

< Omitted text>

– *BWP-UplinkCommon*

The IE *BWP-UplinkCommon* is used to configure the common parameters of an uplink BWP. They are "cell specific" and the network ensures the necessary alignment with corresponding parameters of other UEs. The common parameters of the initial bandwidth part of the PCell are also provided via system information. For all other serving cells, the network provides the common parameters via dedicated signalling.

***BWP-UplinkCommon* information element**

-- ASN1START

-- TAG-BWP-UPLINKCOMMON-START

BWP-UplinkCommon ::= SEQUENCE {

 genericParameters BWP,

 rach-ConfigCommon SetupRelease { RACH-ConfigCommon } OPTIONAL, -- Need M

 pusch-ConfigCommon SetupRelease { PUSCH-ConfigCommon } OPTIONAL, -- Need M

 pucch-ConfigCommon SetupRelease { PUCCH-ConfigCommon } OPTIONAL, -- Need M

 ...,

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 rach-ConfigCommonIAB-r16 SetupRelease { RACH-ConfigCommon } OPTIONAL, -- Need M

 useInterlacePUCCH-PUSCH-r16 ENUMERATED {enabled} OPTIONAL, -- Need R

 msgA-ConfigCommon-r16 SetupRelease { MsgA-ConfigCommon-r16 } OPTIONAL -- Cond SpCellOnly2

 ]],

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 enableRA-PrioritizationForSlicing-r17 BOOLEAN OPTIONAL, -- Cond RA-PrioSliceAI

 additionalRACH-ConfigList-r17 SetupRelease { AdditionalRACH-ConfigList-r17 } OPTIONAL, -- Cond SpCellOnly2

 rsrp-ThresholdMsg3-r17 RSRP-Range OPTIONAL, -- Need R

 numberOfMsg3-RepetitionsList-r17 SEQUENCE (SIZE (4)) OF NumberOfMsg3-Repetitions-r17 OPTIONAL, -- Cond Msg3Rep

 mcs-Msg3-Repetitions-r17 SEQUENCE (SIZE (8)) OF INTEGER (0..31) OPTIONAL -- Cond Msg3Rep

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}

AdditionalRACH-ConfigList-r17 ::= SEQUENCE (SIZE(1..maxAdditionalRACH-r17)) OF AdditionalRACH-Config-r17

AdditionalRACH-Config-r17 ::= SEQUENCE {

 rach-ConfigCommon-r17 RACH-ConfigCommon OPTIONAL, -- Need R

 msgA-ConfigCommon-r17 MsgA-ConfigCommon-r16 OPTIONAL, -- Need R

 ...

}

NumberOfMsg3-Repetitions-r17::= ENUMERATED {n1, n2, n3, n4, n7, n8, n12, n16}

-- TAG-BWP-UPLINKCOMMON-STOP

-- ASN1STOP

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| ***BWP-UplinkCommon* field descriptions** |
| ***additionalRACH-ConfigList***List of feature or feature combination-specific RACH configurations, i.e. the RACH configurations configured in addition to the one configured by *rach-ConfigCommon* and by *msgA-ConfigCommon*. The network associates all possible preambles of an additional RACH configuration to one or more feature(s) or feature combination(s). The network does not configure this list to have more than 16 entries. If both *rach-ConfigCommon* and *msgA-ConfigCommon* are configured for a specific *FeatureCombination*, the network always provides them in the same *additionalRACH-Config*. |
| ***enableRA-PrioritizationForSlicing***Indicates whether or not the *ra-PrioritizationForSlicing/ra-PrioritizationForSlicingTwoStep* should override the *ra-PrioritizationForAccessIdentity*. The field is applicable only when the UE is configured by upper layers with both NSAG and Access Identity 1 or 2. If value *TRUE* is configured, the UE should only apply the *ra-PrioritizationForSlicing/ra-PrioritizationForSlicingTwoStep*. If value *FALSE* is configured, the UE should only apply *ra-PrioritizationForAccessIdentity*. If the field is absent, whether to use *ra-PrioritizationForSlicing/ra-PrioritizationForSlicingTwoStep* or *ra-PrioritizationForAccessIdentity* is up to UE implementation. |
| ***mcs-Msg3-Repetitions***Configuration of eight candidate MCS indexes for PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI. Only the first 4 configured or default MCS indexes are used for PUSCH transmission scheduled by RAR UL grant. This field is only applicable when the UE selects Random Access resources indicating Msg3 repetition in this BWP. If this field is absent when the set(s) of Random Access resources with MSG3 repetition indication are configured in the *BWP-UplinkCommon*, the UE shall apply the values {0, 1, 2, 3, 4, 5, 6, 7} (see TS 38.214 [19], clause 6.1.4). |
| ***msgA-ConfigCommon***Configuration of the cell specific PRACH and PUSCH resource parameters for transmission of MsgA in 2-step random access type procedure. The NW can configure *msgA-ConfigCommon* only for UL BWPs if the linked DL BWPs (same bwp-Id as UL-BWP) are the initial DL BWPs or DL BWPs containing the SSB associated to the initial BL BWP |
| ***numberOfMsg3-RepetitionsList***The number of repetitions for PUSCH transmission scheduled by RAR UL grant and DCI format 0\_0 with CRC scrambled by TC-RNTI. This field is only applicable when the UE selects Random Access resources indicating Msg3 repetition in this BWP. If this field is absent when the set(s) of Random Access resources with MSG3 repetition indication are configured in the *BWP-UplinkCommon*, the UE shall apply the values {n1, n2, n3, n4} (see TS 38.214 [19], clause 6.1.2.1). |
| ***pucch-ConfigCommon***Cell specific parameters for the PUCCH of this BWP.  |
| ***pusch-ConfigCommon***Cell specific parameters for the PUSCH of this BWP. |
| ***rach-ConfigCommon***Configuration of cell specific random access parameters which the UE uses for contention based and contention free random access as well as for contention based beam failure recovery in this BWP. The NW configures SSB-based RA (and hence *RACH-ConfigCommon*) only for UL BWPs if the linked DL BWPs (same *bwp-Id* as UL-BWP) are the initial DL BWPs or DL BWPs containing the SSB associated to the initial DL BWP or for RedCap UEs DL BWPs associated with *nonCellDefiningSSB* or the RedCap-specific initial downlink BWP. The network configures *rach-ConfigCommon*, whenever it configures contention free random access (for reconfiguration with sync or for beam failure recovery).  |
| ***rach-ConfigCommonIAB***Configuration of cell specific random access parameters for the IAB-MT. The IAB specific IAB RACH configuration is used by IAB-MT, if configured. |
| ***rsrp-ThresholdMsg3***Threshold used by the UE for determining whether to select resources indicating Msg3 repetition in this BWP, as specified in TS 38.321 [3]. The field is mandatory if both set(s) of Random Access resources with MSG3 repetition indication and set(s) of Random Access resources without MSG3 repetition indication are configured in the BWP. It is absent otherwise. |
| ***useInterlacePUCCH-PUSCH***If the field is present, the UE uses uplink frequency domain resource allocation Type 2 for cell-specific PUSCH, e.g., PUSCH scheduled by RAR UL grant (see TS 38.213 [13] clause 8.3 and TS 38.214 [19], clause 6.1.2.2) and uses interlaced PUCCH Format 0 and 1 for cell-specific PUCCH (see TS 38.213 [13], clause 9.2.1). |

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| **Conditional Presence** | **Explanation** |
| *Msg3Rep* | This field is optionally present, Need S, if the set(s) of Random Access resources with MSG3 repetition indication are configured in the *BWP-UplinkCommon*. It is absent otherwise. |
| *RA-PrioSliceAI* | The field is optionally present in *SIB1*, Need R, if both parameters *ra-PrioritizationForAccessIdentity* and the *ra-PrioritizationForSlicing/ra-PrioritizationForSlicingTwoStep* are present in *SIB1*. It is absent otherwise. |
| *SpCellOnly2* | The field is optionally present, Need M, in the *BWP-UplinkCommon* of an SpCell. It is absent otherwise. |

< Omitted text>

– *RACH-ConfigCommonTwoStepRA*

The IE *RACH-ConfigCommonTwoStepRA* is used to specify cell specific 2-step random-access type parameters.

***RACH-ConfigCommonTwoStepRA* information element**

-- ASN1START

-- TAG-RACH-CONFIGCOMMONTWOSTEPRA-START

RACH-ConfigCommonTwoStepRA-r16 ::= SEQUENCE {

 rach-ConfigGenericTwoStepRA-r16 RACH-ConfigGenericTwoStepRA-r16,

 msgA-TotalNumberOfRA-Preambles-r16 INTEGER (1..63) OPTIONAL, -- Need S

 msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB-r16 CHOICE {

 oneEighth ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},

 oneFourth ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},

 oneHalf ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},

 one ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32,n36,n40,n44,n48,n52,n56,n60,n64},

 two ENUMERATED {n4,n8,n12,n16,n20,n24,n28,n32},

 four INTEGER (1..16),

 eight INTEGER (1..8),

 sixteen INTEGER (1..4)

 } OPTIONAL, -- Cond 2StepOnly

 msgA-CB-PreamblesPerSSB-PerSharedRO-r16 INTEGER (1..60) OPTIONAL, -- Cond SharedRO

 msgA-SSB-SharedRO-MaskIndex-r16 INTEGER (1..15) OPTIONAL, -- Need S

 groupB-ConfiguredTwoStepRA-r16 GroupB-ConfiguredTwoStepRA-r16 OPTIONAL, -- Need S

 msgA-PRACH-RootSequenceIndex-r16 CHOICE {

 l839 INTEGER (0..837),

 l139 INTEGER (0..137),

 l571 INTEGER (0..569),

 l1151 INTEGER (0..1149)

 } OPTIONAL, -- Cond 2StepOnly

 msgA-TransMax-r16 ENUMERATED {n1, n2, n4, n6, n8, n10, n20, n50, n100, n200} OPTIONAL, -- Need R

 msgA-RSRP-Threshold-r16 RSRP-Range OPTIONAL, -- Cond 2Step4Step

 msgA-RSRP-ThresholdSSB-r16 RSRP-Range OPTIONAL, -- Need R

 msgA-SubcarrierSpacing-r16 SubcarrierSpacing OPTIONAL, -- Cond 2StepOnlyL139

 msgA-RestrictedSetConfig-r16 ENUMERATED {unrestrictedSet, restrictedSetTypeA,

 restrictedSetTypeB} OPTIONAL, -- Cond 2StepOnly

 ra-PrioritizationForAccessIdentityTwoStep-r16 SEQUENCE {

 ra-Prioritization-r16 RA-Prioritization,

 ra-PrioritizationForAI-r16 BIT STRING (SIZE (2))

 } OPTIONAL, -- Cond InitialBWP-Only

 ra-ContentionResolutionTimer-r16 ENUMERATED {sf8, sf16, sf24, sf32, sf40, sf48, sf56, sf64} OPTIONAL, -- Cond 2StepOnly

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 ra-PrioritizationForSlicingTwoStep-r17 RA-PrioritizationForSlicing-r17 OPTIONAL, -- Cond InitialBWP-Only

 featureCombinationPreamblesList-r17 SEQUENCE (SIZE(1..maxFeatureCombPreamblesPerRACHResource-r17)) OF FeatureCombinationPreambles-r17 OPTIONAL -- Cond AdditionalRACH-AndRedCap

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}

GroupB-ConfiguredTwoStepRA-r16 ::= SEQUENCE {

 ra-MsgA-SizeGroupA ENUMERATED {b56, b144, b208, b256, b282, b480, b640, b800,

 b1000, b72, spare6, spare5, spare4, spare3, spare2, spare1},

 messagePowerOffsetGroupB ENUMERATED {minusinfinity, dB0, dB5, dB8, dB10, dB12, dB15, dB18},

 numberOfRA-PreamblesGroupA INTEGER (1..64)

}

-- TAG-RACH-CONFIGCOMMONTWOSTEPRA-STOP

-- ASN1STOP

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| ***RACH-ConfigCommonTwoStepRA* field descriptions** |
| ***featureCombinationPreamblesList***Specifies a series of preamble partitions each associated to a combination of features and 2-step RA. The network does not configure this list to have more than 16 entries. |
| ***groupB-ConfiguredTwoStepRA***Preamble grouping for 2-step random access type. If the field is absent then there is only one preamble group configured and only one msgA PUSCH configuration. |
| ***msgA-CB-PreamblesPerSSB-PerSharedRO***Number of contention-based preambles used for 2-step RA type from the non-CBRA 4-step type preambles associated with each SSB for RO shared with 4-step type RA. The number of preambles for 2-step RA type shall not exceed the number of preambles per SSB minus the number of contention-based preambles per SSB for 4-step type RA. The possible value range for this parameter needs to be aligned with value range for the configured SSBs per RACH occasion in *ssb-perRACH-OccasionAndCB-PreamblesPerSSB* in *RACH-ConfigCommon*. The field is only applicable for the case of shared ROs with 4-step type random access. |
| ***msgA-PRACH-RootSequenceIndex***PRACH root sequence index. If the field is not configured in *RACH-ConfigCommonTwoStepRA* which is configured directly within a BWP (i.e., not within *AdditionalRACH-Config*), the UE applies the value in field *prach-RootSequenceIndex* in *RACH-ConfigCommon* in the configured BWP. If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE applies the corresponding value of *prach-RootSequenceIndex* in *RACH-ConfigCommon* in the same *AdditionalRACH-Config*. When both 2-step and 4-step type random access is configured, this field is only configured for the case of separate ROs between 2-step and 4-step type random access.For FR2-2, only the following values are applicable depending on the used subcarrier spacing:120 kHz: L=139, L=571, and L=1151480 kHz: L=139, and L=571960 kHz: L=139 |
| ***msgA-RestrictedSetConfig***Configuration of an unrestricted set or one of two types of restricted sets for 2-step random access type preamble. If the field is not configured in *RACH-ConfigCommonTwoStepRA* which is configured directly within a BWP (i.e. not within *AdditionalRACH-Config*), the UE applies the value in field *restrictedSetConfig* in *RACH-ConfigCommon* in the configured BWP. If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE applies the value of *restrictedSetConfig* in *RACH-ConfigCommon* in the same *AdditionalRACH-Config*. When both 2-step and 4-step type random access is configured, this field is only configured for the case of separate ROs between 2-step and 4-step type random access. |
| ***msgA-RSRP-Threshold***The UE selects 2-step random access type to perform random access based on this threshold (see TS 38.321 [3], clause 5.1.1). This field is only present if both 2-step and 4-step RA type are configured for the BWP. |
| ***msgA-RSRP-ThresholdSSB***UE may select the SS block and corresponding PRACH resource for path-loss estimation and (re)transmission based on SS blocks that satisfy the threshold (see TS 38.213 [13]). |
| ***msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB***The meaning of this field is twofold: the CHOICE conveys the information about the number of SSBs per RACH occasion. Value *oneEight* corresponds to one SSB associated with 8 RACH occasions, value *oneFourth* corresponds to one SSB associated with 4 RACH occasions, and so on. The ENUMERATED part indicates the number of Contention Based preambles per SSB. Value *n4* corresponds to 4 Contention Based preambles per SSB, value *n8* corresponds to 8 Contention Based preambles per SSB, and so on. The total number of CB preambles in a RACH occasion is given by *CB-preambles-per-SSB* \* max(1, *SSB-per-rach-occasion*). If the field is not configured in *RACH-ConfigCommonTwoStepRA* which is configured directly within a BWP (i.e. not within *AdditionalRACH-Config*) and both 2-step and 4-step are configured for the BWP, the UE applies the value in the field *ssb-perRACH-OccasionAndCB-PreamblesPerSSB* in *RACH-ConfigCommon.* If the field is not configured in *AdditionalRACH-Config* and both 2-step and 4-step are configured in *AdditionalRACH-Config*, the UE applies the value in the field *ssb-perRACH-OccasionAndCB-PreamblesPerSSB* in *RACH-ConfigCommon* in the same *AdditionalRACH-Config*. The field is not present when RACH occasions are shared between 2-step and 4-step type random access in the BWP. |
| ***msgA-SSB-SharedRO-MaskIndex***Indicates the subset of 4-step type ROs shared with 2-step random access type for each SSB. This field is configured when there is more than one RO per SSB. If the field is absent, and 4-step and 2-step has shared ROs, then all ROs are shared. |
| ***msgA-SubcarrierSpacing***Subcarrier spacing of PRACH (see TS 38.211 [16], clause 5.3.2).Only the following values are applicable depending on the used frequency:FR1: 15 or 30 kHzFR2-1: 60 or 120 kHzFR2-2: 120, 480, or 960 kHz.If the field is absent, the UE applies the SCS as derived from the *msgA-PRACH-ConfigurationIndex* in *RACH-ConfigGenericTwoStepRA* (see tables Table 6.3.3.1-1, Table 6.3.3.1-2, Table 6.3.3.2-2 and Table 6.3.3.2-3, TS 38.211 [16]) in case of 2-step only BWP, otherwise the UE applies the same SCS as Msg1 derived from *RACH-ConfigCommon*. The value also applies to contention free 2-step random access type (*RACH-ConfigDedicated*). |
| ***msgA-TotalNumberOfRA-Preambles***Indicates the total number of preambles used for contention-based and contention-free 2-step random access type when ROs for 2-step are not shared with 4-step. If the field is absent, and 2-step and 4-step does not have shared ROs, all 64 preambles are available for 2-step random access type. |
| ***msgA-TransMax***Max number of MsgA preamble transmissions performed before switching to 4-step random access (see TS 38.321 [3], clauses 5.1.1). This field is only applicable when 2-step and 4-step RA type are configured and switching to 4-step type RA is supported. If the field is absent, switching from 2-step RA type to 4-step RA type is not allowed. |
| ***ra-ContentionResolutionTimer***The initial value for the contention resolution timer for fallback RAR in case no 4-step random access type is configured (see TS 38.321 [3], clause 5.1.5). Value *sf8* corresponds to 8 subframes, value *sf16* corresponds to 16 subframes, and so on. If both 2-step and 4-step random access type resources are configured on the BWP, then this field is absent. If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE shall apply the corresponding value in *RACH-ConfigCommon* in the same *AdditionalRACH-Config*. |
| ***ra-Prioritization***Parameters which apply for prioritized random access procedure on any UL BWP of SpCell for specific Access Identities (see TS 38.321 [3], clause 5.1.1a). |
| ***ra-PrioritizationForAI***Indicates whether the field *ra-Prioritization-r16* applies for Access Identities. The first/leftmost bit corresponds to Access Identity 1, the next bit corresponds to Access Identity 2. Value *1* for an Access Identity indicates that the field *ra-Prioritization-r16* applies, otherwise the field does not apply. |
| ***ra-PrioritizationForSlicingTwoStep***Parameters which apply to configure prioritized CBRA 2-step random access type for slicing. |
| ***rach-ConfigGenericTwoStepRA***2-step random access type parameters for both regular random access and beam failure recovery. |

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| ***GroupB-ConfiguredTwoStepRA* field descriptions** |
| ***messagePowerOffsetGroupB***Threshold for preamble selection. Value is in dB. Value *minusinfinity* corresponds to –infinity. Value *dB0* corresponds to 0 dB, *dB5* corresponds to 5 dB and so on. (see TS 38.321 [3], clause 5.1.1). |
| ***numberOfRA-PreamblesGroupA***The number of CB preambles per SSB in group A for idle/inactive or connected mode. The setting of the number of preambles for each group should be consistent with *msgA-SSB-PerRACH-OccasionAndCB-PreamblesPerSSB* or *msgA-CB-PreamblesPerSSB-PerSharedRO* if configured. |
| ***ra-MsgA-SizeGroupA***Transport block size threshold in bits below which the UE shall use a contention-based RA preamble of group A. (see TS 38.321 [3], clause 5.1.1). |

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| **Conditional Presence** | **Explanation** |
| *2Step4Step* | The field is mandatory present if both 2-step random access type and 4-step random access type are configured in the BWP, otherwise the field is not present.The field is mandatory present in *msgA-ConfigCommon* field in *AdditionalRACH-Config* if both 2-step random access type and 4-step random access type are configured for the same feature combination in the BWP. |
| *2StepOnlyL139* | The field is mandatory present if *msgA-PRACH-RootSequenceIndex* L=139 and no 4-step random access type is configured, otherwise the field is absent, Need S. |
| *2StepOnly* | The field is mandatory present in *msgA-ConfigCommon* field in B*WP-UplinkCommon* if *rach-ConfigCommon* field is absent in this *BWP-UplinkCommon*, otherwise the field is optionally present in *msgA-ConfigCommon* field in *BWP-UplinkCommon*, Need S.The field is mandatory present in *msgA-ConfigCommon* field in *AdditionalRACH-Config* if *rach-ConfigCommon* field is absent in this *AdditionalRACH-Config*, otherwise the field is optionally present in *msgA-ConfigCommon* field in *AdditionalRACH-Config*, Need S. |
| *AdditionalRACH-AndRedCap* | The field is mandatory present if the *RACH-ConfigCommon* is included in *initialUplinkBWP-RedCap* or in an *AdditionalRACH-Config*. Otherwise, it is optional, Need R. |
| *InitialBWP-Only* | This field is optionally present, Need R, if this BWP is the initial BWP of SpCell. Otherwise, the field is absent. |
| *SharedRO* | The field is mandatory present if the 2-step random access type occasions are shared with 4-step random access type, otherwise the field is not present. |

< Omitted text>

– *RACH-ConfigGenericTwoStepRA*

The IE *RACH-ConfigGenericTwoStepRA* is used to specify the 2-step random access type parameters.

***RACH-ConfigGenericTwoStepRA* information element**

-- ASN1START

-- TAG-RACH-CONFIGGENERICTWOSTEPRA-START

RACH-ConfigGenericTwoStepRA-r16 ::= SEQUENCE {

 msgA-PRACH-ConfigurationIndex-r16 INTEGER (0..262) OPTIONAL, -- Cond 2StepOnly

 msgA-RO-FDM-r16 ENUMERATED {one, two, four, eight} OPTIONAL, -- Cond 2StepOnly

 msgA-RO-FrequencyStart-r16 INTEGER (0..maxNrofPhysicalResourceBlocks-1) OPTIONAL, -- Cond 2StepOnly

 msgA-ZeroCorrelationZoneConfig-r16 INTEGER (0..15) OPTIONAL, -- Cond 2StepOnly

 msgA-PreamblePowerRampingStep-r16 ENUMERATED {dB0, dB2, dB4, dB6} OPTIONAL, -- Cond 2StepOnlyNoCFRA

 msgA-PreambleReceivedTargetPower-r16 INTEGER (-202..-60) OPTIONAL, -- Cond 2StepOnlyNoCFRA

 msgB-ResponseWindow-r16 ENUMERATED {sl1, sl2, sl4, sl8, sl10, sl20, sl40, sl80, sl160, sl320}

 OPTIONAL, -- Cond NoCFRA

 preambleTransMax-r16 ENUMERATED {n3, n4, n5, n6, n7, n8, n10, n20, n50, n100, n200} OPTIONAL, -- Cond 2StepOnlyNoCFRA

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 msgB-ResponseWindow-v1700 ENUMERATED {sl240, sl640, sl960, sl1280, sl1920, sl2560} OPTIONAL -- Cond NoCFRA2

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-- TAG-RACH-CONFIGGENERICTWOSTEPRA-STOP

-- ASN1STOP

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| ***RACH-ConfigGenericTwoStepRA* field descriptions** |
| ***msgA-PreamblePowerRampingStep***Power ramping steps for msgA PRACH. If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE shall apply the corresponding value in *RACH-ConfigCommon* in the same *AdditionalRACH-Config*. If the field is absent in other cases, UE shall use the value of *powerRampingStep* in *RACH-ConfigGeneric* in the configured BWP (see TS 38.321 [3], 5.1.3). This field may only be present if no 4-step type RA is configured in the BWP or in the case of separate ROs with 4-step type RA. The field is absent if *RACH-ConfigGenericTwoStepRA* is included in *CFRA-TwoStep* in *RACH-ConfigDedicated* and thenthe UE uses the value of *msgA-PreamblePowerRampingStep* in *RACH-ConfigGenericTwoStepRA* configured forCBRA. |
| ***msgA-PreambleReceivedTargetPower***The target power level at the network receiver side (see TS 38.213 [13], clause 7.1.1 and TS 38.321 [3], clause 5.1.1). Only multiples of 2 dBm may be chosen (e.g -202, -200, -198, …). If the field is absent, UE shall use the value of *preambleReceivedTargetPower* in *RACH-ConfigGeneric* in the configured BWP. This field may only be present if no 4-step type RA is configured in the BWP. The field is absent if *RACH-ConfigGenericTwoStepRA* is included in *CFRA-TwoStep* in *RACH-ConfigDedicated* and thenthe UE uses the value of *msgA-PreambleReceivedTargetPower*in *RACH-ConfigGenericTwoStepRA* configured forCBRA*.* |
| ***msgA-PRACH-ConfigurationIndex***Cell-specific PRACH configuration index for 2-step RA type. If the field is absent in *RACH-ConfigCommonTwoStepRA* which is configured directly within a BWP (i.e. not within *AdditionalRACH-Config*), the UE shall use the value of corresponding 4-step random access parameter in the configured BWP. If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE shall apply the corresponding value in *RACH-ConfigCommon* in the same *AdditionalRACH-Config*. If the value is in the range of 256 to 262, the field *prach-ConfigurationIndex-v1610* should be considered configured (see TS 38.211 [16], clause 6.3.3.2). This field may only be present if no 4-step type RA is configured in the BWP or in the case of separate ROs with 4-step type RA. |
| ***msgA-RO-FDM***The number of msgA PRACH transmission occasions Frequency-Division Multiplexed in one time instance. If the field is absent in *RACH-ConfigCommonTwoStepRA* which is configured directly within a BWP (i.e. not within *AdditionalRACH-Config*), UE shall use value of *msg1-FDM* in *RACH-ConfigGeneric* in the configured BWP. If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE shall apply the value of *msg1-FDM* in *RACH-ConfigCommon* in the same *AdditionalRACH-Config* (see TS 38.211 [16], clause 6.3.3.2). This field may only be present if no 4-step type RA is configured in the BWP or in the case of separate ROs with 4-step type RA. |
| ***msgA-RO-FrequencyStart***Offset of lowest PRACH transmissions occasion in frequency domain with respect to PRB 0. If the field is absent in *RACH-ConfigCommonTwoStepRA* which is configured directly within a BWP (i.e. not within *AdditionalRACH-Config*), UE shall use value of *msg1-FrequencyStart* in *RACH-ConfigGeneric* in the configured BWP. If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE shall apply the value of *msg1-FrequencyStart* in *RACH-ConfigCommon* in the same *AdditionalRACH-Config* (see TS 38.211 [16], clauses 5.3.2 and 6.3.3.2). This field may only be present if no 4-step type RA is configured in the BWP or in the case of separate ROs with 4-step type RA. |
| ***msgA-ZeroCorrelationZoneConfig***N-CS configuration for msgA preamble, see Table 6.3.3.1-5 in TS 38.211 [16]. If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE shall apply the corresponding value in *RACH-ConfigCommon* in the same *AdditionalRACH-Config*. If the field is absent in other cases, UE shall use value *zeroCorrelationZoneConfig* in *RACH-ConfigGeneric* in the configured BWP. This field may only be present if no 4-step type RA is configured in the BWP or in the case of separate ROs with 4-step type RA. |
| ***msgB-ResponseWindow***MsgB monitoring window length in number of slots. The network configures a value lower than or equal to 40ms (see TS 38.321 [3], clause 5.1.1). The network does not configure *msgB-ResponseWindow-r16* simultaneously with *msgB-ResponseWindow-v1700*, and if both fields are absent,the UE uses the value of *msgB-ResponseWindow* in *RACH-ConfigGenericTwoStepRA* configured for CBRA. |
| ***preambleTransMax***Max number of RA preamble transmission performed before declaring a failure (see TS 38.321 [3], clauses 5.1.4, 5.1.5). If the field is absent in *RACH-ConfigCommonTwoStepRA* in *AdditionalRACH-Config*, the UE shall apply the corresponding value in *RACH-ConfigCommon* in the same *AdditionalRACH-Config*. If the field is absent in other cases, UE shall use the value of *preambleTransMax* in *RACH-ConfigGeneric* in the configured BWP. The field is absent if *RACH-ConfigGenericTwoStepRA* is included in *CFRA-TwoStep* in *RACH-ConfigDedicated* and thenthe UE uses the value of *preambleTransMax*in *RACH-ConfigGenericTwoStepRA* configured forCBRA*.* |

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| **Conditional Presence** | **Explanation** |
| *2StepOnly* | The field is mandatory present in *msgA-ConfigCommon* fieldin *BWP-UplinkCommon* if *rach-ConfigCommon* field is absent in this *BWP-UplinkCommon*, otherwise the field is optionally present in *msgA-ConfigCommon* fieldin *BWP-UplinkCommon*, Need S.The field is mandatory present in *msgA-ConfigCommon* in *AdditionalRACH-Config* if *rach-ConfigCommon* field is absent in this *AdditionalRACH-Config,* otherwise the field is optionally present in *msgA-ConfigCommon* fieldin *AdditionalRACH-Config*, Need S. |
| *2StepOnlyNoCFRA* | The field is mandatory present if *RACH-ConfigGenericTwoStepRA* is included in the *RACH-ConfigCommonTwoStepRA* and there are no 4-step random access configurations configured in the BWP (i.e only 2-step random access type configured in the BWP), otherwise (i.e. 4-step random access configuration also exists in the BWP) the field is optionally present, Need S. When *RACH-ConfigGenericTwoStepRA* is included in the *RACH-ConfigDedicated*, this field is absent. |
| *NoCFRA* | The field is mandatory present if *msgB-ResponseWindow-r17* is absent and *RACH-ConfigGenericTwoStepRA* is not included in *CFRA-TwoStep* in *RACH-ConfigDedicated,* otherwise the field is absent, Need S. |
| *NoCFRA2* | The field is mandatory present if *msgB-ResponseWindow-r16* is absent and *RACH-ConfigGenericTwoStepRA* is not included in *CFRA-TwoStep* in *RACH-ConfigDedicated*, otherwise the field is absent, Need S. |