**3GPP TSG-RAN WG2 Meeting #125bis *R2-2403913***

**Changsha, China, 15th April – 19th April, 2024**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
|  |
|  | **38.331** | **CR** | **4768** | **rev** |  | **Current version:** | **18.1.0** |  |
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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:***  | RRC CR for agreed Coverage extension RILs |
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| ***Source to WG:*** |  Huawei, HiSilicon  |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_cov\_enh2-Core |  | ***Date:*** | 2024-04-24 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-18 |
|  | *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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** | In RAN2#125bis meeting, the following CE agreements were made, which should be captured into the RRC spec:* [M871][M872] revert the upper bound back to 16 configurations with 16 RACH partitions for each
* [S831] For SI request with MSG1 repetition, atleast for the non-REDCAP specific initial BWP, UE uses the rach-ConfigCommon associated with the same repetition number only.
* The change for definition of ra-PreambleStartIndex in SI-RequestConfig with MSG1 repetition in [S831] is agreed.
* PRACH mask configuration is not supported for MSG1 based repetition in Re-18
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| ***Summary of change:*** | 1. To implement RIL M871: In the field description of *additionalRACH-ConfigList*, it is clarified that the network does not configure this list to have more than 16 entires.2. To implement RIL M872: In the field description of *featureCombinationPreamblesList*, it is clarified that the network does not configure the list to have more than 16 entires.3. To implement the comments to *ra-PreambleStartIndex* in RIL 831: To add desciptions of this field under IE *SI-RequestConfigRepetition*: If N SSBs are associated with a RACH occasion, where N > = 1, for the i-th SSB (i=0, …, N-1) the preamble with preamble index = ra-PreambleStartIndex + i is used for SI request; For N < 1, the preamble with preamble index = ra-PreambleStartIndex is used for SI request.4. To clarify in the field description of *ra-ssb-OccasionMaskIndex* under IE CFRA that this parameter is not used for Msg1 repetition.5. To remove the field *ra-ssb-OccasionMaskIndex* under IE *SI-RequestConfigRepetition*.6. To clarify in the field description of *ssb-SharedRO-MaskIndex* under IE *featureCombinationPreambles* that this parameter is not configured for Msg1 repetition. |
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| ***Consequences if not approved:*** | RIL M871, M872 and agreements made in RAN2#125bis on CE are not reflected in RRC spec. |
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| ***Clauses affected:*** | 6.3.2 |
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|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

===================================================== Start of change =============================================================

– *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, excluding *additionalRACH-perPCI-ToAddModList* and *additionalRACH-perPCI-ToReleaseList*, 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

 ...,

 [[

 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

 ]],

 [[

 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-perPCI-ToAddModList-r18 SEQUENCE (SIZE (1.. maxNrofAdditionalPRACHConfigs-r18)) OF RACH-ConfigTwoTA-r18

 OPTIONAL, -- Cond 2TA-Only

 additionalRACH-perPCI-ToReleaseList-r18 SEQUENCE (SIZE (1.. maxNrofAdditionalPRACHConfigs-r18)) OF RACH-ConfigTwoTAIndex-r18

 OPTIONAL, -- Need N

 rsrp-ThresholdMsg1-RepetitionNum2-r18 RSRP-Range OPTIONAL, -- Need R

 rsrp-ThresholdMsg1-RepetitionNum4-r18 RSRP-Range OPTIONAL, -- Need R

 rsrp-ThresholdMsg1-RepetitionNum8-r18 RSRP-Range OPTIONAL, -- Need R

 preambleTransMax-Msg1-Repetition-r18 ENUMERATED {n1, n2, n4, n6, n8, n10, n20, n50, n100, n200} OPTIONAL -- Cond Msg1Rep1

 ]]

}

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*. |
| ***additionalRACH-perPCI-ToAddModList***List of RACH configurations for the additional PCIs. The RACH configuration for an additional PCI is applied for Random Access procedure initiated by PDCCH order towards to the additional PCI, as specified in TS 38.321 clause 5.1.1b. This list includes the same number of elements like *additionalPCI-ToAddModList* for this serving cell and the *n*-th element of this list is for the PCI in the *n*-th element of *additionalPCI-ToAddModList*. This configuration may be different for different UEs. |
| ***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 DL BWP or DL BWPs associated with *nonCellDefiningSSB* or, for (e)RedCap UEs, the RedCap-specific initial downlink 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). |
| ***preambleTransMax-Msg1-Repetition***Max number of transmissions of MSG1 repetitions number (2, 4 and 8) performed before switching to higher repetition number (see TS 38.321 [3], clauses 5.1.1). This field is only applicable when more than one repetition numbers are configured in shared RO. If the field is absent, switching from lower repetition number to higher repetition number is not allowed. |
| ***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 DL BWPs associated with *nonCellDefiningSSB* or, for (e)RedCap UEs, the RedCap-specific initial downlink BWP. The network configures *rach-ConfigCommon* (without suffix) and/or *rach-ConfigCommon-r17*, whenever it configures contention free random access (for reconfiguration with sync or for beam failure recovery), the UE then applies the corresponding configuration depending on the RACH resource set selected upon RACH initialization, as specified in TS 38.321 [3]. For RedCap-specific initial uplink BWP, *rach-ConfigCommon* is always configured when *msgA-ConfigCommon* is configured in this BWP. |
| ***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-ThresholdMsg1-RepetitionNum2, rsrp-ThresholdMsg1-RepetitionNum4, rsrp-ThresholdMsg1-RepetitionNum8***Threshold used by the UE for determining whether to select resources indicating Msg1 repetition number 2, 4 or 8 in this BWP, as specified in TS 38.321 [3]. The value applies to all the BWPs and all RACH configurations. For a given MSG1 repetition number, this corresponding field is mandatory if both set(s) of Random Access resources with MSG1 repetition indication associated with this MSG1 repetition number and set(s) of Random Access resources without MSG1 repetition indication are configured in the BWP, or if the set(s) of Random Access resources with MSG1 repetition indication associated with this MSG1 repetition number and set(s) of Random Access resources with MSG1 repetition indication associated with a lower repetition number are configured in the BWP. It is absent otherwise. |
| ***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** |
| *Msg1Rep1* | This field is optionally present, Need R, if the set(s) of Random Access resources with MSG1 repetition indication are configured in the *BWP-UplinkCommon*. It is absent otherwise. |
| *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. |
| *2TA-Only* | The field is optionally present, Need N in the *BWP-UplinkCommon* if *additionalPCI-ToAddModList* is present in *spCellConfigDedicated* or *sCellConfigDedicated* and it has the same number of entries as the a*dditionalPCI-ToAddModList*. It is absent otherwise. |

===================================================== next change =============================================================

– *FeatureCombinationPreambles*

The IE *FeatureCombinationPreambles* associatesa set of preambles with a feature combination. For parameters which can be provided in this IE, the UE applies this field value when performing Random Access using a preamble in this featureCombinationPreambles, otherwise the UE applies the corresponding value as determined by applicable Need Code, e.g. Need S. On a specific BWP, there can be at most one set of preambles associated with a given feature combination per RA Type (i.e. 4-step RACH or 2-step RACH) per MSG1 repetition number.

***FeatureCombinationPreambles* information element**

-- ASN1START

-- TAG-FEATURECOMBINATIONPREAMBLES-START

FeatureCombinationPreambles-r17 ::= SEQUENCE {

 featureCombination-r17 FeatureCombination-r17,

 startPreambleForThisPartition-r17 INTEGER (0..63),

 numberOfPreamblesPerSSB-ForThisPartition-r17 INTEGER (1..64),

 ssb-SharedRO-MaskIndex-r17 INTEGER (1..15) OPTIONAL, -- Need S

 groupBconfigured-r17 SEQUENCE {

 ra-SizeGroupA-r17 ENUMERATED {b56, b144, b208, b256, b282, b480, b640,

 b800, b1000, b72, spare6, spare5,spare4, spare3, spare2, spare1},

 messagePowerOffsetGroupB-r17 ENUMERATED { minusinfinity, dB0, dB5, dB8, dB10, dB12, dB15, dB18},

 numberOfRA-PreamblesGroupA-r17 INTEGER (1..64)

 } OPTIONAL, -- Need R

 separateMsgA-PUSCH-Config-r17 MsgA-PUSCH-Config-r16 OPTIONAL, -- Cond MsgAConfigCommon

 msgA-RSRP-Threshold-r17 RSRP-Range OPTIONAL, -- Need R

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

 deltaPreamble-r17 INTEGER (-1..6) OPTIONAL, -- Need R

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 msg1-RepetitionNum-r18 ENUMERATED {n2, n4, n8, spare1} OPTIONAL, -- Cond Msg1Rep2

 msg1-RepetitionTimeOffsetROGroup-r18 ENUMERATED {n4, n8, n16, spare1} OPTIONAL -- Cond Msg1Rep3

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}

-- TAG-FEATURECOMBINATIONPREAMBLES-STOP

-- ASN1STOP

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| ***FeatureCombinationPreambles* field descriptions** |
| ***deltaPreamble***Power offset between msg3 or msgA-PUSCH and RACH preamble transmission. If configured, this parameter overrides *msg3-DeltaPreamble* or *msgA-DeltaPreamble*, Actual value = field value \* 2 [dB] (see TS 38.213 [13], clause 7.1). If *msgA-DeltaPreamble* is configured in *separateMsgA-PUSCH-Config-r17*, this field is absent. This field is set to the same value for all *FeatureCombinationPreambles* for MSG1 repetitions. |
| ***featureCombination***Indicates which combination of features that the preambles indicated by this IE are associated with. The UE ignores a RACH resource defined by this *FeatureCombinationPreambles* if any feature within the *featureCombination* is not supported by the UE or if any of the spare fields within the *featureCombination* is set to *true*. |
| ***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 5.1.2). |
| ***msg1-RepetitionNum***Indicates which MSG1-repetition number that this *FeatureCombinationPreambles* is associated with. |
| ***msg1-RepetitionTimeOffsetROGroup***Indicates a time offset of the starting ROs between two successive RO groups for a given repetition number (2, 4 or 8) associated with this *FeatureCombinationPreambles* for each frequency resource index within a time period (see TS 38.213 [13]). If this field is absent, the time offset is implicitly determined (see TS 38.213 [13]).For each MSG1 repetition number, the following values are applicable.• {n16}, for RO groups for MSG1 repetition number 8• {n8, n16}, for RO groups for MSG1 repetition number 4• {n4, n8, n16}, for RO groups for MSG1 repetition number 2 |
| ***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 concerned feature combination in the BWP. If configured, this parameter overrides *msgA-RSRP-Threshold-r16*. If absent, the UE applies *msgA-RSRP-Threshold-r16*, if configured |
| ***numberOfPreamblesPerSSB-ForThisPartition***It determines how many consecutive preambles are associated to the Feature Combination starting from the starting preamble(s) per SSB. |
| ***numberOfRA-PreamblesGroupA***It determines how many consecutive preambles per SSB are associated to Group A starting from the starting preamble(s). The remaining preambles associated to the Feature Combination are associated to Group B |
| ***ra-SizeGroupA***Transport Blocks size threshold in bits below which the UE shall use a contention-based RA preamble of group A. (see TS 38.321 [3], clause 5.1.2). If this feature combination preambles are associated to a *RACH-ConfigCommon-twostepRA*, this field correspond to *ra-MsgA-SizeGroupA*, otherwise it corresponds to *ra-Msg3SizeGroupA*. |
| ***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]). If this parameter is included in *FeatureCombinationPreambles* which is included in *RACH-ConfigCommonTwoStepRA*, it corresponds to *msgA-RSRP-ThresholdSSB*, as defined in TS 38.321 [3]. If this parameter is included in *FeatureCombinationPreambles* which is included in *RACH-ConfigCommon*, it it corresponds to *rsrp-ThresholdSSB*, as defined in TS 38.321 [3]. |
| ***separateMsgA-PUSCH-Config***If present it specifies how the 2-step RACH preambles identified by this *FeatureCombinationPreambles* are mapped to a PUSCH slot separate from the one defined in MsgA-ConfigCommon-r16. If the field is absent, the UE should apply the corresponding parameter in the *RACH-ConfigCommonTwoStepRA* of the BWP which includes the *FeatureCombinationPreambles IE*. |
|  |
| ***ssb-SharedRO-MaskIndex***Mask index (see TS 38.321 [3]).Indicates a subset of ROs where preambles are allocated for this feature combination.If this field is configured within *FeatureCombinationPreambles* which is included in *RACH-ConfigCommonTwoStepRA*:- in case of separate ROs are configured for 4-step and 2-step random access, this field indicates a subset of ROs configured within this *RACH-ConfigCommonTwoStepRA*;- in case shared ROs are used for 4-step and 2-step random access, it indicates the subset of ROs configured within *RACH-ConfigCommon*, which are the subset of ROs configured for 2-step random access.This field is configured when there is more than one RO per SSB. If the field is absent, all ROs configured in *RACH-ConfigCommon* or *RACH-ConfigCommonTwoStepRA* containing this *FeatureCombinationPreambles* are shared. The network does not configure this field, if the field *msg1-RepetitionNum* is configured. |
| ***startPreambleForThisPartition***It defines the first preamble associated with the Feature Combination. If the UE is provided with a number N of SSB block indexes associated with one PRACH occasion, and N<1, the first preamble in each PRACH occasion is the one having the same index as indicated by this field. If N>=1, N blocks of preambles associated with the Feature Combination are defined, each having start index + *startPreambleForThisPartition*, where n refers to SSB block index (see TS 38.213 [13], clause 8.1). |

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| **Conditional Presence** | **Explanation** |
| *MsgAConfigCommon* | The field is optionally present, Need S, if *FeatureCombinationPreambles* is included in *RACH-ConfigCommonTwoStepRA*. Otherwise, it is absent. If the field is absent in *FeatureCombinationPreambles* included in *RACH-ConfigCommonTwoStepRA*, the UE applies *MsgA-PUSCH-Config* included in the corresponding *MsgA-ConfigCommon*. |
| *Msg1Rep2* | The field is mandatory present, Need R, if msg1-Repetitions is included in FeatureCombination for this concerned FeatureCombinationPreambles. Otherwise, it is absent. |
| *Msg1Rep3* | The field is optionally present, Need S, if msg1-Repetitions is included in FeatureCombination for this concerned FeatureCombinationPreambles. Otherwise, it is absent. |

===================================================== next change =============================================================

– *RACH-ConfigCommon*

The IE *RACH-ConfigCommon* is used to specify the cell specific random-access parameters.

***RACH-ConfigCommon* information element**

-- ASN1START

-- TAG-RACH-CONFIGCOMMON-START

RACH-ConfigCommon ::= SEQUENCE {

 rach-ConfigGeneric RACH-ConfigGeneric,

 totalNumberOfRA-Preambles INTEGER (1..63) OPTIONAL, -- Need S

 ssb-perRACH-OccasionAndCB-PreamblesPerSSB 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, -- Need M

 groupBconfigured SEQUENCE {

 ra-Msg3SizeGroupA 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)

 } OPTIONAL, -- Need R

 ra-ContentionResolutionTimer ENUMERATED { sf8, sf16, sf24, sf32, sf40, sf48, sf56, sf64},

 rsrp-ThresholdSSB RSRP-Range OPTIONAL, -- Need R

 rsrp-ThresholdSSB-SUL RSRP-Range OPTIONAL, -- Cond SUL

 prach-RootSequenceIndex CHOICE {

 l839 INTEGER (0..837),

 l139 INTEGER (0..137)

 },

 msg1-SubcarrierSpacing SubcarrierSpacing OPTIONAL, -- Cond L139

 restrictedSetConfig ENUMERATED {unrestrictedSet, restrictedSetTypeA, restrictedSetTypeB},

 msg3-transformPrecoder ENUMERATED {enabled} OPTIONAL, -- Need R

 ...,

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 ra-PrioritizationForAccessIdentity-r16 SEQUENCE {

 ra-Prioritization-r16 RA-Prioritization,

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

 } OPTIONAL, -- Cond InitialBWP-Only

 prach-RootSequenceIndex-r16 CHOICE {

 l571 INTEGER (0..569),

 l1151 INTEGER (0..1149)

 } OPTIONAL -- Need R

 ]],

 [[

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

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

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}

-- TAG-RACH-CONFIGCOMMON-STOP

-- ASN1STOP

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| ***RACH-ConfigCommon* field descriptions** |
| ***featureCombinationPreamblesList***Specifies a series of preamble partitions each associated to a combination of features and 4-step RA. The network does not configure this list to have more than 16 entries. |
| ***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 5.1.2). This field is set to the same value for different repetition numbers associated with a specific *FeatureCombination*. |
| ***msg1-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 kHzIf absent, the UE applies the SCS as derived from the *prach-ConfigurationIndex* in *RACH-ConfigGeneric* (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]). The value also applies to contention free random access (*RACH-ConfigDedicated*), to SI-request and to contention-based beam failure recovery (CB-BFR). But it does not apply for contention free beam failure recovery (CF-BFR) (see *BeamFailureRecoveryConfig*). |
| ***msg3-transformPrecoder***Enables the transform precoder for Msg3 transmission according to clause 6.1.3 of TS 38.214 [19]. If the field is absent, the UE disables the transformer precoder (see TS 38.213 [13], clause 8.3). |
| ***numberOfRA-PreamblesGroupA***The number of CB preambles per SSB in group A. This determines implicitly the number of CB preambles per SSB available in group B. (see TS 38.321 [3], clause 5.1.1). The setting should be consistent with the setting of *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*. |
| ***prach-RootSequenceIndex***PRACH root sequence index (see TS 38.211 [16], clause 6.3.3.1). The value range depends on whether L=839 or L=139 or L=571 or L=1151. The length of the root sequence corresponding with the index indicated in this IE should be consistent with the one indicated in *prach-ConfigurationIndex* in the *RACH-ConfigDedicated* (if configured). If *prach-RootSequenceIndex-r16* is signalled, UE shall ignore the *prach-RootSequenceIndex* (without suffix).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 |
| ***ra-ContentionResolutionTimer***The initial value for the contention resolution timer (see TS 38.321 [3], clause 5.1.5). Value *sf8* corresponds to 8 subframes, value *sf16* corresponds to 16 subframes, and so on. |
| ***ra-Msg3SizeGroupA***Transport Blocks size threshold in bits below which the UE shall use a contention-based RA preamble of group A (see TS 38.321 [3], clause 5.1.2). This field is set to the same value for different repetition numbers associated with a specific *FeatureCombination*. |
| ***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 indicates that the field *ra-Prioritization-r16* applies otherwise the field does not apply (see TS 23.501 [32]). |
| ***ra-PrioritizationForSlicing***Parameters which apply to configure prioritized CBRA 4-step random access type for slicing. |
| ***rach-ConfigGeneric***RACH parameters for both regular random access and beam failure recovery. |
| ***restrictedSetConfig***Configuration of an unrestricted set or one of two types of restricted sets, see TS 38.211 [16], clause 6.3.3.1. |
| ***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]). |
| ***rsrp-ThresholdSSB-SUL***The UE selects SUL carrier to perform random access based on this threshold (see TS 38.321 [3], clause 5.1.1). The value applies to all the BWPs and all RACH configurations. |
| ***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 *oneEighth* 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*). See TS 38.213 [13]. |
| ***totalNumberOfRA-Preambles***Total number of preambles used for contention based and contention free 4-step or 2-step random access in the RACH resources defined in *RACH-ConfigCommon*, excluding preambles used for other purposes (e.g. for SI request). If the field is absent, all 64 preambles are available for RA. The setting should be consistent with the setting of *ssb-perRACH-OccasionAndCB-PreamblesPerSSB*, i.e. it should be a multiple of the number of SSBs per RACH occasion. |

|  |  |
| --- | --- |
| **Conditional Presence** | **Explanation** |
| *AdditionalRACH* | The field is mandatory present if the *RACH-ConfigCommon* is included in an *AdditionalRACH-Config*. When included in *initialUplinkBWP-RedCap* to indicate other feature(s) than *redcap and eRedCap,* this field is mandatory present with at least *FeatureCombinationPreambles* list entries: the list entry/entries indicating only *redcap* or *eRedCap* and the other(s) indicating both *redcap* or *eRedCap* and one or multiple other feature(s) (e.g., *smallData, nsag* or *msg3-Repetitions*).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. |
| *L139* | The field is mandatory present if *prach-RootSequenceIndex* L=139, otherwise the field is absent, Need S. |
| *SUL* | The field is mandatory present in *rach-ConfigCommon* in *initialUplinkBWP* if *supplementaryUplink* is configured in *ServingCellConfigCommonSIB* or if *supplementaryUplinkConfig* is configured in *ServingCellConfigCommon*; otherwise, the field is absent. This field is not configured in *additionalRACH-Config*. |

===================================================== next change =============================================================

– *RACH-ConfigDedicated*

The IE *RACH-ConfigDedicated* is used to specify the dedicated random access parameters.

***RACH-ConfigDedicated* information element**

-- ASN1START

-- TAG-RACH-CONFIGDEDICATED-START

RACH-ConfigDedicated ::= SEQUENCE {

 cfra CFRA OPTIONAL, -- Need S

 ra-Prioritization RA-Prioritization OPTIONAL, -- Need N

 ...,

 [[

 ra-PrioritizationTwoStep-r16 RA-Prioritization OPTIONAL, -- Need N

 cfra-TwoStep-r16 CFRA-TwoStep-r16 OPTIONAL -- Need S

 ]]

}

CFRA ::= SEQUENCE {

 occasions SEQUENCE {

 rach-ConfigGeneric RACH-ConfigGeneric,

 ssb-perRACH-Occasion ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}

 OPTIONAL -- Cond Mandatory

 } OPTIONAL, -- Need S

 resources CHOICE {

 ssb SEQUENCE {

 ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource,

 ra-ssb-OccasionMaskIndex INTEGER (0..15)

 },

 csirs SEQUENCE {

 csirs-ResourceList SEQUENCE (SIZE(1..maxRA-CSIRS-Resources)) OF CFRA-CSIRS-Resource,

 rsrp-ThresholdCSI-RS RSRP-Range

 }

 },

 ...,

 [[

 totalNumberOfRA-Preambles INTEGER (1..63) OPTIONAL -- Cond Occasions

 ]],

 [[

 msg1-RepetitionNum-r18 ENUMERATED {n2, n4, n8, spare1} OPTIONAL -- Cond 4StepCFRArep

 ]]

}

CFRA-TwoStep-r16 ::= SEQUENCE {

 occasionsTwoStepRA-r16 SEQUENCE {

 rach-ConfigGenericTwoStepRA-r16 RACH-ConfigGenericTwoStepRA-r16,

 ssb-PerRACH-OccasionTwoStepRA-r16 ENUMERATED {oneEighth, oneFourth, oneHalf, one,

 two, four, eight, sixteen}

 } OPTIONAL, -- Need S

 msgA-CFRA-PUSCH-r16 MsgA-PUSCH-Resource-r16,

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

 resourcesTwoStep-r16 SEQUENCE {

 ssb-ResourceList SEQUENCE (SIZE(1..maxRA-SSB-Resources)) OF CFRA-SSB-Resource,

 ra-ssb-OccasionMaskIndex INTEGER (0..15)

 },

 ...

}

CFRA-SSB-Resource ::= SEQUENCE {

 ssb SSB-Index,

 ra-PreambleIndex INTEGER (0..63),

 ...,

 [[

 msgA-PUSCH-Resource-Index-r16 INTEGER (0..3071) OPTIONAL -- Cond 2StepCFRA

 ]]

}

CFRA-CSIRS-Resource ::= SEQUENCE {

 csi-RS CSI-RS-Index,

 ra-OccasionList SEQUENCE (SIZE(1..maxRA-OccasionsPerCSIRS)) OF INTEGER (0..maxRA-Occasions-1),

 ra-PreambleIndex INTEGER (0..63),

 ...

}

-- TAG-RACH-CONFIGDEDICATED-STOP

-- ASN1STOP

|  |
| --- |
| ***CFRA-CSIRS-Resource* field descriptions** |
| ***csi-RS***The ID of a CSI-RS resource defined in the measurement object associated with this serving cell. |
| ***ra-OccasionList***RA occasions that the UE shall use when performing CF-RA upon selecting the candidate beam identified by this CSI-RS. The network ensures that the RA occasion indexes provided herein are also configured by prach-ConfigurationIndex and msg1-FDM. Each RACH occasion is sequentially numbered, first, in increasing order of frequency resource indexes for frequency multiplexed PRACH occasions; second, in increasing order of time resource indexes for time multiplexed PRACH occasions within a PRACH slot and Third, in increasing order of indexes for PRACH slots. |
| ***ra-PreambleIndex***The RA preamble index to use in the RA occasions associated with this CSI-RS. |

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| ***CFRA* field descriptions** |
| ***msg1-RepetitionNum***Indicates the MSG1 repetition number used for contention free 4-step random access type in TS 38.321 [3]. If this field is absent, the UE performs contention free 4-step random access without MSG1-Repetitions. |
| ***occasions***RA occasions for contention free random access. If the field is absent, the UE uses the RA occasions configured in *RACH-ConfigCommon* in the first active UL BWP. |
| ***ra-ssb-OccasionMaskIndex***Explicitly signalled PRACH Mask Index for RA Resource selection in TS 38.321 [3]. The mask is valid for all SSB resources signalled in *ssb-ResourceList*. The UE shall ignore this field if the field *msg1-RepetitionNum* included in *CFRA* is configured. |
| ***rach-ConfigGeneric***Configuration of contention free random access occasions for CFRA. The UE shall ignore *preambleReceivedTargetPower*, *preambleTransMax*, *powerRampingStep*, *ra-ResponseWindow* signaled within this field and use the corresponding values provided in *RACH-ConfigCommon*. |
| ***ssb-perRACH-Occasion***Number of SSBs per RACH occasion. |
| ***totalNumberOfRA-Preambles***Total number of preambles used for contention free random access in the RACH resources defined in CFRA, excluding preambles used for other purposes (e.g. for SI request). If the field is absent but the field *occasions* is present, the UE may assume all the 64 preambles are for RA. The setting should be consistent with the setting of *ssb-perRACH-Occasion*, if present, i.e. it should be a multiple of the number of SSBs per RACH occasion. |

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| ***CFRA-SSB-Resource* field descriptions** |
| ***msgA-PUSCH-Resource-Index***Identifies the index of the PUSCH resource used for MSGA CFRA. The PUSCH resource index indicates a valid PUSCH occasion (as specified in TS 38.213 [13], clause 8.1A) and the associated DMRS resources corresponding to a PRACH slot. The PUSCH resource indexes are sequentially numbered and are mapped to valid PUSCH occasions corresponding to a PRACH slot which are ordered, first, in increasing order of frequency resource indexes for frequency multiplexed PUSCH occasions; second, in increasing order of DMRS resource indexes within a PUSCH occasion, where a *DMR*$S\_{id}$ resource index is determined first in an ascending order of a DMRS port index and then in an ascending order of a DMRS sequence index, third in increasing order of time resource indexes for time multiplexed PUSCH occasions within a PUSCH slot and fourth, in increasing order of indexes for PUSCH slots. For the case of contention free 2-step random access type, if this field is absent, the UE shall use the value 0. |
| ***ra-PreambleIndex***The preamble index that the UE shall use when performing CF-RA upon selecting the candidate beams identified by this SSB. |
| ***ssb***The ID of an SSB transmitted by this serving cell. |

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| --- |
| ***CFRA-TwoStep* field descriptions** |
| ***msgA-CFRA-PUSCH***PUSCH resource configuration(s) for msgA CFRA. |
| ***msgA-TransMax***Max number of MsgA preamble transmissions performed before switching to 4-step type 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 in *cfra-TwoStep*, switching from 2-step RA type to 4-step RA type is not allowed. |
| ***occasionsTwoStepRA***RA occasions for contention free random access. If the field is absent, the UE uses the RA occasions configured in *RACH-ConfigCommonTwoStepRA* in the first active UL BWP. |
| ***ra-SSB-OccasionMaskIndex***Explicitly signalled PRACH Mask Index for RA Resource selection in TS 38.321 [3]. The mask is valid for all SSB resources signalled in *ssb-ResourceList*. |
| ***rach-ConfigGenericTwoStepRA***Configuration of contention free random access occasions for CFRA 2-step random access type. |
| ***ssb-PerRACH-OccasionTwoStep***Number of SSBs per RACH occasion for 2-step random access type. |

|  |
| --- |
| ***RACH-ConfigDedicated* field descriptions** |
| ***cfra***Parameters for contention free random access to a given target cell. If this field and *cfra-TwoStep* are absent, the UE performs contention based random access. |
| ***cfra-TwoStep***Parameters for contention free 2-step random access type to a given target cell. Network ensures that *cfra* and *cfra-TwoStep* are not configured at the same time. If this field and *cfra* are absent, the UE performs contention based random access. This field may only be present if *msgA-ConfigCommon* is configured on the BWP. |
| ***ra-prioritization***Parameters which apply for prioritized random access procedure to a given target cell (see TS 38.321 [3], clause 5.1.1). |
| ***ra-PrioritizationTwoStep***Parameters which apply for prioritized 2-step random access type procedure to a given target cell (see TS 38.321 [3], clause 5.1.1). |

|  |  |
| --- | --- |
| **Conditional Presence** | **Explanation** |
| *Mandatory* | The field is mandatory present. |
| *Occasions* | The field is optionally present, Need S, if the field *occasions* is present, otherwise it is absent. |
| *2StepCFRA* | The field is optionally present for the case of 2-step RA type contention free random access, Need S, otherwise it is absent. |
| *4StepCFRArep* | For non-(e)RedCap UEs, the field is optionally present, Need S, if *resources* is set to *ssb* and there is one *FeatureCombinationPreambles* entry indicating only *msg1-Repetitions* which is associated with the same Msg1 repetition number.For RedCap UEs or if RedCap is considered to be applicable for this Random Access procedure for eRedCap UEs, the field is optionally present, Need S, if *resources* is set to *ssb* and there is one *FeatureCombinationPreambles* entry indicating only *redCap* and *msg1-Repetitions* which is associated with the same Msg1 repetition number.For eRedCap UEs, if eRedCap is considered to be applicable for this Random Access procedure, the field is optional present, Need S, if *resource* is set to *ssb* and there is one *FeatureCombinationPreambles* entry indicating only *eRedCap* and *msg1-Repetitions* which is associated with the same Msg1 repetition number.Otherwise, it is absent. |

===================================================== next change =============================================================

*– SI-RequestConfigRepetition*

The IE *SI-RequestConfigRepetition* contains configuration for Msg1 based SI request with Msg1 repetition.

***SI-RequestConfigRepetition* information element**

-- ASN1START

-- TAG-SI-REQUESTCONFIGREPETITION-START

SI-RequestConfigRepetition-r18 ::= SEQUENCE {

 rach-OccasionsSI-r18 SEQUENCE {

 rach-ConfigSI-r18 RACH-ConfigGeneric,

 ssb-perRACH-Occasion-r18 ENUMERATED {oneEighth, oneFourth, oneHalf, one, two, four, eight, sixteen}

 } OPTIONAL, -- Need R

 si-RequestResourcesRepetitionNum2-r18 SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResourcesRepetition-r18 OPTIONAL, -- Need R

 si-RequestResourcesRepetitionNum4-r18 SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResourcesRepetition-r18 OPTIONAL, -- Need R

 si-RequestResourcesRepetitionNum8-r18 SEQUENCE (SIZE (1..maxSI-Message)) OF SI-RequestResourcesRepetition-r18 OPTIONAL, -- Need R

 ...

}

SI-RequestResourcesRepetition-r18 ::= SEQUENCE {

 ra-PreambleStartIndex-r18 INTEGER (0..63)

}

-- TAG-SI-REQUESTCONFIGREPETITION-STOP

-- ASN1STOP

|  |
| --- |
| **S*I-RequestConfigRepetition* field descriptions** |
| ***si-RequestResourcesRepetitionNum2, si-RequestResourcesRepetitionNum4, si-RequestResourcesRepetitionNum8***Indicates the configurations for Msg1-based SI request with Msg1 repetition for repetition number 2, 4 and 8, respectively.If there is only one entry in the list, the configuration is used for all SI messages for which *si-BroadcastStatus* or *posSI-BroadcastStatus* is set to *notBroadcasting*. Otherwise:- If *si-SchedulingInfo-v1700* is not present and the *SI-RequestConfigRepetitionNum2*/*SI-RequestConfigRepetitionNum4*/*SI-RequestConfigRepetition*Num8 is used for on-demand SI request in *SI-SchedulingInfo* or *PosSI-SchedulingInfo*, the 1st entry in the list corresponds to the first SI message in *schedulingInfoList* or *posSchedulingInfoList* for which *si-BroadcastStatus* or *posSI-BroadcastStatus* is set to *notBroadcasting*, 2nd entry in the list corresponds to the second SI message in *schedulingInfoList* or *posSchedulingInfoList* for which *si-BroadcastStatus* or *posSI-BroadcastStatus* is set to *notBroadcasting* and so on.- If *si-SchedulingInfo-v1700* is present and *SI-RequestConfigRepetitionNum2*/*SI-RequestConfigRepetitionNum4*/*SI-RequestConfigRepetitionNum8* is configured in *SI-SchedulingInfo* for on-demand SI request, the UE generates a list of concatenated SI messages by appending the SI messages containing type1 SIB configured by *schedulingInfoList2* in *si-SchedulingInfo-v1700* to the SI messages configured by *schedulingInfoList* in *si-SchedulingInfo*. The 1st entry in the list corresponds to the first SI message for which *si-BroadcastStatus* is set to *notBroadcasting*, 2nd entry in the list corresponds to the second SI message for which *si-BroadcastStatus* is set to *notBroadcasting* and so on.- If *si-SchedulingInfo-v1700* is present and *SI-RequestConfigRepetitioNum2*/*SI-RequestConfigRepetitionNum4*/*SI-RequestConfigRepetitionNum8n* is configured in *PosSI-SchedulingInfo* for on-demand SI request, the UE generates a list of concatenated SI messages by appending the SI messages containing type2 SIB configured by *schedulingInfoList2* in *si-SchedulingInfo-v1700* to the SI messages configured by *posSchedulingInfoList* in *posSI-SchedulingInfo*. The 1st entry in the list corresponds to the first SI message for which *posSI-BroadcastStatus* or *si-BroadcastStatus* is set to *notBroadcasting*, 2nd entry in the list corresponds to the second SI message for which *posSI-BroadcastStatus* or *si-BroadcastStatus* is set to *notBroadcasting* and so on.Change of *si-RequestResourcesRepetitionNum2*/*SI-RequestConfigRepetitionNum4*/*SI-RequestConfigRepetitionNum8* should not result in system information change notification. |

|  |
| --- |
| *SI-RequestResourcesRepetition* field descriptions |
|  |
| ***ra-PreambleStartIndex***If N SSBs are associated with a RACH occasion, where N > = 1, for the i-th SSB (i=0, …, N-1) the preamble with preamble index = *ra-PreambleStartIndex* + i is used for SI request with Msg1 repetition; For N < 1, the preamble with preamble index = *ra-PreambleStartIndex* is used for SI request with Msg1 repetition. |

===================================================== end of change =============================================================